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Blood pressure and body fat distribution patterns in children and adolescents from Montevideo

Presión arterial en niños y adolescentes de Montevideo según el patrón de distribución de la grasa corporal

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Abstract

Introduction: Hypertension (AHT) at an early age is determinant for the negative evolution of cardiovascular diseases in adult life. *Objective*: To relate blood pressure levels to the body fat distribution patterns in a group of children and adolescents in Montevideo. *Methodology*: A sample was defined for convenience and consisted of 47 preschoolers, 44 school children and 41 adolescents. Weight, height, waist and arm circumference, and subcutaneous folds were measured, enabling the construction of indicators of body fat distribution, as well as systolic and diastolic blood pressures. Correlations were studied using Pearson's linear correlation coefficient. For variables that could influence blood pressure, a linear regression model was performed. *Results*: Blood pressure was altered in 9.8% of the study population, with no significant gender or age differences. Excess of central fat was observed in 32.7% of the population studied and excess of peripheral fat was found in 18.2%, with no statistically significant gender differences. The waist circumference showed a moderate positive correlation with systolic pressure (R = 0.618), and a weak relationship with the arm fat area (R = 0.414). According to the linear regression model, for each centimeter of waist increment, systolic blood pressure is expected to increase 0.619 mmHg. *Conclusions*: The present study found a pattern of centripetal body fat distribution moderately related to BP and with no significant gender differences, therefore it is necessary to incorporate into everyday pediatric practice the measurement of waist circumference and the control of BP as predictors of metabolic risk.

Keywords: Blood Pressure, Children and Adolescents, Body Fat Distribution.

Resumen

Introducción: La hipertensión a edades tempranas es determinante para la evolución negativa de las enfermedades cardiovasculares en la vida adulta. *Objetivo*: Relacionar los niveles de presión arterial con el patrón de distribución de grasa corporal en un grupo de niños y adolescentes de Montevideo. *Metodología*: Se tomó una muestra por conveniencia de 47 preescolares, 44 escolares y 41 adolescentes. Se midió su peso, estatura, circunferencia de cintura y brazo y pliegues subcutáneos, que permitieron construir indicadores de patrón de distribución de grasa corporal, y también su presión arterial sistólica y diastólica. Las correlaciones se estudiaron a través del coeficiente de correlación lineal de Pearson. Para las variables que podrían influir en la presión arterial, se realizó un modelo de regresión lineal. *Resultados*: Se observó una presión arterial alterada en el 9,8% de la población estudiada, sin diferencias significativas entre los sexos ni relacionadas a la edad. El exceso de grasa central se observó en 32,7%, y el exceso de grasa periférica en 18,2%, sin diferencias estadísticamente significativas por sexo. La circunferencia de cintura mostró una correlación positiva moderada con la presión sistólica (R=0,618), y una relación débil con el área grasa del brazo (R =0,414). Según el modelo de regresión lineal, por cada centímetro de cintura que aumenta, se espera que la presión sistólica aumente 0,619 mmHg. *Conclusión*: a través del presente trabajo se observó un patrón de distribución de grasa corporal centrípeta, sin diferencias según sexo, moderadamente relacionado con la presión arterial, por lo que es necesario incorporar en la práctica pediátrica el uso de la circunferencia de cintura y el control de la presión arterial como predictores de riesgo metabólico.

Palabras clave: Presión Arterial, Niños y Adolescentes, Distribución de Grasa Corporal.

Introduction

Lifestyle-related diseases, especially cardiovascular diseases (CVD), are the leading cause of death worldwide,[1,2] and hypertension (HBP) is one of the most significant risk factors for the development of these illnesses. Hypertension in children is associated with its presence in adulthood.[3] It has been observed that children who have higher levels of blood pressure tend to have the same levels of blood pressure in adulthood.[4]

Although studies on the prevalence of high blood pressure (HBP) in the pediatric population are relatively scarce, their prevalence has increased in recent years,[5,6] and has been the key element of this consensus.[7,8] The progression of hypertension at an early age has been related to the parallel increase in obesity, a fact that has been demonstrated in countries such as United States[9], Venezuela[10] and Mexico.[11] Moreover, the results of medium or long-term follow-up epidemiological studies corroborate that HBP at an early age is determinant for the negative evolution of cardiovascular diseases in adulthood.[12-14] From these findings, it is clear the importance of detecting infantile hypertension before complications occur and lead to health problems in later stages of life.

Obesity is defined as the increase in body fat.[15] It may be evenly distributed throughout the body or become more predominant in the abdominal region.[16] BMI is an measurement tool used to define total body mass, and it indicates, at high levels, that there is an excessive fat deposition. The confirmation that a high BMI value is due to an excess of fat can be achieved by measuring the subcutaneous fat tissue, as approximately half the total body fat is deposited under the skin, or waist circumference, qwhich reveals fat deposition in the visceral region.[17] Abdominal or visceral fat, which primarily serves to quickly and easily mobilize energy reserves, is closely related to an increase in the prevalence of metabolic diseases, including cardiovascular illnesses.

