RELATION BETWEEN SUM OF SKINFOLDS AND SYSTEMIC BLOOD PRESSURE IN ADOLESCENTS

Relação entre somatório de dobras cutâneas e pressão arterial sistêmica em adolescentes

Relación del total de pliegues cutáneos y presión arterial sistémica de adolescentes

ABSTRACT

Objective: To relate the sum of skinfolds to systemic blood pressure in adolescents attending public schools. **Methods:** Cross-sectional study conducted with 543 adolescents from public schools of Curitiba-PR-Brazil, aged between 11 and 17 years, regardless of sex, in the period from August 2010 to June 2011. Body weight, height and skinfolds (triceps, subscapular, suprailiac, abdominal and calf) were measured. Systolic (SBP) and diastolic (DBP) blood pressure were determined by duplicate auscultatory method. A new evaluation was performed the day after the first collection in adolescents identified with pre-hypertension or hypertension. Partial correlation was used as a measure of association between variables, considering height and age as control variables. Analyses were stratified by sex and the level of significance was set at 5%. **Results:** Among male adolescents, the sum of skinfolds presented a correlation to SBP and DBP of 0.18 ($p<0.01$) and 0.14 ($p<0.05$), respectively. Among female adolescents, the correlation of the sum of skinfolds to SBP and DBP was 0.15 ($p<0.01$) and 0.19 ($p<0.01$), respectively. Of the total sample, 9.2% (n=50) were pre-hypertensive and 7.6% (n=41) were hypertensive. Conclusion: the sum of skinfolds were directly related to the systemic blood pressure of the adolescents assessed.

Descriptors: Adolescent; Skinfold Thickness; Body Fat Distribution; Blood Pressure.

RESUMO

Objetivo: *Relacionar o somatório de dobras cutâneas com a pressão arterial sistêmica em adolescentes da rede pública.* **Métodos:** *Estudo transversal realizado com 543 adolescentes da rede pública de ensino de Curitiba-PR-Brasil, com idade entre 11 e 17 anos e independente do sexo, no período de agosto de 2010 a junho de 2011. Mediu-se peso corporal, estatura e dobras cutâneas (triciptal, subescapular, suprailiaca, abdominal e panturrilha). Mensurou-se a pressão arterial sistólica (PAS) e diastólica (PAD) através do método auscultatório, em duplicata. Realizou-se uma nova avaliação no dia posterior à primeira coleta nos adolescentes identificados com pré-hipertensão ou hipertensão. Utilizou-se a correlação parcial como medida de associação entre as variáveis, considerando estatura e idade como variáveis de controle. As análises foram estratificadas por sexo e o nível de significância foi de 5%.* **Resultados:** *Entre adolescentes do sexo masculino, o somatório de dobras cutâneas teve uma correlação com a PAS e a PAD de 0,18 (p<0,01) e 0,14 (p<0,05), respectivamente. Entre adolescentes do sexo feminino, a correlação do somatório de dobras cutâneas com a PAS e PAD foi de 0,15 (p<0,01) e 0,19 (p<0,01), respectivamente. Da amostra total, 9,2% (n=50) foram considerados pré-hipertensos e 7,6% (n=41) hipertensos.* **Conclusão:** *O somatório de dobras cutâneas apresentou relação direta com pressão arterial sistêmica nos adolescentes investigados.*

Descritores: *Adolescente; Dobras Cutâneas; Distribuição da Gordura Corporal; Pressão Arterial.*

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RESUMEN

Objetivo: *Relacionar el total de pliegues cutáneos y la presión arterial sistémica de adolescentes de la red pública.* **Métodos:** *Estudio transversal realizado con 543 adolescentes de la red pública de enseñanza de Curitiba-PR-Brasil, con edad entre los 11 y 17 años y independiente del sexo en el período entre agosto de 2010 y junio de 2011. Se medio el peso corporal, la estatura y los pliegues cutáneos (tricipital, subescapular, suprailíaco, abdominal y pantorrilla). Se mensuro dos veces la presión arterial sistólica (PAS) y diastólica (PAD) a través del método auscultatorio. Se realizó una nueva evaluación el día después de la primera en los adolescentes identificados con pre-hipertensión o hipertensión elevada. Se utilizó la correlación parcial como medida de asociación de variables, considerando estatura y edad como variables control. Los análisis fueron estratificados por sexo y el nivel de significación fue del 5%.* **Resultados:** *El total de pliegues cutáneos entre los adolescentes del sexo masculino se correlacionó con la PAS y la PAD en 0,18 (p<0,01) y 0,14 (p<0,05), respectivamente. La correlación del total de pliegues cutáneos com la PAS y PAD de los adolescentes del sexo femenino fue de 0,15 (p<0,01) e 0,19 (p<0,01), respectivamente. De toda la muestra, el 9,2% (n=50) fueron considerados pre-hipertensos y el 7,6% (n=41) hipertensos.* **Conclusión:** *El total de pliegues cutáneos presentó relación directa con la presión arterial sistémica de los adolescentes investigados.*

