ASSOCIATION OF ANTHROPOMETRIC INDICATORS AND BLOOD PRESSURE WITH WAIST-TO-HEIGHT RATIO IN SCHOOL CHILDREN

Associação de indicadores antropométricos e pressão arterial com a relação cintura/estatura em escolares

Asociación entre indicadores antropométricos y presión arterial con el índice cintura-altura de escolares

ABSTRACT

Objective: To associate anthropometric indicators and blood pressure with waist-to-height ratio in school students. **Method**s: Cross-sectional study conducted with 342 school students aged 6-11 years from a municipality of Rio Grande do Sul, Brazil, with data collected from March to November of 2014 by measuring weight, height, systolic and diastolic blood pressure (SBP/DBP), waist circumference (WC) and the waist-to-height ratio (WHtR). T-student and Qui-squared tests were used with significance level set at 5% (p≤0.05). **Results:** Of all students, 54.4% (n=186) were female, 32.7% (n=112) were overweight and 5% (n=17) were obese according to BMI classification; 11.1% (n=38) were pre-hypertensive and 5% (n=17) had stage I hypertension according to the overall SBP/DPB classification; 37.1% (n=127) had an increased WC and 23.4% (n=80) had an increased WHtR. There were no students with stage II and III hypertension in the sample. Thinness and normal weight (p≤0.01), normal SBP and DPB (p≤0.01) and normal WC (p≤0.01) were significantly associated with normal WHtR whereas overweight and obesity (p≤0.01), pre-hypertension (p≤0.01) and increased WC (p≤0.01) were significantly associated with increased WHtR. **Conclusion:** The male gender presented significantly increased anthropometric measures than the female gender. Thinness, normal weight, blood pressure and waist circumference were associated with normal waist-to-height ratio (WHtR) whereas overweight, obesity, pre-hypertension and increased WC (p≤0.01) were associated with increased WHtR.

Descriptors: Nutritional Status; Waist Circumference; Arterial Pressure.

RESUMO

Objetivo: *Associar os indicadores antropométricos e pressão arterial com a relação cintura/estatura em escolares.* **Métodos:** *Estudo transversal envolvendo 342 escolares de 6 a 11 anos, de um município do Rio Grande do Sul, Brasil, com coleta realizada de março a novembro de 2014, aferindo peso, altura, pressão arterial sistólica e diastólica (PAS/PAD), circunferência da cintura (CC) e relação cintura/estatura (RCE). Utilizaram-se os testes estatísticos de t-Student e Qui-quadrado, e nível de significância de 5% (p≤0,05).* **Resultados:** *Do total de escolares, 54,4% (n=186) eram do sexo feminino, 32,7% (n=112) estavam com sobrepeso e 5% (n=17) eram obesos, de acordo com a classificação do IMC; 11,1% (n=38) eram pré-hipertensos, 5% (n=17) estavam com HAS estágio I, na classificação da PAS/PAD geral; 37,1% (n=127) tinham CC elevada e 23,4% (n=80), RCE elevada. Não foram encontrados escolares com HAS estágios II e III na amostra estudada. Magreza e eutrofia (p≤0,01), PAS e PAD normal (p≤0,01) e CC normal (p≤0,01) foram significativamente associadas à classificação de RCE normal, assim como sobrepeso e obesidade (p≤0,01), pré-hipertensão (p≤0,01) e CC elevada (p≤0,01) foram significativamente associados à RCE elevada.* **Conclusão:** *Concluiu-se que o sexo masculino apresentou medidas antropométricas significativamente superiores às do sexo feminino. Magreza, eutrofia, pressão arterial sistêmica e circunferência de cintura normais foram associadas à relação cintura/estatura (RCE) normal, enquanto sobrepeso, obesidade, pré-hipertensão e circunferência de cintura elevada estiveram associados à classificação elevada de RCE.*

Descritores: *Estado Nutricional; Circunferência da Cintura; Pressão Arterial.*

Luiza Christmann[1]
Simone Morello Dal Bosco[2]
Fernanda Scherer Adami[1]

1) Univates University Center (*Centro Universitário Univates - UNIVATES*) - Lajeado (RS) - Brazil

2) Federal University of Health Sciences of Porto Alegre (*Universidade Federal de Ciências da Saúde de Porto Alegre - UFCSPA*) - Porto Alegre (RS) - Brazil

