

Obesity among public school teenagers: the performance of three anthropometric criteria*

Sobrepeso em adolescentes de escolas públicas: desempenho de três critérios diagnósticos

Exceso de Peso en adolescentes de Escuelas públicas: desempeño de tres criterios diagnósticos

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ABSTRACT

Objective: To compare the performance of three anthropometric criteria used in clinical practice to identify obesity among Brazilian teenagers. **Methods:** A cross-sectional study was conducted with 720 students, aged 14 to 19 years old, from public schools of Fortaleza. The body mass index was used to classify students' weight according to each one of the three criteria. **Results:** There were disagreements among the three criteria to classify students' weight. Higher disagreements occurred during classification of weight among male students aged 16 years old (13.3%) and female students aged 14 years old (12.5%). **Conclusion:** The use of at least two anthropometric criteria can be a useful strategy to improve the identification and classification of teenagers with abnormal body weight.

Keywords: Overweight/diagnosis; Anthropometry; Adolescent; Adolescent health

RESUMO

Objetivo: Comparar as diferentes prevalências de sobrepeso em nível clínico e populacional em um grupo de adolescentes brasileiros, segundo os três critérios antropométricos utilizados em práticas assistenciais. **Métodos:** Estudo transversal com 720 alunos de escolas públicas de Fortaleza, situados entre 14 e 19 anos. Calculou-se o índice de massa corporal, classificando os sujeitos como possuidores ou não de sobrepeso, segundo cada critério. **Resultados:** Observou-se que, para todas as faixas etárias, houve discordância entre os três critérios. A maior delas de 13,3%, na faixa etária de 16 anos, para os homens; e de 12,5%, na faixa etária de 14 anos, para as mulheres. **Conclusão:** Uma estratégia para identificar sobrepeso seria adotar dois critérios que permitam, simultaneamente, englobar o maior número de adolescentes com indicativos de sobrepeso e extrair, dentre estes, aqueles com indicadores mais evidentes deste problema.

Descritores: Sobrepeso/diagnóstico; Antropometria; Adolescente; Saúde do adolescente

RESUMEN

Objetivo: Comparar las diferentes prevalencias de exceso de peso a nivel clínico y poblacional en un grupo de adolescentes brasileños, según los tres criterios antropométricos utilizados en prácticas asistenciales. **Métodos:** Se trata de un estudio transversal realizado con 720 alumnos de escuelas públicas de Fortaleza, comprendidos entre las edades de 14 y 19 años. Se calculó el índice de masa corporal, clasificando a los sujetos como poseedores o no de exceso de peso, según cada criterio. **Resultados:** Se observó que, para todos los grupos etáreos, hubo discordancia entre los tres criterios. La mayor de ellas de 13,3%, en la faja etárea de 16 años, para los hombres; y de 12,5%, en la faja etárea de 14 años, para las mujeres. **Conclusión:** Una estrategia para identificar el exceso de peso sería adoptar dos criterios que permitan, simultáneamente, agrupar el mayor número de adolescentes con indicativos de exceso de peso y extraer, de éstos, aquellos con indicadores más evidentes de este problema.

Descriptores: Sobrepeso/diagnóstico; Antropometría; Adolescente; Salud del adolescente

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INTRODUCTION

Adolescence is an important period for growth and maturing of human beings, it ranges from 10 to 19 years old and it is a phase where many of the adult characteristics are established⁽¹⁾. Regarding nutrition, overweight and obesity associated with comorbidities such as hypertension, dyslipidemia, and type 2 diabetes were, up to some years ago, more evident in adults. However, these diseases can now be frequently observed at a younger age group⁽²⁾. We know that there is a great probability that overweight adolescents become obese adults⁽³⁾. Additionally, some studies suggest that the duration of obesity is directly associated with morbidity and mortality due to heart diseases⁽⁴⁾. These evidences show the importance of identifying and treating effectively overweight in adolescents⁽⁵⁾.