Descriptores: *Adolescentes; Grosor de Pliegues Cutáneos; Distribución de la Grasa Corporal; Presión arterial.*

INTRODUCTION

Systemic arterial hypertension is an important independent risk factor for cardiovascular disease, cerebrovascular accident (CVA) and kidney disease, showing a direct relationship to these conditions, significantly increasing morbidity and mortality [1,2]. More than 1 billion people are affected around the world[3] and in Brazil, population-based surveys present a high prevalence in adults, with proportions ranging from 22.3% to 43.9%[2].

These high prevalence rates found in adults are worrisome; however, the national literature has observed hypertension prevalence values in children and adolescents ranging from 3.6% to 21.2%[4-7]. This disease is linked to several environmental risk factors such as low physical activity levels, smoking, excessive intake of salt and alcohol, besides family history, diabetes and socioeconomic level, both in adults and in adolescents[2].

Despite this range of risk factors, excess body fat and its impact on the individual's health have been widely studied because this condition has increased considerably in last decades[8,9]. This assessment of body fat in the young population can be performed by various methods. However, simpler and less-costly methods, such as anthropometric measurements, have often been used for large-scale studies[10]. Among these anthropometric methods, the body mass index (BMI) is the most used indicator in clinical practice and epidemiological studies[10]; however, it does not directly estimates the body fat[11]. Accordingly, the use of the sum of skinfolds can measure more precisely the fat mass[10], responsible for organ dysfunctions such as systemic arterial hypertension[2].

In view of these considerations, the present study had the objective to relate the sum of skinfolds to systemic blood pressure in adolescents attending public schools.

METHODS

An observational cross-sectional study was conducted with adolescents from the 6th grade of elementary school to the 2nd year of high school enrolled in public schools of the city of Curitiba-PR-Brazil, being held from August 2010 to June 2011.

The study target population included 115,524 adolescents enrolled in the 6th, 7th and 8th grades of elementary school (160 schools) and in the 1st and 2nd years of high school (106 schools) from public schools in the city of Curitiba-PR. The study comprised of 543 adolescents, regardless of sex, and aged 11 to 17 years from 44 schools randomly chosen. The exclusion criteria included: the non-delivery of the free and informed consent form signed by parents or guardians until the data collection day, lack of anthropometric data, lack of re-evaluation of blood pressure, continuous use of oral contraceptives, pregnancy, use of antihypertensive drugs and withdrawal from study participation.

Data collection occurred in two stages. At first, measurement of height, body weight, skinfolds and resting blood pressure of the subjects were performed. In the second step, blood pressure from adolescents that first showed increased values was re-evaluated.

Standardized procedures[10] were applied to define body height and weight. Body height was assessed by the WISO® portable stadiometer with a 1mm scale and body weight was determined by the WISO® portable digital scale with a 100g measurement scale.

A scientific skinfold caliper (Cescorf®) was used to perform the skinfold measurements. The repair points were the subscapular, triceps, suprailiac, abdominal and calf skinfolds, following international measurement standards[10]. Three non-consecutive skinfold measurements were performed at each repair point following the calculation of the average of the measurements. The adiposity level of individuals was defined by the skinfold sum of the five repair points.