The present study aims at relating blood pressure levels body fat distribution patterns in a group of preschoolers, school children and adolescents from Montevideo.

Methodology

This is an observational epidemiological cross-sectional study. The sample was defined for convenience and consisted of 47 preschoolers, 44 school children, and 41 adolescents attending Kindergarten No. 362, School No. 122 and Centro Espigas, public education institutions located in the city of Montevideo, between April and May 2016. Pregnant adolescents were not included in the survey.

The directors of the selected educational centers received a formal and detailed request on the importance, objectives and methodology of the study, through which they could give their consent to participate on a voluntary basis.

This study was approved by the Ethics and Research Committee of the Catholic University of Uruguay. Meetings were held with parental participation, in order to explain the reason guiding the survey and ask for their consent.

In a second step, the anthropometric measurements of all participants were performed. Measurements were carried out by a group of nutrition experts using appropriately standardized techniques.[18,19] The participants were weighed and measured barefoot and wearing lightweight clothing. The weight was recorded using a Seca® model 841 digital scale (100g accuracy). The height

was measured by a Seca® digital height rod (0.1cm accuracy). The body mass index (BMI=Weight/Height^2) was calculated. The brachial circumference was measured using a Seca® inextensible tape measure, and the tricipital skinfold thickness was measured with a Lange® caliper.

Waist circumference measurement was performed according to WHO guidelines, in the plane passing through the midpoint between the costal inferior border and the iliac crest, using the above-mentioned tape measure. Each measurement was performed in duplicate and in a non-consecutive way. The BMI/Age index was compared to the WHO reference tables.[20] The brachial fat area (BFA) was determined using the Frisancho formulae and compared with the reference table by the same author.[21] Waist circumference values (WC) were compared with NHANES III tables [22] and were considered high when they were above the 90th percentile.

BP was measured using an OMRON automatic blood pressure monitor, previously calibrated with a mercury sphygmomanometer. Two measurements were performed with a 5-minute interval between each one. Differences in the results were compared and, the cases in whcih differences greater than 5% were found in either of the two pressures (systolic and/or diastolic), a third BP measurement was carried out. BP measurements were compared with those established in the 3rd Uruguayan Consensus on Hypertension in Children and Adolescents.[8] Blood pressure was considered altered when systolic (SBP) and/or diastolic blood pressure (DBP) was above the 95th percentile, according to sex and age.

Statistical analysis: The quantitative variables were expressed through mean values with a 95% confidence interval, and the qualitative variables by means of absolute frequency and percentages. The variables were analyzed through the Student's t test for independent samples and the Chi-square hypothesis test, respectively. Correlations were evaluated using Pearson's r correlation coefficient (adjusted r-squared) and the Linear Regression Model.

All tests were considered statistically significant at a (α) level of 0.05. For data processing, the IBM SPSS software, Statistics 20 was used.

Results

Data were collected from 132 children and adolescents: 35.6% were preschoolers (n = 47), 33.3% were school children (n = 44) and 31.1% (n = 41) were adolescents. The distribution by sex was even in all age groups.

Table 1 shows the mean values and 95% confidence interval for the anthropometric variables surveyed, differentiated by sex. The results indicate a similar morphological profile between boys and girls and reveal some differences only in the fat area measured in the tricipital skinfold thickness (p = 0.001) and fat area (p = 0.008), where girls showed slightly superior values in comparison with those observed among boys.

Table 1. Mean value and 95% confidence interval for all anthropometric values assessed by gender.

	Males	Females	Total	p
Weight (Kg.)	37,5 (32,3-42,7)	37,4 (32,5-42,2)	37,4 (33,8-41,1)	NS
Height (cm)	132,2 (125,6-138,7)	134,1 (127,2-140,9)	132,9 (128,2-137,7)	NS
BMI (Kg/m^2)	19,1 (18,2-20,1)	19,5 (18,6-20,5)	19,3 (18,6-19,9)	NS
Arm circumference (mm)	206,6 (194,4-218,7)	216,9 (203,4-230,4)	210,6 (201,6-219,6)	NS
Triceps skinfold (mm)	10,7 (9,6-11,8)	14,0 (12,4-15,6)	12,0 (11,1-12,9)	0,001
Fat area (mm^2)	1065 (913-1217)	1422 (1195-1650)	1205 (1074-1335)	0,008
Muscular area (mm^2)	2525 (2199-2852)	2470 (2154-2785)	2504 (2273-2735)	NS
Waist circumference (cm)	60,9 (57,8-64,0)	62,9 (59,7-66,1)	61,7 (59,4-63,9)	NS

An altered blood pressure (> P95 according to age and sex) was observed in 9.8% of the studied population. La alteración de la PAS se verificó en el 6,8% de la muestra y de la PAD en 6,1%. No significant differences were found between males and females, nor between the age groups (Table 2).