Obesity is a chronic disease defined as the excess of body fat and overweight, it is a relative proportion of weight higher than what is expected in relation to height⁽⁶⁾. These conditions imply many factors whose development is influenced by biological, psychological, cultural and socioeconomic factors⁽⁷⁾. In this context, we know that there is the influence of genetic factors related to the problem of obesity, they enable the action of environmental factors that are essential for maintaining a healthy weight.

Additionally, culturally speaking, food preferences as well as physical activities are practices directly influenced by parents' habits that continue in the adult life⁽⁸⁾. Complementarily, the epidemic feature and the growing prevalence of overweight and obesity in developed and developing countries are consequences of the so called nutrition transition, characterized by the excessive increase in fat food with a high calorie content, together with a sedentary lifestyle⁽⁹⁾.

Obesity may affect 10% of the world population and more than a third of the American population in a few years time⁽¹⁰⁾. According to a specialized study, conducted from 1988 to 1994, the prevalence of overweight between adolescents from 12 to 17 years old was 10.6%. Among males at the age group from 12 to 14, overweight prevalence was 10.7% and for the age group from 15 to 17, it was 12%; among females, prevalences were 11.5% for the age group from 12 to 14, and 8.2% for the age group from 15 to 17. This reality is similar to that of Europe, where there has been an increase between 10 to 40% of obesity in just 10 years⁽¹¹⁾.

In Brazil, when two national surveys were compared, performed in 1975 and 1989, there was 100% increase in the prevalence of obesity in men and 70% among women, for all age groups⁽¹²⁾. The speed in the increase in obesity prevalences varies in the different geographic regions, income groups, age groups and genders⁽¹³⁾. Another

Brazilian survey conducted in 2004 demonstrated that the frequency of overweight in the adult Brazilian population is ten times higher than that of underweight⁽¹⁴⁾.

It is known that the more intense and earlier overweight and obesity are, the higher the risk of persistence in adulthood, with more severe comorbidities⁽¹⁵⁾. Therefore, this has become a major public health problem, especially in developed countries, calling attention to the anthropometric history in obese adolescents and adults, as well as the risk factors associated with overweight⁽¹⁾.

Anthropometry is an important diagnoses method, providing an estimate of the prevalence and severity of nutritional alterations. It is the most useful method to identify obese people since it is low cost, non-invasive, universally applied and well accepted by population. Anthropometric indexes are obtained from the combination of two or more basic anthropometric pieces of information (weight, gender, age, height)⁽¹⁾.

Measuring weight and height enables the calculation of one of the three most commonly used anthropometric indexes which are based on body mass index (BMI). The authors are part of a group that is the one of the first to relate statistical criteria for continuity of BMI values with those adopted in adulthood. The curves represent percentiles according to age group for each gender and the cut-off points for overweight used for adults (25kg and 30 kg/m²) have been mandatorily adjusted according to BMI percentile values of 85 and 95 at 18 years old⁽¹⁶⁾. Therefore, for the present study, this anthropometric index will be called criterion A.

The literature reports another criterion used to diagnoses nutritional state. Through a mathematic method, including data on age and percentiles 85 and 95, the study is considered the only reference on BMI data that meets the requirements for the whole population of adolescents in the USA. Authors' distribution for BMI was made to classify people from 6 to 74, according to gender, age and race. Cut-off points proposed by authors define as overweight adolescents with BMI between percentiles 85 and 95. In pediatric routine and public health, the indexes classified by these authors are one of the most commonly used for diagnosing overweight in children and adolescents⁽¹⁷⁾. This anthropometric index will be called criterion B.

The classification proposed by other interested parts shows the relevance of specificity on sensitivity, since when specificity is maximized the proportion of adolescents that will be incorrectly classified as overweight decreases. They based themselves on the percentile values found in the literature, changing only the cut-off point between overweight risk and overweight. Thus, adolescents with BMI \geq 95 percentile or >30 kg/m² for gender and age should be considered as overweight. The term overweight should be used instead of obesity if body fat

and lean mass are not determined as occurs for BMI⁽¹⁸⁾. The criteria explained above will be called criteria C.