RESUMEN

Objetivo: *Asociar los indicadores antropométricos y la presión arterial con el índice cintura-altura de escolares.* **Métodos:** *Estudio transversal con 342 escolares entre 6 y 11 años de un municipio de Río Grande de Sur, Brasil, y recogida de datos realizada entre marzo y noviembre de 2014 a través de la medición del peso, la altura, la presión arterial sistólica y diastólica (PAS/PAD), la circunferencia da la cintura (CC) y el índice cintura-altura (ICA). Se utilizó las pruebas estadísticas de t-Student e Chi-cuadrado y el nivel de significación del 5% (p≤0,05).* **Resultados:** *Del total de escolares, el 54,4% (n=186) eran del sexo femenino, el 32,7% (n=112) tenían sobrepeso y el 5% (n=17) eran obesos según la clasificación del IMC; el 11,1% (n=38) eran pre-hipertensos, el 5% (n=17) tenían HAS fase I de la clasificación de la PAS/PAD general; el 37,1% (n=127) tenían la CC elevada y el 23,4% (n=80) el ICA elevado. No se ha encontrado escolares en fase II y III de HAS en la muestra estudiada. La delgadez y la eutrofia (p≤0,01), la PAS, la PAD (p≤0,01) y la CC normales (p≤0,01) estaban significativamente asociadas con la clasificación del ICA normal así como el sobrepeso y la obesidad (p≤0,01), la pre-hipertensión (p≤0,01) y la CC elevada (p≤0,01) estaban significativamente asociados con el ICA elevado.* **Conclusión:** *Se concluye que el sexo masculino presentó medidas antropométricas significativamente mayores que el sexo femenino. La delgadez, la eutrofia, la presión arterial sistémica y la circunferencia de la cintura normales estuvieron asociadas con el índice cintura-altura (ICA) normal mientras que el sobrepeso, la obesidad, la pre-hipertensión y la circunferencia de la cintura elevada estuvieron asociados con la clasificación elevada del ICA.*

Descriptores: *Estado Nutricional; Circunferencia de la Cintura; Presión Arterial.*

INTRODUCTION

In recent years there have been major changes in the nutritional profile of children, such as increased intake of processed foods high in sodium, fats and sugars, and reduced intake of fruits and vegetables, which favor excess weight and associated diseases, including arterial pressure[1].

The Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística - IBGE*)[2] reported a significant increase in the number of children with excess weight in the country, especially in the age group between 5 and 9 years old. In Latin America, there was a steady increase in overweight and obesity rates in the last three decades among children and adolescents. Current data estimate that between 42.4 and 51.8 million children and adolescents are overweight or obese, which represents 20-25% of the total population of children and adolescents[3]. The childhood obesity epidemic poses numerous complications to the health of children, who – if not diagnosed and treated properly – tend to remain obese in adulthood, becoming more vulnerable to develop heart disease and diabetes[4].

In addition to excess weight rates, it is estimated that 1-13% of children and adolescents have hypertension and that overweight and central obesity are directly associated with blood pressure levels in adults[5].

Therefore, as hypertensive children are more likely to become hypertensive adults due to increased aggregation of cardiovascular risk factors and longer period of exposure to changes in the organs[1], it is important to use anthropometric parameters such as simple, universal, non-invasive and inexpensive methods to assess the nutritional status of this population, encouraging early prevention and health promotion within the population in order to reduce the impact of these diseases on public health[6].

Cardiovascular disease is a leading cause of death among adults worldwide; it is a progressive disease that has its roots in the early years of life. Childhood and adolescence are important stages in this process as they are periods of biological changes in the human body when individuals adopt independent standards and behaviors that influence the risk of these diseases[7].

Waist circumference (WC) is the main marker of abdominal fat and has been widely used to assess local adiposity; it constitutes an important tool for the assessment of overweight and obesity in children and it identifies those who are at risk of developing metabolic and cardiovascular complications[3]. The waist-to-height ratio (WHtR) has advantages over waist circumference only as its combination with the height allows the establishment of a single cutoff point (0.50) that can be used for individuals over the age of five and in the general population regardless of gender, age and ethnicity[8].

Given the importance of anthropometric and blood pressure measurements of school students and considering that this age group represents a stage of changes, the present study aimed to associate anthropometric indicators and blood pressure with waist-to-height ratio in school students.