Systemic arterial blood pressure was measured by the auscultatory method[12] using an aneroid sphygmomanometer (BD®). The measurement was performed on the right arm with sitting students having at least a 5-minute rest. Appropriate cuffs corresponding to 40% of the arm circumference and at least to 80% of its length were applied to the study[12]. Proposed values by the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents[12] were used to categorize the adolescents according to gender, age and height percentile, being considered as pre-hypertensive subjects the individuals having a systolic blood pressure (SBP) and/or a diastolic blood pressure (DBP) ≥90th percentile and <95th percentile and with values of 120/80 mmHg and as hypertensive subjects the individuals having a SBP and/or a DBP ≥ 95th percentile. In the case of adolescents being categorized as pre-hypertensive or hypertensive subjects on the first day of data collection, a new evaluation of SBP and DBP was held the day after the first assessment. In these cases, the second evaluation values were used in the study.

In the descriptive statistical analysis, based on means and standard deviations, the description of continuous variables and the relative frequency analysis were used for identifying the proportions of pre-hypertensive and hypertensive individuals. The comparison between genders in the proportion of subjects with normal and high blood pressure levels were obtained by chi-square tests.

Partial correlation was applied to analyze the association among the sum of skinfolds and SBP and DBP values. In these analyses, height and age were placed as control variables. Analyses were performed by gender, considering a significance level of $p<0.05$.

This study was approved by the Research Ethics Committee of the Federal University of Paraná (Santa Catarina) with protocol No. 131.341, following the regulations for research involving human subjects from the National Health Council (Resolution No. 466/12). Only adolescents whose parents agreed and signed the free and informed consent form joined the research.

RESULTS

The study sample comprised 257 (47.4%) male adolescents and 286 (52.6%) female adolescents, with a mean age of 14.76±1.63 years. The sample was characterized through means and standard deviations of age, height, body weight, triceps, subscapular, supra iliac, abdominal and calf skinfolds, SBP and DBP levels from adolescents enrolled in public schools from the city of Curitiba-PR (Table I).

Regarding the systemic arterial blood pressure classification, 83.2% (n=452) of the evaluated adolescents presented normal values, 9.2% (n=50) were considered as having pre-hypertension and 7.6% (n=41) hypertension.

Figure I displays the sample classification according to blood pressure values in both genders. There was no significant difference between genders to normal blood pressure ($X^2=3.358$, p = 0.07), pre-hypertension ($X^2=3.449$, p=0.06) and hypertension ($X^2=0.639$; p=0.22).

Table I - Distribution of analyzed variables by gender of adolescents from public schools. Curitiba-PR, 2010-2011.

Variables	Males(n=257)		Females (n=286)	
	Mean	SD(±)	Mean	SD (±)
Age (years)	14.71	1.61	14.79	1.65
Height (m)	1.65	0.10	1.59	0.06
Body weight (kg)	57.87	13.80	53.49	10.15
Triceps SF (mm)	12.09	5.58	17.80	5.79
Subscapular SF (mm)	11.36	6.73	15.04	6.77
Suprailiac SF (mm)	15.92	11.50	23.01	10.99
Abdominal SF (mm)	17.65	11.16	25.26	10.25
Calf SF (mm)	12.90	6.66	18.88	6.62
$\sum$SF (mm)	69.94	38.77	100.01	36.69
SBP (mmHg)	111.65	9.66	107.46	8.78
DBP (mmHg)	70.95	7.07	70.84	6.68

SD; standard deviation; SF; skinfold; SBP; systolic blood pressure; DBP; diastolic blood pressure, $\sum$SF; the sum of skinfolds
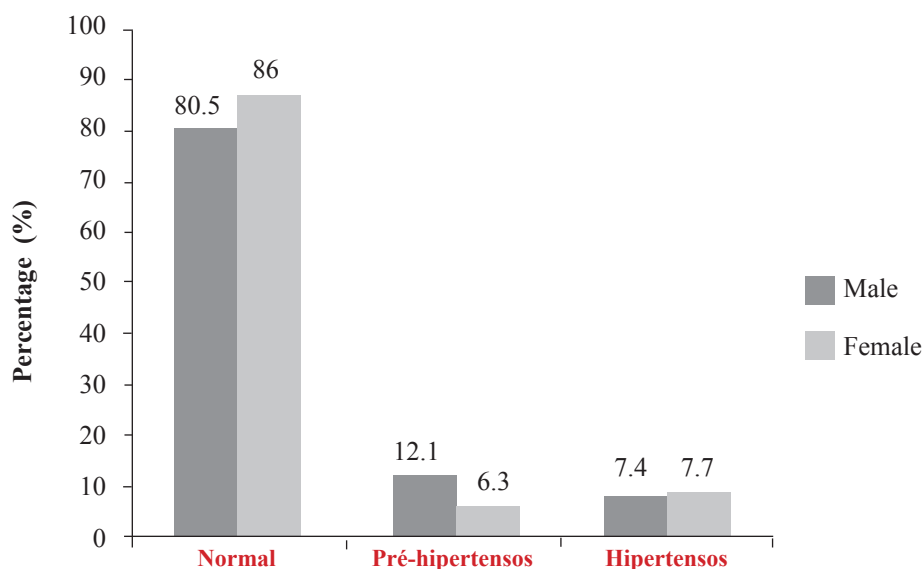
Figure I - Classification of systemic arterial blood pressure by gender of students from public schools. Curitiba-PR, 2010-2011.