In addition to be instruments for nutritional assessment, anthropometric data are also useful to make temporal comparisons in the same group or among populations. However, criteria for assessment of overweight in children and adolescents vary a lot. Thus, it is essential to determine the most suitable measure to identify nutritional state⁽¹⁹⁾.

The present study compared the different overweight prevalence at clinical and population level in a group of Brazilian adolescents, according to three anthropometric criteria used in care practices.

METHODS

Cross-sectional study, whose data were withdrawn from a data base built for the development of the study "Identification of risk factors for type 2 diabetes mellitus in adolescents", inserted in the project "Integrated actions on the prevention of type 2 diabetes mellitus", supported by CNPq. The survey mentioned was performed in 12 schools among the public schools of the state, located in the city of Fortaleza- Ceará. According to information for the Regional Center for Education Development, Fortaleza is divided into six regions and, in January 2006 it had 194 schools with a total of 284,611 students enrolled. When information on the number of students enrolled at the age group from 14 to 19 years old was requested, a total of 114,304 students in the six regions was obtained.

To calculate the sample we used the formula for infinite population⁽⁸⁾.

$$n = \frac{t^2 \cdot 5\% \cdot P \cdot Q}{e^2}$$

Where t= value of Student distribution (t_{5%} = 1.96); P=50%; Q=100-P= 50%; e = absolute sampling error = 4%. The values above mentioned were considered for P and Q since they provide a maximum sample size, as well as the significance level ($\hat{\alpha}$ =0.05) and the absolute sampling error of 4%. Thus, the number of participants determined was equivalent to 600 adolescents. Because of the probable loss of subjects and/or information, we placed a 20% margin to this sample size. Thus, the final "n" had 720 students.

The sample was stratified by region, according to Chart 1.

Two schools have been chosen for each of the six regions, located in different districts and with different infrastructure, services, and socioeconomic conditions, in order to build a broad picture of the city of Fortaleza. The sample, according to region, was divided by 2 to obtain the number of students that would be surveyed in

each school. The project has been approved by the Ethical Committee in Research with Human Beings of the Federal University of Ceará under Protocol # 217/05.

Chart 1 – Stratified sample of students enrolled in public schools according to region. Fortaleza – CE, 2007

Region	Number of enrolled students in the age group of interest	Sample by region
1	17,902	113
2	15,450	98
3	16,670	105
4	18,020	113
5	24,740	156
6	21,513	135
Total	114,304	720

Selection of subject was random; a draw was performed among those who agreed to take part on the research and gave their written consent signed both by them and their guardians. However, before that, principals, teachers and students were informed on the objectives and methodology of the survey.

Data collection was performed in February and March 2006, from Monday to Friday in the afternoon. We used a form where name, age, gender, weight, height and Body Mass Index (BMI) were recorded.

In the presentation of prevalence, students' ages were grouped in complete years from 14 to 19 years old (for example, an adolescent at 14 years and 5 months was considered as being 14). To measure weight, individuals were barefoot, wearing light clothes, standing in an upright position and with their arms parallel to their bodies. A digital portable scale with capacity to record 120 kg and 0.1kg accuracy, automatic display, triggered by feet touch and horizontally positioned was used.

Height was assessed using a tape measure with 0.5 cm accuracy, fixed on a plain wall. Height measures were taken with students barefoot, with their backs to the wall, feet together and parallel, in an upright position and looking forward with the support of a rule that was placed on participants' head to ensure accuracy⁽¹⁾. Weight and height were measured only once. Values obtained referring to weight, height, gender and BMI underwent triple typing to detect possible errors and stored on a data base developed in Excel version 7.

Based on these data, analysis of the nutritional state of adolescents were performed and they were classified as overweight according to criterion A, B and C, which were structured on tables using Microsoft Word version 7. Prevalence and frequencies were estimated at each age group and compared in terms of nominal values. To verify the difference in the proportion of overweight identified by each of the three criterion assessed according to gender and age, Fisher-Freeman-Halton tests were applied. Significance level adopted was 5%.