METHODS

This is a quantitative observational cross-sectional study conducted in a public school of a municipality located in the countryside of the state of Rio Grande do Sul with 342 school students aged 6 to 11 years from March to November 2014. The students who participated in the study presented the Free Informed Consent Form duly signed by their legal guardians and agreed to participate in the stages

of anthropometric measurements. Students who were not present at the school on the day of data collection and who refused or gave up participating in some stage of the research were excluded.

First, school principals were asked to provide their written authorization for the study, then the Free Informed Consent Forms were sent to parents/legal guardians who should sign and return them if they authorized the study. Finally, the school student authorized the measurements; in all cases, their willingness to participate or not in the study was respected.

Data collection consisted of: weight, height, waist circumference (WC), diastolic blood pressure (DBP) and systolic blood pressure (SBP) measurements. The indicators used were the Body Mass Index (BMI), WC, waist-to-height ratio (WHtR) and blood pressure (BP). The BMI was classified according to gender and age into underweight (< 5th percentile), normal weight (≥ 5th percentile and < 85th percentile), overweight (≥ 85th percentile and < 95th percentile) and obesity (≥ 95th percentile) based on the curves and percentiles of the World Health Organization (WHO)[9].

The anthropometric and blood pressure measurements were performed individually after the school snack break by trained researchers in an airy classroom with comfortable temperature and lighting in the presence of one examiner and one teacher responsible for the child.

Students' weight was measured using a Britânia® digital scale with a capacity of 0 to 150 kg/100g appropriately calibrated according to each student measured. Students were positioned with their back to the scale, barefoot, with minimal clothing, in the center of the equipment, standing erect with their feet together and arms extended along the body[10].

Students' height was measured using a Sanny® portable stadiometer with the child barefoot and head free of adornments, positioned in the center of the equipment standing upright with arms extended along the body and head up staring at a fixed point at eye level[10].

Students' WC was measured using a Sanny® inelastic measuring tape with the reference point being the narrowest part of the trunk between the lowest rib and the iliac crest, a one-decimal place accuracy, and with no clothes at the site where the tape was positioned. Students should stand erect with their hands down along the body. Then, the ratio between WC and height was calculated and classified as cardiovascular risk in children when the value found was above or equal to 0.50[11]. The 50th percentiles were used for WC and they were classified according to

the recommendations for this age group into normal or increased WC[12].

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured by the auscultation method using a sphygmomanometer for children, who should remain at rest, sitting, for five minutes with their right arm semi-flexed and relaxed at the heart level; measurements were carried out twice with a two-minute interval between them[13]. The average of the two measurements was used in the analysis and classified into hypertensive when resting SBP and DBP > 95th percentile according to the specifications for gender, age and height, respectively, described by the III Brazilian Consensus on Arterial Hypertension (*III Consenso Brasileiro de Hipertensão Arterial*)[14].

The research was approved by the Research Ethics Committee of the UNIVATES University Center (*Centro Universitário UNIVATES*) under Opinion No. 909.562.

Data are described in tables using Student's t-test and Chi-squared test. All tests were performed with a significance level of 5% (p≤0.05) using the Statistical Package for the Social Sciences (SPSS) version 13.0.

RESULTS

Of the 342 school students, 54.4% (n=186) were female, 32.7% (n=112) were overweight and 5% (n=17) were obese according to the BMI classification; 11.1% (n=38) were pre-hypertensive and 5% (n=17) had stage I systemic hypertension (SH) according to the overall SBP/DBP classification. In addition, 37.1% (n=127) had an increased WC and 23.4% (n=80) had an increased WHtR. There were no students with stage II and III hypertension in the sample (Table I).

In Table II it is observed that the mean height (p≤0.01), weight (p≤0.01), BMI (p≤0.01), DBP (p=0.027), SBP (p≤0.01), WC (p≤0.01) and WHtR (p=0.013) values were significantly higher among men compared to women.

Table III presents the results of the association of BMI, SBP, DBP, SBP/DBP and WC variables with WHtR. It was observed that thinness and normal weight (p≤0.01), normal SBP and DPB (p≤0.01) and normal WC (p≤0.01) were significantly associated with normal WHtR whereas overweight and obesity (p≤0.01), pre-hypertension (p≤0.01) and increased WC (p≤0.01) were significantly associated with increased WHtR.