With reference to the partial correlation analysis, it was observed that there was a significant correlation between the sum of skinfolds with SBP (r=0.18; p<0.01) and DBP values (r=0.14; p<0.05) for males. For females, there was also a significant correlation between the skinfold sum with SBP (r=0.15; p<0.01) and DBP values (r=0.19; p<0.01). The results show that the bigger the sum of skinfold is, the greater SBP and DBP values are; however, the correlations found are weak.

DISCUSSION

Investigations conducted in several regions of the country showed higher prevalence rates of adolescents with systemic arterial hypertension, with up to 11.8%[7] and 21.2%[5]. However, such studies carried out the blood pressure assessment in a single day, in a way that this single assessment may overestimate its prevalence, since the high blood pressure levels tend to decrease during the following evaluations due to an accommodation effect generated by the reduction of anxiety of adolescents related to the familiarity with the procedures and the evaluator[12].

Studies performing blood pressure measurements in two or more days, as this current study, presented lower hypertension prevalence levels. Accordingly, previous studies pointed out that 3.2% of a sample of adolescents presented hypertension[13] and that its prevalence may range from 2.8% for males to 0.9% for females[6].

Other investigations have found similar results in the correlation between the sum of skinfolds and high blood pressure. A research conducted in Rio de Janeiro in 1998 with 646 adolescents had already drawn attention to a relationship between the sum of skinfolds and hypertension, finding a positive correlation between the sum of skinfolds (triceps and calf) with SBP (r=0,36) and DBP values (r=0.30) in males and the SBP and DBP values (r=0.26) in females[14]. A cross-sectional study placed in Santa Cruz do Sul-RS found, as in the present study, a weak correlation (r=0.30 and r=0.27) to the sum of triceps and subscapular skinfolds with SBP and DBP levels, respectively[15]. This correlation was also found in a study of 1,253 adolescents enrolled in public and private schools in the city of Maceió-AL, detecting significant correlation between the triceps skinfold and SBP (r=0.25) and DBP levels (r=0.24) in adolescents of both genders[16].

These studies support the findings of this research, pointing out that the increase in SBP and DBP levels is associated with an increase in skinfold values. However, some methodological differences must be taken into account to explain the variability in the achieved results.

In the present study, five repair points were used to the skinfold sum, with the remaining studies using only one or two skinfolds. In this regard, the five-skinfold protocol seems to better represent the total amount of fat in individuals by measuring a greater number of body segments.

Additionally, the other studies used simple correlation analyses, lacking other variable controls that may contribute to increased blood pressure. In the present study, age was a control variable, since it is known that the systemic arterial blood pressure tends to increase proportionally over the

years[2]. It is highlighted that age should be considered as a control variable in studies on blood pressure prevalence rates and correlations[17].

Furthermore, the height of the subjects was also a control variable, since this variable may be related to the maturation level of individuals. Similarly as age [17], it is used in normative tables for systemic blood pressure classification in young individuals[12].

Nevertheless, correlations found in this research were weak. This is linked to the fact of the employ of only one risk factor, which can represent a limitation, since the increased systemic blood pressure levels depend on a combination of genetic and environmental factors. These factors usually present in a combined form, especially in families with unhealthy lifestyles [2,17].

However, it was demonstrated in this study a consistent result with the literature, confirming that high blood pressure levels are related to higher skinfold values. This identification is important because young individuals with higher blood pressure levels, even within limits considered normal, are more likely to become adults with increased blood pressure levels [18].

CONCLUSION

The sum of skinfolds presented a direct relationship to systemic arterial blood pressure in the investigated adolescents.

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