RESULTS

Table 1 presents the sample profile according to gender and age. Of the 720 students taking part on the survey, 293 (40.69%) were males and 427 (59.31%) were females. The age group with greatest prevalence among males was the 18-year-old group (30.7%), and among females, the 15-year-old group (19.4%).

Table 1 – Public school adolescents according to gender and age. Fortaleza-CE. 2007

Age group	Males		Females		Total	
	n	%	n	%	n	%
14	36	12.3	74	17.3	110	15.3
15	42	14.3	83	19.4	125	17.4
16	45	15.4	81	19.0	126	17.5
17	42	14.3	71	16.6	113	15.7
18	90	30.7	82	19.2	172	23.9
19	38	13.0	36	8.4	74	10.3
Total	293	100.0	427	100.0	720	100.0

Table 2 presents overweight prevalence for male students according to age group and anthropometric criteria. It is seen that for all age groups, there was disagreement between the three criteria. The greatest difference found was 13.3%, in the 16-year-old age group between criterion A and C (p=0.046).

Criterion A estimated prevalences higher than those of the other two criteria to classify overweight among male adolescents. Percentage differences regarding criterion B were +2.7% (14 years), +2.2% (16 years), +2.4% (17 years), +6.7% (18 years) and +2.6% (19 years). Difference between criterion A and B were not found in the 15-year-old age group (p=0.645).

Criteria C, compared to B, disagreed in -5.5% (14 years), -4.8% (15 years), -11.1% (16 years), -2.4% (17 years), -4.4% (18 years) and -2.6% (19 years). Criterion A, compared to C, showed differences in the following age groups: +8.3% (14 years), +4.8% (15 years), +13.3% (16 years), +4.8% (17 years), +11.1% (18 years) and +5.3% (19 years).

In terms of statistically significant differences, only at ages 16 (p=0.046) and 18 (p=0.016) for the total sample (p<0.001), different proportions between the criterion Assessed were observed. In all cases, criteria C presented proportions smaller than the other two criteria, confirming the tendency to privilege specificity. On the other hand, according to criterion A, greater proportion of overweight adolescents has been identified.

Table 3 shows estimated overweight prevalence for female adolescent students, according to age group and anthropometric criteria. There was disagreement on the three criteria in all ages. The greatest difference found was 12.2%, at the 14-year-old age group between criterion A and C (p=0.010).

Table 2 – Overweight prevalence among male adolescents according to age group and anthropometric criteria. Fortaleza-CE. 2007

Age group and anthropometric criteria	Overweight		P value
	n	%	
14 years old			
Criterion A	4	11.1	0.388
Criterion B	3	8.3	
Criteria C	1	2.8	
15 years old			
Criterion A	3	7.1	0.645
Criterion B	3	7.1	
Criteria C	1	2.4	
16 years old			
Criterion A	6	13.3	0.046
Criterion B	5	11.1	
Criteria C	-	-	
17 years old			
Criterion A	2	4.8	0.359
Criterion B	1	2.4	
Criteria C	-	-	
18 years old			
Criterion A	12	13.3	0.016
Criterion B	6	6.7	
Criteria C	2	2.2	
19 years old			
Criterion A	3	7.9	0.589
Criterion B	2	5.3	
Criteria C	1	2.6	
Total			
Criterion A	30	10.2	<0.001
Criterion B	20	6.8	
Criteria C	5	1.7	

Criterion A estimated the greatest prevalences to identify overweight in female adolescents if compared to the other two criteria. Percentage differences regarding criterion B were +2.7% (14 years old), +1.2% (15 years old), +2.5% (16 years old), +2.8% (17 years old), +2.4% (18 years old) and +2.9% (19 years old).