Among the students with normal WHtR, 71.4% (187) were at normal weight, 88.2% (231) had normal SBP/DBP and 81.7% (214) had normal WC; and among those with increased WHtR, 76.3% (61) were overweight, 25% (20), were pre-hypertensive, and 98.8% (79) had increased WC.

Table I - Characterization of the study population. Lajeado, Rio Grande do Sul, 2014.

Variable	Category	n	%
Gender	Female	186	54.4
	Male	156	45.6
Age (years)	6	5	1.5
	7	70	20.5
	8	142	41.5
	9	54	15.8
	10	62	18.1
	11	9	2.6
BMI classification	Thinness	24	7.0
	Normal	189	55.3
	Overweight	112	32.7
	Obesity	17	5.0
SBP classification	Normal	298	87.1
	Pre-hypertension	11	3.2
	Stage I SH	33	9.6
DBP classification	Normal	322	94.2
	Pre-hypertension	3	0.9
	Stage I SH	17	5.0
SBP/DBP classification	Normal	287	83.9
	Pre-hypertension	38	11.1
	Stage I SH	17	5.0
WC classification	Normal	215	62.9
	Increased	127	37.1
WHtR classification	Normal	262	76.6
	Increased	80	23.4

BMI: Body Mass Index. SBP: Systolic Blood Pressure. DBP: Diastolic Blood Pressure. SBP/DBP: Comparison between Systolic and Diastolic Blood Pressure. WC: Waist Circumference. WHtR: Waist-to-Height Ratio.

Table II - Comparison between anthropometric/blood pressure measurements and gender. Lajeado, Rio Grande do Sul, 2014.

Variable	Gender	n	Mean	Standard Deviation	p-value
Age	Female	186	8.35	1.13	0.848
	Male	156	8.38	1.11	
Height	Female	186	1.35	0.10	$p \leq 0.01$
	Male	156	1.39	0.08	
Weight	Female	186	32.53	8.74	$p \leq 0.01$
	Male	156	36.11	10.37	
BMI	Female	186	17.69	3.00	$p \leq 0.01$
	Male	156	21.18	9.14	
SBP	Female	186	99.11	8.86	$p \leq 0.01$
	Male	156	104.56	14.19	
DBP	Female	186	65.13	7.46	0.027
	Male	156	67.17	9.51	
WC	Female	186	62.75	7.65	$p \leq 0.01$
	Male	156	66.91	10.94	
WHtR	Female	186	0.47	0.05	0.013
	Male	156	0.48	0.06	

Student's t-test. BMI: Body Mass Index. SBP: Systolic Blood Pressure. DBP: Diastolic Blood Pressure. WC: Waist Circumference. WHtR: Waist-to-Height Ratio.

Table III - Association of anthropometric and blood pressure measurements with waist-to-height ratio (WHtR). Lajeado, Rio Grande do Sul, 2014.

Variable	Category	Normal		Increased		p-value
		n	%	n	%	
BMI classification	Thinness	24	9.2	-	-	p≤0.01
	Normal	187	71.4	2	2.5	
	Overweight	51	19.5	61	76.3	
	Obesity	-	-	17	21.3	
SBP classification	Normal	235	89.7	63	78.8	p≤0.01
	Pre-hypertension	11	4.2	-	-	
	Stage I SH	16	6.1	17	21.3	
DBP classification	Normal	254	96.9	68	85.0	p≤0.01
	Pre-hypertension	2	0.8	1	1.3	
	Stage I SH	6	2.3	11	13.8	
SBP/DBP classification	Normal	231	88.2	56	70.0	p≤0.01
	Pre-hypertension	18	6.9	20	25.0	
	Stage I SH	13	5.0	4	5.0	
WC classification	Normal	214	81.7	1	1.3	p≤0.01
	Increased	48	18.3	79	98.8	

Header note: WHtR Classification spans Normal and Increased columns.

Chi-squared test. BMI: Body Mass Index. SBP: Systolic Blood Pressure. DBP: Diastolic Blood Pressure. SBP/DBP: Comparison between Systolic and Diastolic Blood Pressure. WC: Waist Circumference. WHtR: Waist-to-Height Ratio.

DISCUSSION

In the present study, all anthropometric and blood pressure measurements were classified as normal according to the literature; however, there was a significant rate of overweight and obesity. In Brazil, the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística - IBGE*) published in 2010 the data from the Consumer Expenditure Survey (*Pesquisa de Orçamentos Familiares*)[2], which point out that the weight of Brazilians has been increasing in recent years.

