Research Article
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Three indicators for overweight and obesity: BMI, CC and P/CC-index in children and adolescents: Pilot study

Abstract

Is a review of indicators to measure obesity in children and adolescents, such as the index of body mass (BMI), waist circumference (CC) and index weight - waist circumference (P/CC), and compare the results. Sample: of 304 children between 6 and 18years of age, 128 of Caracas, 139 of Mérida and 37 of Valencia, of fourth educational institutions, Objective: to compare three indicators that measure overweight and obesity. Method: it is a descriptive, transversal study correlational; applied descriptive measures of association and correlation, the variables age, weight, height, waist circumference (WC), hip (C DAC) circumference, measured and calculated indicators: body mass mass index (BMI), waist to hip rate (ICC) and index Peso-circumference waist (P/CC). Results: According to CDC for BMI, 9.87% at risk of overweight, and 5.26% overweight; average of 65 CC, 92±7, 78cm, and percentile increases with age; average P/DC 0, 67±0, 11, higher in males and evidence sexual dimorphism from the age of 15. (R>0.70) correlations were obtained between weight-ccin.; weight c cad. BMI-weight; P/CC-age, height, weight and c cad. Conclusions: BMI remains a good indicator to assess overweight and obesity, DC complements the evaluation, but there is still no matching criteria for reference values; index P/CC, can be useful, since it discriminates by gender and correlated with age, weight, height, BMI, C hip.

Keywords: children, teens, BMI, waist circumference, index weight-waist circumference.

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Introduction

As already mentioned, in many studies before, the problem of obesity in children and adolescents has been a concern for national and international organizations, due to the fact that it has increased considerably in recentyears, so much so that has called "public health problem", both in developed countries, and in underdeveloped countries.

The WHO, in its technical report 894, states that individuals who have excess abdominal fat, have a risk to health, as a result of obesity; also refers that there are additional tools to assess obesity, such as underwater weight, magnetic resonance imaging, double watermark; which have practical difficulties for their use, coupled with high costs.[1]

In the same report, he reports that comorbidities of obesity include coronary heart disease, high blood pressure and stroke, certain types of cancer, non-insulin-dependent diabetes, diabetes mellitus, gallbladder disease, dyslipidemia, osteoarthritis and gout, and lung diseases, including sleep apnea.[1]

It must be taken into account that the body mass index (BMI), which has been useful for the evaluation in adults, has recently been recommended for the evaluation of children and adolescents. In the same way, different groups of experts and international organizations have set themselves the task of proposing reference standards of the IMC for international use; among them the Centers for Disease Control and Prevention (CDC) of the United States of America and the Working Group on Obesity (IOTF) of the World Health Organization.[2]

With regard to waist circumference, the results obtained in the studies that have been carried out in countries such as Brazil, Spain, the United States, England and Italy show that, in children and adolescents, waist circumference is a good indicator of central obesity, with clinical and epidemiological utility.[3] A cardiological study conducted in Bogalusa, shows that in the case of children, from 5 to 17years, the distribution of abdominal fat, measured by waist circumference, is associated with abnormal concentrations of triglycerides, low and high density lipoproteins and insulin.[4] Likewise, in a study conducted by Barreira et al, they found an association between waist circumference and fat mass, as well as between waist circumference and abdominal subcutaneous area and visceral adipose tissue.[5]

In Venezuela, there is talk of children between 7 and 14years old, with an incidence of 19.31% with overweight (above the 90th percentile), and particularly in the Capital District, the figure is 23.26%.[6] In a study of overweight and obesity in Venezuela, conducted by the INN, they say that for the population of 7 to 12years, there are 17.57% overweight and 9.87% of obesity nationwide; and for the group of 13 to 17years, they report a 12.03% of overweight and a 9.33% of obesity; They also report that when the sample is discriminated in the group of 7 to 17years, a higher prevalence of overweight and obesity was observed in males, with figures of 15.32% and 10.63%, respectively.[7] This increase in malnutrition has its possible causes in the so-called demographic and nutritional transition, reflected in changes in the diet (high consumption of carbohydrates) and a decrease in individual physical activity, which has been very accelerated in recentyears, and It is also typical of developing regions, which has resulted in the presence of malnutrition, obesity and overweight, a situation that also leads to an increase in deaths from CVD, cancer, hypertension and cerebrovascular diseases.[7,8]