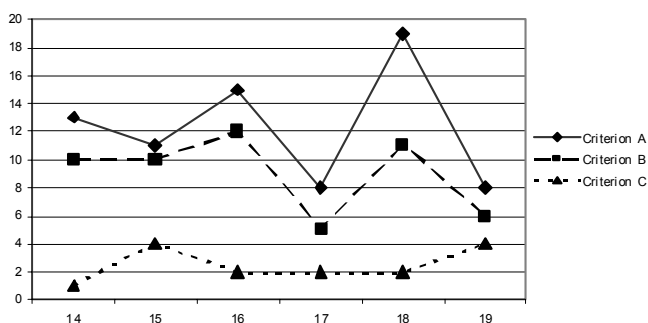
Criteria C, compared to B, presented disagreement of -9.5% (14 years old), - 4.8% (15 years old), -6.1% (16 years old), -2.8% (17 years old), -6.1% (18 years old) and -2.8% (19 years old). As for criterion A, compared to C, it differed on the following age groups: +11.9% (14 years old), +9.2% (15 years old), +10.2% (16 years old), +8.0% (17 years old), +8.5% (18 years old) and +13.4% (19 years old).

Similar to the male adolescent group, criteria C demonstrated tendency to greater specificity in the identification of overweight among female adolescents. In this sense, statistically significant differences were identified at the ages of 14 (p=0.010) and 18 (p=0.032) years old and in the total group (p=0.001). Criterion A estimated overweight prevalences greater than those of the other two studies, in both genders at all ages, except for 15 year-old males where criterion A and B obtained the same values.

Table 3 – Overweight prevalence among female adolescent students, according to age group and anthropometric criteria. Fortaleza-CE. 2007

Age group and anthropometric criteria	Overweight		P value
	n	%	
14 years old			
Criterion A	9	12.1	0.010
Criterion B	7	9.5	
Criteria C	-	-	
15 years old			
Criterion A	8	9.6	0.284
Criterion B	7	8.4	
Criteria C	3	3.6	
16 years old			
Criterion A	9	11.1	0.096
Criterion B	7	8.6	
Criteria C	2	2.5	
17 years old			
Criterion A	6	8.5	0.346
Criterion B	4	5.6	
Criteria C	2	2.8	
18 years old			
Criterion A	7	8.5	0.032
Criterion B	5	6.1	
Criteria C	-	-	
19 years old			
Criterion A	5	13.9	0.754
Criterion B	4	11.1	
Criteria C	3	8.3	
Total			
Criterion A	44	10.3	<0.001
Criterion B	34	8.0	
Criteria C	10	2.2	

In the present study, the three criteria used to compare the number of overweight adolescents showed differences among themselves as observed on Picture 1. Criterion A and B agreed on the variation of their results according to age group, except for the change in age from 14 to 15 years old, values obtained for criterion B remained constant, whereas those obtained from criterion A decreased. However, criteria C did not follow the same standards, remaining the one with less variation.



Picture 1 – Comparison of the number of adolescents classified as overweight by the three criterion According to age⁽¹⁶⁻¹⁸⁾. Fortaleza, 2007

DISCUSSION

Choosing a broad anthropometric criterion to assess overweight in adolescents is more difficult than for other age groups due to the great variation in growth and development during puberty⁽²⁰⁾.

Criterion A approached in the study used BMI as an anthropometric data to classify overweight and, although it presents good correlation with fat measuring in adolescents, it does not reflect accurately the many body changes which occur in this age group and that are different between the genders. However, due to the difficulties of using more sophisticated methods to measure body fat in epidemiological studies, BMI is still a feasible option, which is easy to determine, to reapply and presents high reliability, not requiring specific training or expensive instruments⁽²⁰⁻²¹⁾.

Lack of consensus presented in the literature regarding the criteria to define overweight in adolescents indicates the need for establishing specific cut-off points for each population. Criterion B is reference for BMI cut-off point values to classify adolescents in the overweight group⁽¹¹⁾. Criterion A tends to overestimate these values, whereas Criteria C underestimates them.