Excess weight in children aged 5 to 9 years has increased more rapidly compared to other age groups, with prevalence rates of 32% for overweight and 11.8% for obesity[15,16]. The present study found a similar percentage of overweight (32.7%) and lower percentage of obesity (5%) among children. Given that, the BMI has been used as a nutritional assessment tool by different authors as it is a rapid and easy diagnosis predictor[16-18].

When children were assessed according to the WC parameter in Canada and Brazil, it was observed that the percentage of children with increased WC indicated increased cardiovascular risk in both genders, but with a higher prevalence among men[19-21]. The mean WC values found in the present study were also significantly higher among men and are similar to the results found by other studies[22,23].

The frequency of high blood pressure in children and adolescents has increased worldwide, and in individuals with excess weight this increase has been even greater[24]. In the present study, the majority of the sample was classified as normal blood pressure, and the prevalence of stage I SH was found in only 5% of participants. These results are similar to those of a study conducted in Bahia that found a prevalence of 4.8% of hypertensive children[25] and those of another study conducted in the state of Santa Catarina, where the prevalence of hypertensive children was 4.5%[26].

In the present study, the prevalence rates of SBP and DBP above normal values were 12.8% and 5.9%, respectively. These rates are lower than those of a study that found rates of 45% of high DBP and 29% of SBP[27] and higher than the findings of another study that revealed a prevalence of 4% of high SBP and 3% of high DBP[28]. Studies have shown higher mean SBP and DBP values among men[20,29]; the same was found in the current study.

The mean WHtR found in the present study in both men and women were similar, but other studies conducted with children[30-32] showed that the mean WHtR was higher

among men. Differently, another study demonstrated that the mean WHtR was higher among women[33].

In the present study, thinness, normal weight, normal SBP and DBP and normal WC were significantly associated with normal WHtR while overweight and obesity, pre-hypertension and increased WC were significantly associated with increased WHtR. This relationship reinforces the information that children with excess weigh have nearly three times more chances to have high blood pressure than their normal weight peers[33].

Considering that the WHtR is a predictor of health risks that is more simple than other anthropometric indicators, such as the BMI/age, since it does not need to be adjusted for age or gender[34,35], it becomes a more practical option for the nutritional assessment of children and adolescents.

Given the increased prevalence of hypertension and obesity in this age group, it is important to emphasize the importance of implementing routine nutritional assessment and blood pressure and waist circumference measurements in children[36].

The fact that the collection of anthropometric and blood pressure data has been performed only once with each school student can be considered a limitation of the present study.

CONCLUSION

It can be concluded that men had significantly higher anthropometric measures than women. Thinness, normal weight, normal blood pressure and waist circumference were associated with normal waist-to-height ratio (WHtR) while overweight, obesity, pre-hypertension and increased waist circumference were associated with increased WHtR.

REFERENCES

1. Pereira FEF, Teixeira FDC, Rausch APDSB, Ribeiro BG. Prevalência de hipertensão arterial em escolares brasileiros: uma revisão sistemática. Nutr Clín Diet Hosp. 2016;36(1):85-93.

2. Instituto Brasileiro de Geografia e Estatística - IBGE. Pesquisa de orçamento familiar 2000-2009 [accessed on 2015 Aug 26]. Available from: http://www.ibge.gov.br/home/presidencia/noticias/imprensa/ppts/0000000108.pdf

3. Rezende B, Rodrigues R, Alves G, Almeida Alves P, Reis M, Moreira F. Fatores de risco cardiovascular em crianças de uma escola pública do município de Gurupi-TO. Amazônia. Science Health. 2014;2(4):2-8.

4. Halpern R, Rech R, Veber B, Casagrande J, Reis L. Correlação entre variáveis antropométricas em escolares na cidade de Caxias do Sul. Do Corpo Ciências Artes. 2013;1(3):1-7.

5. Schommer VA, Barbiero SM, Cesa CC, Silva AD, Pellanda LC. Excesso de Peso, Variáveis Antropométricas e Pressão Arterial em Escolares de 10 a 18 Anos. Arq Bras Cardiol. 2014;102(4):312-8.