Considerando que se ha incrementado la incidencia de sobrepeso y obesidad en la población infantil de Venezuela en los últimos diez años, se ha planteado la posibilidad de realizar un estudio en el cual se incluyan otros índices, con el fin de disponer de otros indicadores para evaluar a esta población, en cuanto a sobrepeso y obesidad, particularmente, si son indicadores mucho más fácil de calcular, y confiables.

Materials and methods

A descriptive, cross-sectional and correlational study was carried out, in which a group of schoolchildren selected by a randomized procedure was used as a sample, from three cities: Caracas, Mérida and Valencia, where schoolchildren from educational institutions of each school were chosen. the cities, El Libertador de Caracas, 128 schoolchildren, Father Madariaga and Los Próceres in Mérida, 139 schoolchildren, and Los Maitines in Valencia, 37 schoolchildren, who made up a sample of 304 children and adolescents, between 6 and 18years old, with the same number of them of each sex. The variables age, weight, height, waist circumference, hip circumference were measured, and the indicators were calculated: Body Mass Index (BMI), Waist-Hip Index (BCI) and Weight-Circumference Waist Index (IPCC). For the evaluation, the criterion suggested by the WHO for the BMI[9] was considered, based on the mean and deviation, with the categories: overweight+1SD<BMI≤+2 SD, obesity BMI>2DE; the CDC criteria for CC,[10] based on the percentiles, with categories cc<5% (Deficit); 5%≤P/CC<85% (Normal); 85%≤P/CC<95% (Overweight risk) and P/CC≥95% (Overweight), and for the hip weight-waist index (P/CC), there are no references, as it is a new index that is experiment in this pilot study. However, the criterion suggested by the CDC for waist circumference was used to classify this index, because it is based on the percentiles. Descriptive and correlation statistics were determined, according to the variables that were related.

Results

In Table 1 & Table 2, the averages of the anthropometric variables of the students are presented, it can be seen that the averages are higher for the male sex; Likewise, it can be observed that, very interestingly, the averages decrease at 12years in males and at 17years in females. In addition, all the variables behave in a similar way, since they increase as the age advances. These differences become visible when the graphic representation is observed, and it can be seen in Figure 1, how the waist and hip circumferences behave, by sex, being very similar during the firstyears and differentiating from the age of 18. In the same way, it is necessary to visualize the Figure 2, it is observed that the waist/hip index, behaves in a similar way during the firstyears, but then accentuates at 17years, evidencing the sexual dimorphism. In the classification, according to the WHO criteria, of the BMI, by sex, and there is a very high percentage (74.79%) of schoolchildren classified as normal weight; 8.88% overweight and 4.14% with Obesity.

Table 1 Average of the variables size, weight, waist circumference, hip circumference. Schoolchildren from three cities of Venezuela