Table 2. Arterial hypertension and excess body fat

	Males	Females	Total	p
N	79	53	132	
Hypertension according to age				
Systolic > P95	8,9%	3,8%	6,8%	NS
Diastolic > P95	6,3%	5,7%	6,1%	NS
Systolic or diastolic> P95	12,7%	5,7%	9,8%	NS
Excess body fat according to position and age				
Central (Waist Circumference > P75)	32,8%	32,6%	32,7%	NS
Central (Waist Circumference > P90)	9,0%	11,6%	10,0%	NS
Peripheral (Arm Fat Area > P75)	26,8%	37,2%	30,9%	NS
Peripheral (Arm Fat Area > P90)	16,4%	20,9%	18,2%	NS

On the other hand, the excess of central fat estimated through waist circumference > P75 was observed in 32.7% of the participants, the excess of peripheral fat estimated through the arm fat area > P90 was noticed in 18.2% of the sample, and no statiscally significant gender differences were observed (Table 2).

When analyzing the correlations of SBP and DBP with waist circumference and arm fat area, a positive significance was observed for both. It can be noticed that central fat, expressed by waist circumference values, shows a moderate positive correlation with the systolic pressure (R = 0.618) and that peripheral fat, expressed through the arm fat area values (R = 0.414), shows a weak relationship with the SBP (Figure 1).