Additionally, for the Brazilian population it has been questioned the suitability of using the American sample as a reference, used by most researchers⁽²⁰⁾. Using the American population as a reference value to estimate overweight in specific groups, such as adolescents, may underestimate this nutritional problem in developing countries such as Brazil⁽²²⁾.

Although they come from American population surveys, criterion B and C did not present identical results, criterion B estimated at 7.5% the amount of overweight adolescents, whereas criteria C estimated only at 2.0%. Cut-off points are the main variable distinguishing the criteria, since overweight classification proposed by criterion B is the interval between percentiles 85 and 95 for adolescents, whereas criteria C presents percentile ≤ 95 as classifying. However, researchers propose to use BMI percentile lower than 85 and close to 70 so that cut-off point will raise better adolescents with risk for obesity⁽²¹⁾.

Criterion A, however, includes BMI data from representative samples of adolescents in six different countries, including Brazil. Thus, values proposed by it are recommended by institutions that dedicate themselves to the study of obesity⁽²³⁾.

CONCLUSION

Data showed that overweight prevalence was greater at all ages and genders when criterion A was used, that is, the use of any of the two criteria would underestimate overweight prevalence, especially of criteria C. Very

specific criteria, such as criteria C, excludes adolescents who would need early professional care, since the tendency for weight gain increases with the coming of adult age.

The search for an ideal criterion for the Brazilian population is necessary, since the risk of morbidity due to heart disease and atherosclerosis is increasing in men and women with overweight risk during adolescence. In adults from both genders who were overweight during adolescence, there was an increase in the risk of colorectal and intestinal cancer among men and of arthritis among women. This reality explains the importance of early identification of overweight in adolescents to prevent related morbidities and mortalities. According to what is recommended by authors in criterion B, adolescent overweight is a powerful predictor of these risks when compared to adult overweight.

A possible strategy to identify and follow up

adolescents would be to adopt two simultaneous classifications that would enable, at the same time, to encompass as many adolescents as possible with anthropometric standards that indicate overweight and select, among these adolescents, those with more evident overweight indicators. The present study shows that this strategy could be achieved by using criterion A as the criteria with greater sensitivity and criteria C as the criteria with greater specificity. This could help introducing strategies specific for each group classified according to these criteria, considering their unique features, related with their anthropometric data.

We must reinforce that the study was performed in public schools of a city from the Brazilian Northeast region, where the proportion of overweight adolescents may be different from other regions of the country. Thus the results presented by this study should be seen with caution and other comparative studies should be conducted in other regions to confirm the findings.