Sex	n	Age	Size	Weight	Waist circumference	Hip circumference
	3	9	139,47±5,03	36,67±15,09	64,67±15,89	75,33±13,47
M	14	10	139,58±3,55	38,14±13,05	66,97±14,93	76,52±14,15
A	38	11	144,34±10,16	38,18±14,07	63,49±13,99	74,86±12,10
S	28	12	148,35±7,67	38,52±8,95	62,10±6,17	73,95±7,14
C	16	13	153,36±4,71	47,38±8,60	69,75±8,06	83,48±8,78
U	18	14	161,38±8,51	52,85±8,15	71,27±6,45	83,58±5,71
L	11	15	164,53±5,69	52,56±7,86	68,40±5,03	83,02±5,44
I	12	16	169,21±7,83	63,92±11,78	76,22±6,63	91,74±8,12
N	11	17	169,85±7,06	63,94±12,08	73,54±7,32	88,2±6,07
O	1	18	187,00±0,00	76,00±0,00	77,90±0,00	99,80±0,00
	Total		**153,36±12,31**	**46,25±13,47**	**67,63±8,66**	**80,01±9,67**
	3	9	135,10±6,43	31,50±12,29	60,37±10,23	72,47±12,70
	28	10	140,19±8,46	37,73±9,61	62,10±6,85	76,84±9,22
F	33	11	147,27±7,15	38,44±7,16	61,75±5,85	78,74±6,45
E	38	12	150,25±5,84	42,29±7,35	63,28±5,39	81,15±7,08
M	14	13	152,93±2,67	46,87±6,59	65,53±7,39	85,90±5,22
E	9	14	154,00±4,99	45,11±5,93	64,63±4,48	82,12±5,91
N	11	15	156,87±4,96	52,45±9,23	69,34±7,28	90,46±7,48
I	9	16	155,56±6,17	55,33±5,76	71,11±3,92	91,79±4,42
N	4	17	152,80±3,84	50,50±7,22	69,95±8,35	87,05±5,65
O	1	18	161,20±0,00	58,50±0,00	70,60±0,00	95,00±0,00
	Total		**148,36±9,21**	**42,55±9,81**	**64,12±6,69**	**81,36±8,86**

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Table 2 Promedio de las variables índice cintura/cadera, IMC e índice peso/circunferencia de cintura. Escolares de tres ciudades de Venezuela

Sex	n	Age	Waist / hip index	IMC	Weight / waist circumference
	3	9	0,85±0,07	18,54±6,16	0,55±0,09
M	14	10	0,87±0,04	19,49±6,88	0,56±0,07
A	38	11	0,85±0,05	18,14±5,40	0,59±0,08
S	28	12	0,84±0,04	17,31± 2,46	0,61±0,09
C	16	13	0,84±0,03	20,14±3,61	0,68±0,07
U	18	14	0,85±0,05	20,24±2,35	0,74±0,08
L	11	15	0,82±0,03	19,32 ±1,87	0,77±0,07
I	12	16	0,83±0,03	22,29± 3,65	0,83±0,10
N	11	17	0,83±0,05	22,07± 3,41	0,86±0,10
O	1	18	0,78±0,00	21,73±0,00	0,98±0,00
	Total		**0,85±0,04**	**19,29±3,50**	**0,67±0,13**
	3	9	0,83±0,3	16,95±4,96	0,51± 0,11
	28	10	0,81±0,04	18,99±3,42	0,60±0,09
F	33	11	0,78±0,05	17,62±2,38	0,63±0,09
E	38	12	0,78±0,03	18,66±2,56	0,66± 0,07
M	14	13	0,76±0,05	20,01±2,47	0,71±0,04
E	9	14	0,79±0,03	19,04±2,45	0,70±0,05
N	11	15	0,77±0,04	21,21±2,79	0,75±0,06
I	9	16	0,78±0,04	22,88±2,25	0,78±0,06
N	4	17	0,80±0,6	21,70±3,70	0,72±0,02
O	1	18	0,74±0,00	22,51±0,00	0,83±0,00
	Total		**0,79±0,04**	**19,13±3,14**	**0,66±0,10**

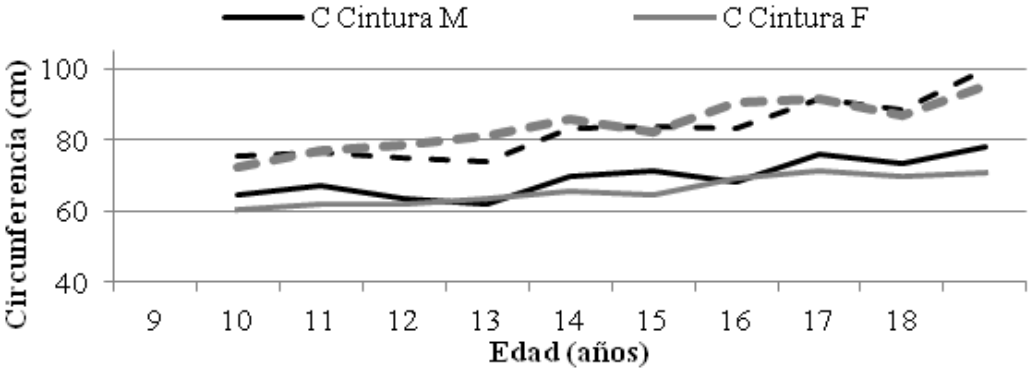

Figure 1 Cirncunferencias de Cintura y Cadera, según sexo. Escolares de tres ciudades, Venezuela.