6. Alves HA, Santos M, Monteiro M, Morais P, Melo F, Ribeiro. Análises dos Parâmetros Antropométricos da Cabeça dos Militares da Força Aérea Brasileira no Projeto de Capacetes Balísticos. Rev Bras Biom. 2011;29(3):472-92.

7. Tsioufis C, Kyvelou S, Tsiachris D, Tolis P, Hararis G, Koufakis N et al. Relation between physical activity and blood pressure levels in young Greek adolescents: the Leontio Lyceum Study. Eur J Public Health. 2011;21(1):63-8

8. Pereira PF, Serrano HMS, Carvalho GQ, Lamounier JA, Peluzio MDCG, Franceschini SC et al. Circunferência da cintura e relação cintura/estatura: úteis para identificar risco metabólico em adolescentes do sexo feminino. Rev Paul Pediatr. 2011;29(3):372-7.

9. World Health Organization - WHO. WHO Growht reference data for 5-19 years, 2007. [accessed on 2016 Jun 7]. Available from: http://www.who.int/growhtref/en/

10. Ministério da Saúde (BR), Sistema de Vigilância Alimentar e Nutricional (SISVAN). Norma Técnica do Sistema de Vigilância Alimentar e Nutricional. Orientações para a coleta e análise de dados antropométricos em serviços de saúde. Ministério da Saúde: Brasília; 2011.

11. Arnaiz P, Grob F, Cavada G, Domínguez A, Bancalar R, Cerda V, et al. La razón cintura estatura en escolares no varía con el género, la edad ni la maduración pubera. Rev Méd Chile. 2014;142(5):574-78.

12. Simão AF, Précoma DB, Andrade JP, Correia H Filho, Saraiva JFK, Oliveira GMM. I Diretriz de Prevenção Cardiovascular da Sociedade Brasileira de Cardiologia. Arq Bras Cardiol. 2014;102(5):420-31.

13. Sociedade Brasileira de Cardiologia, Sociedade Brasileira de Hipertensão Sociedade Brasileira de Nefrologia. VI Diretriz Brasileira de Hipertensão. Rev Bras Hipertens. 2010;17(1):4-64.

14. Sociedade Brasileira de Hipertensão, Sociedade Brasileira de Cardiologia, Sociedade Brasileira de

Nefrologia. III Consenso Brasileiro de Hipertensão Arterial. Arq Bras Endocrinol Metab. 2010;43(1):257-86.

15. Pedroni JL, Rech RR, Halpern R, Marin S, Roth LDR, Sirtoli M, et al. Prevalência de obesidade abdominal e excesso de gordura em escolares de uma cidade serrana no sul do Brasil. Ciênc Saúde Coletiva. 2013;18(5):1417-25.

16. Passos DR, Gigante DP, Maciel FV, Matijasevich A. Comportamento alimentar infantil: comparação entre crianças sem e com excesso de peso em uma escola do município de Pelotas, RS. Rev Paul Pediatr. 2015;33(1):42-9.

17. Miranda JMDQ, Palmeira MV, Polito LFT, Brandão MRF, Bocalini DS, Figueira AJ Junior et al. Prevalence of overweight and obesity in childhood in educational institutions: public vs private. Rev Bras Med Esporte. 2015;21(2):104-7.

18. Carrazzoni DS, Pretto ADB, Albernaz EP, Pastore CA. Prevalência de fatores na primeira infância relacionados à gênese da obesidade em crianças atendidas em um ambulatório de Nutrição. RBONE. 2015;9(50):74-81.

19. Khoury M, Manlhiot C, Mccrindle B. Role of the waist/height ratio in the cardiometabolic risk assessment of children classified by body mass index. J Am Coll Cardiol. 2013;62(8):742-51.

20. Guilherme FR, Molena-Fernandes CA, Guilherme VR, Fávero MTM, Reis EJB, Rinaldi W. Inatividade física e medidas antropométricas em escolares de Paranavaí, Paraná, Brasil. Rev Paul Pediatr. 2015;33(1):50-5.

21. Moser DC, Giuliano IDCB, Titski ACK, Gaya AR, Leite N. Indicadores antropométricos e pressão arterial em escolares. J Pediatr (Rio J). 2013;89(3):243-9.

22. Clemente APG, Santos CDDL, Martins VJ, Albuquerque MP, Fachim MB, Sawaya AL. Lower waist circumference in mildly-stunted adolescents is associated with elevated insulin concentration. J Pediatr (Rio J). 2014;90(5):479-85.