REFERENCES

- Organización Mundial de la Salud. El estado físico: uso e interpretación de la antropometría: informe de un Comité de Expertos de la OMS. Ginebra: Organización Mundial de la Salud; 1995. [OMS - Série de Informes Técnicos; 854].
- Styne DM. Childhood and adolescent obesity. Prevalence and significance. *Pediatr Clin North Am.* 2001;48(4):823-54; vii.
- Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics.* 1998;101(3 Pt 2):518-25.
- Must A, Jacques PF, Dallal GE, Bejama CJ, Dietz WH. Long-term morbidity and mortality of overweight adolescents. A follow-up of the Harvard Growth Study of 1922 to 1935. *N Engl J Med.* 1992;327(19):1350-5. Comment in: *N Engl J Med.* 1992;327(19):1379-80.
- Dietz WH. What constitutes successful weight management in adolescents? *Ann Intern Med.* 2006;145(2):145-6. Comment on: *Ann Intern Med.* 2006;145(2):81-90. *Ann Intern Med.* 2006;145(2):91-7.
- Sotelo YOM, Colugnati FAB, Taddei JAAC. Prevalência de sobrepeso e obesidade entre escolares da rede pública segundo três critérios de diagnóstico antropométrico. *Cad Saúde Pública = Rep Public Health.* 2004;20(1):233-40.
- Oliveira AMA, Cerqueira EMM, Souza JS, Oliveira AC. Sobrepeso e obesidade infantil: influência de fatores biológicos e ambientais em Feira de Santana, BA. *Arq Bras Endocrinol Metab.* 2003;47(2):144-50.
- Yanovski SZ, Yanovski JA. Obesity. *N Engl J Med.* 2002;346(8):591-602. Comment in: *N Engl J Med.* 2002;346(26):2092-3; author reply 2092-3. *N Engl J Med.* 2002;346(26):2092-3; author reply 2092-3. *N Engl J Med.* 2002;346(26):2092-3; author reply 2092-3.
- Damiani D, Carvalho DP, Oliveira RG. Obesidade na infância: um grande desafio! *Pediatr Mod.* 2000;36(8):489-523.
- Francischi RPP, Pereira LO, Freitas CS, Klopfer M, Santos RC, Vieira P, Lancha Júnior AH. Obesidade: atualização sobre sua etiologia, morbidade e tratamento. *Rev Nutr.* 2000;13(1):17-28.
- World Health Organization. Obesity: preventing and managing the global epidemic; report of a WHO Consultation on Obesity. Geneva: World Health Organization; 1998.
- Coitinho DC, Leão MM, Recine E, Sichieri R. Condições nutricionais da população brasileira: adultos e idosos. Brasília: INAN; 1991.
- Monteiro CA, Conde WL, Popkin BM. Independent effects of income and education on the risk of obesity in the Brazilian adult population. *J Nutr.* 2001;131(3):881S-886S. Comment in: *J Nutr.* 2005;135(10):2496.
- Araújo MFM, Beserra EP, Chaves ES. O papel da amamentação ineficaz na gênese da obesidade infantil: um aspecto para a investigação de enfermagem. *Acta Paul Enferm.* 2006;19(4):450-5.
- Must A. Morbidity and mortality associated with elevated body weight in children and adolescents. *Am J Clin Nutr.* 1996;63(3 Suppl):445S-447S.
- Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ.* 2000;320(7244):1240-3. Comment in: *BMJ.* 2000;321(7269):1158. *BMJ.* 2000;321(7269):1158-9. *BMJ.* 2000;321(7269):1159. *BMJ.* 2001;323(7319):999.
- Must A, Dallal GE, Dietz WH. Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht²) and triceps skinfold thickness. *Am J Clin Nutr.* 1991;53(4):839-46. Erratum in: *Am J Clin Nutr.* 1991;54(5):773. Comment in: *Am J Clin Nutr.* 1991;54(5):953-6.
- Himes JH, Dietz WH. Guidelines for overweight in adolescent preventive services: recommendations from an expert committee. The Expert Committee on Clinical Guidelines for Overweight in Adolescent Preventive Services. *Am J Clin Nutr.* 1994;59(2):307-16.
- Gibson RS. Principles of nutritional assessment. New York: Oxford University Press; 1990.
- Vieira ACR, Alvarez MM, Marins VMR, Sichieri R, Veiga GV. Desempenho de pontos de corte do índice de massa corporal de diferentes referências na predição de gordura corporal em adolescentes. *Cad Saúde Pública = Rep Public*

- Health. 2006;22(8):1681-90.
21. Monteiro POA, Victora CG, Barros FC, Tomasi E. Diagnóstico de sobrepeso em adolescentes: estudo de desempenho de diferentes critérios para o Índice de Massa Corporal. *Rev Saúde Pública = J Public Health*. 2000;34(5):506-13.
 22. Magalhães VC, Azevedo G, Mendonça S. Prevalência e fatores associados a sobrepeso e obesidade em adolescentes de 15 a 19 anos das regiões Nordeste e Sudeste do Brasil, 1996 a 1997. *Cad Saúde Pública = Rep Public Health*. 2003;19(Supl 1):S129-39.
 23. Fernandes RA, Kawaguti SS, Agostini L, Oliveira AR, Ronque ERV, Freitas Júnior IF. Prevalência de sobrepeso e obesidade em alunos de escolas privadas do município de Presidente Prudente – SP. *Rev Bras Cineantropom Desempenho Hum*. 2007;9(1):21-7.