The school children were classified according to the BMI value, according to the WHO, and the averages of the waist and hip circumferences are considerably higher (81.78±5.69cm, 96.19±4, 98cm, respectively) for school children who are in the obesity category; while the averages of the CC and Weight/CC index are slightly higher in the obese group (0.85±0.06 and 0.79±0.11, respectively). In addition, we have that the averages are statistically significant ($p<0.001$), for waist circumference, hip circumference and weight/C waist index. With regard to waist circumference, the average is 65.92±7.89cm, for the total sample, being 67.63±8.66 in males, higher than the average of females (64, 12±6.69), which is statistically significant ($p<0.001$). When the waist circumference is evaluated, by means of the

percentiles suggested by the CDC, the value increases as the age advances, in addition, the Differences are more accentuated in the percentile values at 10, 12 and 17years, in the case of males (Figure 3). Regarding the behavior of the percentiles, in the case of females, the behavior is similar to that of males, with the difference that the values are more distant at 17years (Figure 4). We proceeded to classify the P/CC index, according to the criterion suggested by the CDc for the CC, since it is the one that fits most for this index, because it is based on the percentiles, and we have that with the risk of overweight. 9.87% and overweight there are 5.26% of school children. The P/CC index resulted in an average of 0.67±0.11, with average values of 0.6733±0.1275 for males and 0.6569±0.0989 for females, which are not statistically significant It was also observed that when the P/CC index is discriminated by sex, it increases as age progresses, and evidences more notable differences after 15years, in the male sex. As for the female sex, it increases as the age increases, and the differences are evident up to 16years, and at 17years, tend to approach. Very good correlations ($r \geq 0.70$) were obtained between waist circumference with weight and with hip circumference; hip circumference with weight, body mass index with weight, waist circumference and hip circumference; the P/C Waist and Age Index, the Size, the Weight and the C Hip. In addition to the P/C Waist index, the distribution behaves approximately normal ($p<0.001$); and the behavior of this index, is similar to the behavior of the waist circumference and the hip circumference, as well as the hip waist index. When considering the classification of BMI, according to the WHO, and classifying schoolchildren according to the P/C Waist index is ≥0.78, based on the 85th percentile, to consider that they are at risk, and<0.78 to consider that it is not At risk, it was obtained that 259 schoolchildren, who represent 85.20% have no risk, and 45 schoolchildren, who represent 14.80% are at risk.

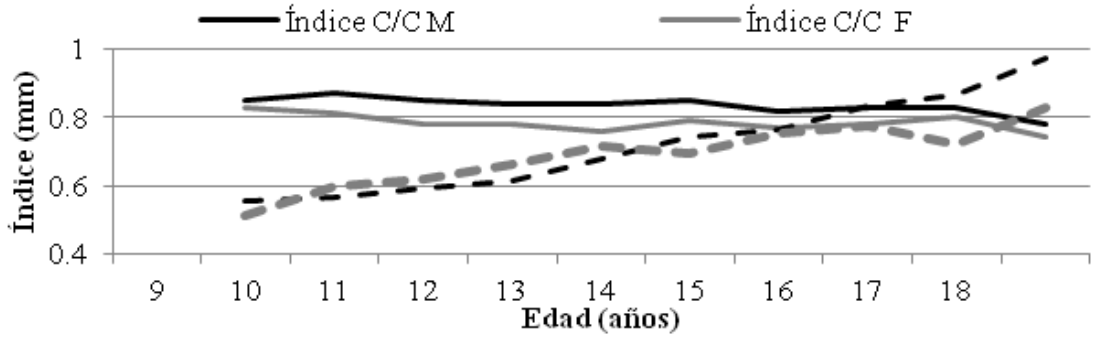

Figure 2 Índices Cintura/Cadera y Peso/C Cintura, según sexo. Escolares de tres ciudades, Venezuela.