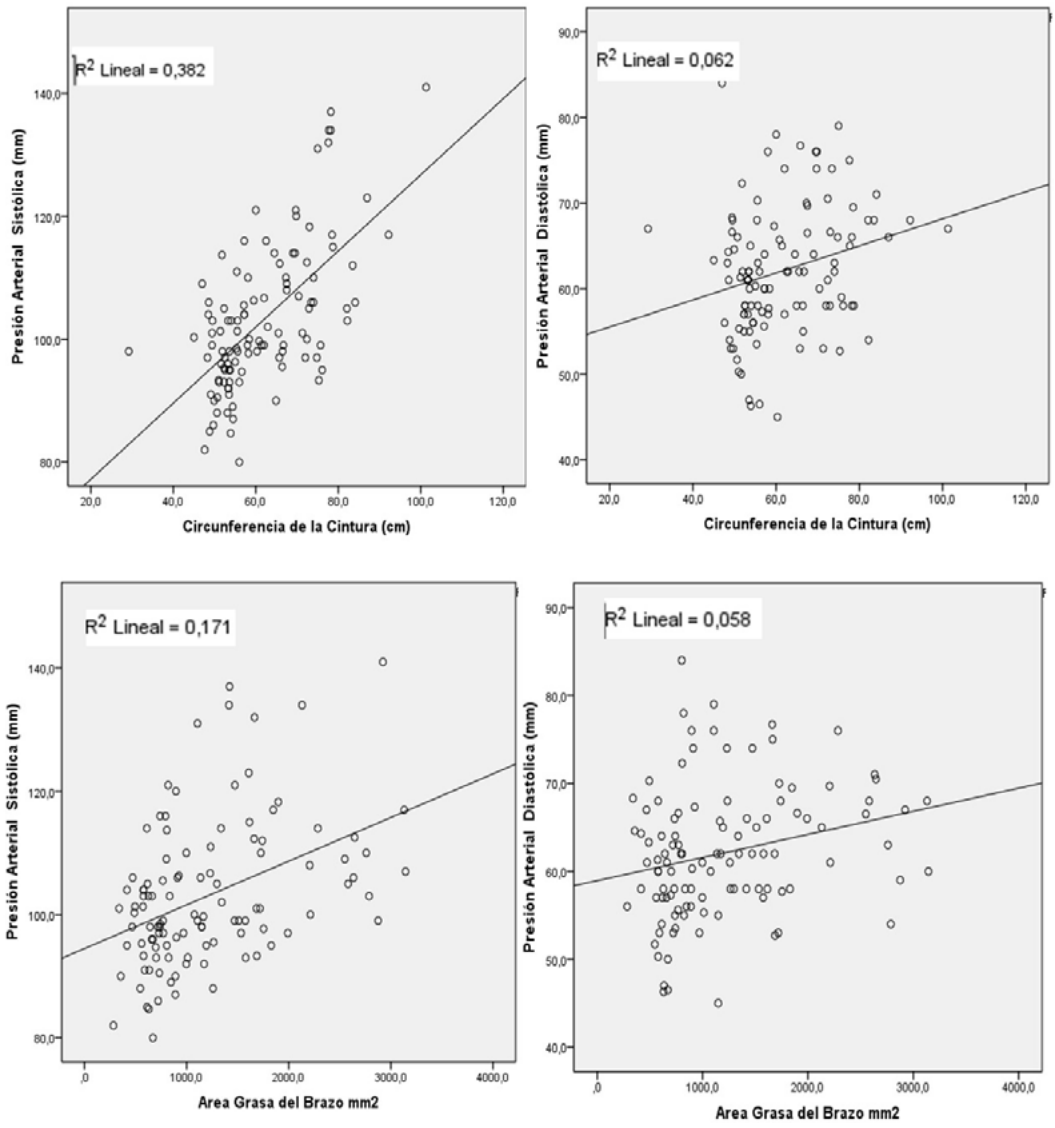

Figure 1. Correlation of Diastolic and Systolic Blood Pressure with Waist Circumference and Arm Fat Area.

According to the linear regression model, for each centimeter of waist increment, systolic blood pressure is expected to increase 0.619 mmHg (Table 3)

Table 3. Lineal regression model of Diastolic and Systolic Blood Pressure in relation to waist circumference and arm fat area

SBP Model	R	r-square	Adjusted r-square	B	Lower Limit	Upper Limit	Sig.
SBP- Waist circumference	0,618	0,382	0,376	0,619	0,469	0,77	<0,001
(Constant)				64,82	55,38	74,257	<0,001
SBP- Arm Fat Area	0,414	0,171	0,163	0,007	0,004	0,01	<0,001
(Constant)				94,49	90,362	98,621	<0,001
DBP Model							
DBP- Waist circumference	0,248	0,062	0,053	0,158	0,04	0,275	0,009
(Constant)				52,36	44,981	59,742	<0,001
DBP- Arm Fat Area	0,242	0,058	0,05	0,003	0,001	0,005	0,011
(Constant)				58,94	56,145	61,73	<0,001

Discussion

The present study aimed at correlating blood pressure levels with body fat distribution patterns of a group of preschoolers, school children and adolescents from Montevideo. Although this work has some limitations, as it is a cross-section sample defined for convenience, without repeating blood pressure measurement on successive days, it was able to determine the subcutaneous fat through the assessment of the tricipital skinfold thickness, a technique barely documented in our midst.

High blood pressure in childhood is an early manifestation of hypertension in adulthood. There are many factors that may be determinant for the development of this pathology in childhood: maternal blood pressure during pregnancy, low birth weight, adverse socioeconomic status, high sodium intake and infant adiposity.[23-25] Regarding this aspect, the present work has focused on measuring abdominal and subcutaneous fat and observing its correlation with blood pressure.

According to the findings of other researches, the best correlations verified in the present study were those corresponding to waist circumference with systolic pressure. Subcutaneous fat showed a lower correlation with blood pressure than the abdominal fat deposition. On the other hand, the assessment of skinfolds thickness, besides showing a lower sensitivity than that of waist circumference, is difficult and requires specialized personnel. The waist circumference reflects the abdominal fat with greater sensitivity and specificity than other indicators such as waist/hip ratio, waist/height and BMI[26] and is clinically and epidemiologically useful.

Waist circumference in children and adolescents is a good predictor of metabolic complications and cardiovascular risk. [27,28] The Bogalusa Heart Study[29] showed that the distribution of central fat determined by waist circumference, for children and adolescents between 5 and 17 years old, as in the case of the participants in the present study, is associated with abnormal concentrations of triglycerides, LDL-C, HDL-C and insulin, i.e., this means that central obesity in comparison with generalized obesity is more strongly correlated with metabolic risk factors[30], and thus, central obesity is an independent risk factor for the development of type 2 diabetes, dyslipidemia and coronary artery disease.[31]

Since the body fat distribution pattern is outlined in the early years of life and predisposes to future noncommunicable diseases, there is therefore a need for prevention, early detection in high-risk populations, and implementation of care and treatment measures. Considering the nutritional epidemiological situation of children in our country, it is recommended the use of body fat distribution pattern indicators to identify the pediatric population at a higher risk of developing noncommunicable diseases.

Concluding remarks

The present study found a pattern of centripetal body fat distribution moderately related to BP and with no significant gender differences, therefore it is necessary to incorporate into everyday pediatric practice the measurement of waist circumference and the control of BP as predictors of metabolic risk.

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Participation

Skapino E: Field survey, contributing writer; Bove MI: Design of the research project, interpretation and discussion of results of the article to be published; Ramirez R: Data processing, performance of statistical tests, elaboration of tables and figures to be published.

Conflicts of interest: The authors state that there were no conflicts of interest.

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