23. Fujita Y, Kouda K, Nakamura H, Iki M. Cut-off values of body mass index, waist circumference, and waist-to-height ratio to identify excess abdominal fat: population-based screening of Japanese schoolchildren. J Epidemiol. 2011;21(3):191-6.

24. Guilherme FR, Molena-Fernandes CA, Guilherme VR, Fávero MTM, Reis EJB, Rinaldi W. Body mass index, waist circumference, and arterial hypertension in students. Rev Bras Enferm. 2015;68(2):214-8.

25. Pinto SL, Silva RDCR, Priore SE, Assis AMO, Pinto EDJ. Prevalência de pré-hipertensão e de hipertensão arterial e avaliação de fatores associados em crianças e adolescentes de escolas públicas de Salvador, Bahia, Brasil. Cad Saúde Pública. 2011;27(6):1065-76.

26. Silva EL, Rosini N, Bruns EC, Camillo GD, Rosini RD, Machado MJ. Multiplicidade de Fatores de Risco Cardiovascular em Crianças e Adolescentes de Guabiruba-SC, Brasil. Rev Saúde Pública de Santa Catarina. 2014;7(3):33-45.

27. Rinaldi AEM, Nogueira PCK, Riyuzo MC, Olbrich-Neto J, Gabriel GFCP, Macedo CS, et al. Prevalência de pressão arterial elevada em crianças e adolescentes do ensino fundamental. Rev Paul Pediatr. 2012;30(1):79-86.

28. Batista MS, Mill JG, Pereira TSS, Fernandes CDR, Molina MDCB. Factors associated with arterial stiffness in children aged 9-10 years. Rev Saúde Pública. 2015;49(1):1-8.

29. Mourato FA, Lima Filho JL, Silva SM. Comparação entre diferentes métodos de rastreamento para distúrbios da pressão arterial em crianças e adolescentes. J Pediatr (Rio J). 2015;91(3):278-83.

30. Lopes L, Santos R, Moreira C, Pereira B, Lopes VP. Sensibilidade e especificidade de diferentes medidas de adiposidade para diferenciação entre pouca/ampla coordenação motora. J Pediatr (Rio J). 2015;91(1):44-51.

31. Ricardo GD, Gabriel CG, Corso ACT. Anthropometric profile and abdominal adiposity of school children aged between 6 and 10 years in southern Brazil. Rev Bras Cineantropom Desempenho Hum. 2012;14(6):636-46.

32. Marrodán MD, Martínez-Álvarez JR, González-Montero DEM, López-Ejeda N, Cabañas MD, Prado C. Diagnostic accuracy of waist to height ratio in screening of overweight and infant obesity. Med Clin (Barc). 2013;140(7):296-301.

33. Ribeiro-Silva RDC, Florence T, Conceição-Machado MEPD, Fernandes GB, Couto RD. Anthropometric indicators for prediction of metabolic syndrome in children and adolescents: a population-based study. Rev Bras Saúde Matern Infant. 2014;14(2):173-81.

34. Magalhães EIDS, Sant'Ana LFDR, Priore SE, Franceschini SDCC. Perímetro da cintura, relação cintura/estatura e perímetro do pescoço como parâmetros na avaliação da obesidade central em crianças. Rev Paul Pediatr. 2014;32(3):273-81.

35. Kuba VM. Avaliação da relação entre circunferência abdominal e altura como preditora de risco cardiometabólico em crianças de 6 a 10 anos [tese]. São Paulo: Faculdade de Medicina da Universidade de São Paulo; 2011.

36. Schommer VA, Barbiero SM, Cesa CC, Oliveira R, Silva AD, Pellanda LC. Excesso de Peso, Variáveis Antropométricas e Pressão Arterial em Escolares de 10 a 18 Anos. Arq Bras Cardiol. 2014;102(4):312-8.

First author's address:
Luiza Christmann
Centro Universitário Univates - UNIVATES
Rua Avelino Talini, 171
Bairro: Universitário
CEP: 95.900-000 - Lajeado - RS - Brasil
E-mail: lchristmann@hotmail.com

Mailing address:
Fernanda Scherer Adami
Centro Universitário Univates - UNIVATES
Rua Avelino Talini, 171
Bairro: Universitário
CEP: 95.900-000 - Lajeado - RS - Brasil
E-mail: fernandascherer@univates.br