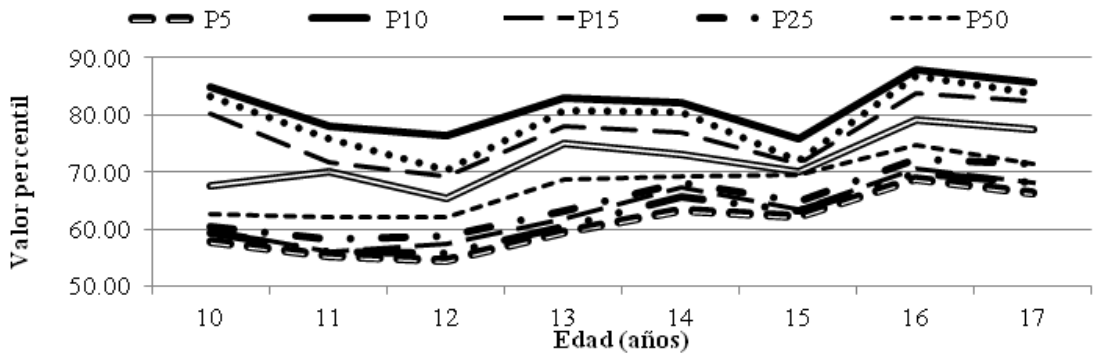

Figure 3 Percentiles de Circunferencia de Cintura por edad, sexo masculino. Escolares de tres ciudades de Venezuela.

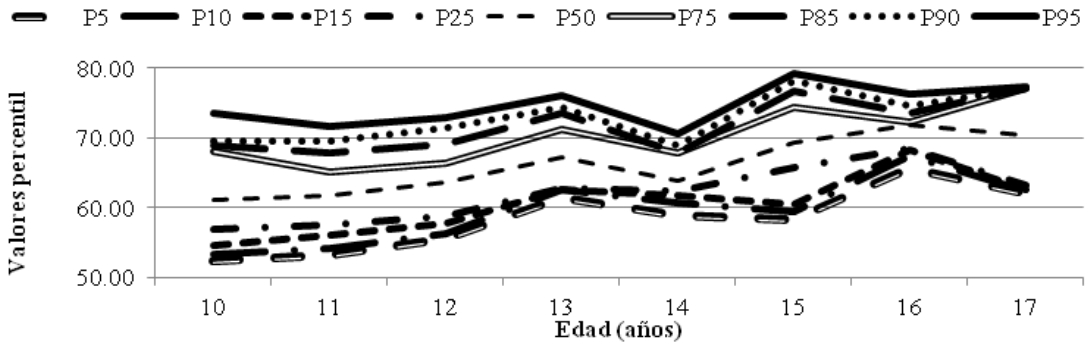

Figure 4 Percentiles de Circunferencia de Cintura por edad, sexo femenino. Escolares de tres ciudades de Venezuela.

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Discussion

It is known that today, overweight and obesity, has become a public health problem in underdeveloped and developing countries,[2] therefore; Likewise, it is known that obesity in childhood and adolescence has reached epidemic proportions in the Americas región.[11] On the other hand, it is necessary to agree with the results of the ENCA 2012, cited by López-Blanco et al (2014), the Venezuelan diet is of low quality, safety and innocuousness, which consolidates a known diet pattern as obesogenic, which contributes to overweight and obesity.[12] In view of the above, to evaluate both overweight and obesity in children and adolescents, the present study was carried out, where the BMI indicators, Circumference of the Waist, Hip Circumference, and a new index that was obtained as the relationship between the Weight and the Circumference of Waist, in order to compare them, and to have reliable indicators to evaluate the obesity. First, we obtained, for the aforementioned indicators, averages differentiated by sex, with higher results in men, with the exception of the hip circumference, these results; however, they are not significant, except for the waist circumference that is significantly higher in children ($p<0.0001$), a result that agrees with that obtained by Mederico et al. As for the averages of the height by age, both in the case of males and females, they are slightly lower than those obtained by Mederico et al, likewise with weight averages, although these are slightly higher than 16, 17 and 18years, in this study.[13] The average BMI of the sample is 19.23±3.29 (kg/m^2) is, and for males it is 19.29±3.50 (kg/m^2), while for females it is 19 , 13±3.14 (kg/m^2), which are not statistically significant, and in both sexes, are lower than those reported by Cordero et al.,[14] but the average in males is higher and in females less, as reported by Cossio-Bolaños et al.[15] The averages are considered by age groups, according to sex, and only weight ($p<0.01$) and height ($p<0.001$) for the group of 13 to 16years and waist circumference are statistically significant. ($p<0.001$) for the group of 10 to 12years; in addition, the averages of the four variables, both in males and females, are greater than those obtained by Benjumea et al.[16] Additionally, there is a 5.26% is classified as obese, a percentage lower than that reported by NHANES, which for the period 2007-2008 is 16.9%, for children and young people from 2 to 19years, who they are above the 95th percentile.[17]

Regarding the waist circumference, it is noteworthy that the reference values differ according to the authors, so for example Hirschler et al.,[18] refers that the CC can be useful to predict metabolic syndrome in children, considering a value>75th percentile ; in which case, for the group studied there is a value of CC>70.65cm and>72.38cm in males and females respectively, it would suggest that 70 students are candidates to suffer from metabolic syndrome. The average waist circumference by sex is 67.63±8.66 (cm) and 64.21±6.65 (cm) in males and females, respectively, lower than those obtained by Mederico, and those reported by Cordero et al.,[14] likewise, the average of the cc for the whole group is of 65.92±7.89 (cm), which is lower than that obtained by Hidalgo et al.,[19] and also when comparing the percentile values, the 25th and 50th percentiles are similar, and the 75th percentile is slightly lower. On the other hand, it was obtained that the averages of the cc by sex are statistically significant ($p<0,001$). When considering percentiles by age for waist circumference, these increase with age in both sexes, coinciding with the results obtained by Esquivel Lauzurique et al.,[20] although slightly higher in men, and differ significantly ($p<0.001$) in the 85th, 90th and 95th percentiles. When considering by age groups with the results obtained by Benjumea et al.,[16] it is possible that the averages of waist circumference obtained in this study are greater in both sexes, although they are not statistically significant among them. In relation to the Weight/CC index, it has been classified based on the average and the standard deviation established the catagories: Severe deficit (<0.44), Moderate deficit (0.44≤p/CC<0.55), Normal (0.55≤P/CC<0.78), overweight (0.78≤P/CC<0.90) and Obesity (≥0.90), with the following percentages by category: 1.32%, 16.45%, 68.09%, 11.51% and 2.63%, respectively, corresponding to an approximately normal distribution. When classifying the values of the P/CC index by percentiles, we have that the 75th percentile is 0.74, if we take into account the suggested by Hirscler et al (3) for the waist circumference, and according to this criterion , schoolchildren are classified, in no risk and risk, in such a way that those who have an index of 0.74 or more are at risk; and there are only 32 esolares, who represent 10, .53%, classified as risk, a percentage higher than that obtained by applying the above criterion.

Conclusion

It has been shown that physical activity plays an important role in the prevention of obesity and exercise levels high enough to counteract excessive caloric intake are needed.[10] The BMI is still a good indicator to assess overweight and obesity in children and adolescents; however, there is a tendency to use other indicators such as waist circumference, which has allowed for a new element to evaluate the school population and prevent metabolic syndrome;[18] but nevertheless there is no agreement as to the criterion to be used to classify in no risk and risk; since there are several criteria, such as suggesting the percentiles by age and sex.[13] The P/C Waist index can be a useful indicator to detect obesity, particularly due to its easy calculation and behavior, since it has been proven that sexual dimorphism can be verified when discriminating by age (Figure 2). In addition, for this particular group, it was found to behave approximately as a normal distribution ($p<0.001$), in addition it is highly correlated with weight, height and hip circumference ($r>0.80$) and moderately with age and BMI ($p>0.69$).

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None.

Conflict of interest

The author declares no conflict of interest.

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