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ABDOMINAL ADIPOSITY EVALUATED BY TWO ANTHROPOMETRIC PAIRS AND ITS RELATIONSHIP WITH CARDIOVASCULAR RISK

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ABSTRACT

Introduction: Obesity is a risk factor, with abdominal adiposity being responsible for most cases of cardiovascular diseases. ***Objective:*** To evaluate abdominal adiposity using two anthropometric parameters and its relationship with cardiovascular risk in adolescents. ***Methods:*** Cross-sectional, quantitative study, with 575 adolescents aged 15 to 19, from public schools in Campina Grande-PB, Brazil. Cardiovascular risk was assessed using the Pathobiological Determinants of Atherosclerosis in Youth score and abdominal adiposity was assessed using waist circumference and waist-to-height ratio. Statistical analyzes included Student's t test, Kappa coefficient and ROC curve. ***Results:*** Waist circumference varied by 3.3% and the waist circumference/height ratio varied by 28.9%. The waist circumference/height ratio was more associated with the average of cardiovascular risk factors. Waist circumference at the 75th percentile showed greater agreement with the waist circumference/height (kappa=0.655), compared to the 90th percentile. ***Conclusion:*** The waist circumference/height ratio had a higher prevalence and greater association with cardiovascular risk factors, being Waist circumference at the 75th percentile is most accurate in this population.

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INTRODUCTION

The World Health Organization (WHO) defines overweight and obesity as abnormal or excessive accumulation of fat (WHO, 2020) and due to the accelerated increase in this morbidity in recent years, it is considered a global epidemic, being considered the most important nutritional disorder existing (WHO, 2022). In adolescents, being overweight is a concern due to the high risk of becoming obese in adulthood, in addition to being more susceptible to developing morbid conditions (Mestre, Caldeira, Almeida, 2021). General obesity is the accumulation of fat throughout the body, and abdominal obesity is excess fat in the abdominal region, which is related to the deposition of adipose tissue in the viscera, increasing cardiovascular risks (Magalhães *et al*., 2021). The measurement of waist circumference (WC) is recommended as an indicator to assess central obesity (Ross *et al*., 2020). A study shows that increased WC measurements are better predictors of CVD due to fat accumulation than high BMI (Favarato *et al*., 2021). Another indicator for evaluating abdominal adiposity is the ratio of WC measurement to height (AC/ AND). Some studies suggest that this is a better indicator of abdominal obesity (Lizardo *et al*., 2022). However, there are controversies regarding the best parameter.

Given the lack of consensus regarding the criteria for assessing nutritional status that is most closely related to CVD, this study proposed to evaluate abdominal adiposity using two anthropometric parameters and verify its relationship with cardiovascular risk in adolescents. Identifying this relationship early can help guide preventive measures to reduce CVD and mortality in adulthood.

MATERIAL E METHODS

Cross-sectional study, carried out with 575 high school adolescents between 15 and 19 years old, enrolled in the public school system in the city of Campina Grande-PB, Brazil. This study is part of a larger project entitled: "Subclinical atherosclerotic disease in school adolescents and its relationship with the Pathobiological Determinants of Atherosclerosis in Youth score, ultrasensitive C-Reactive Protein and lung function" approved by the University's Ethics and Research Committee State of Paraíba CAEE: 0077.0. 133,000 -12. The target population consisted of 9294 students, aged between 15 and 19 years old, enrolled in 264 high schools. The sample was calculated by conglomerate in two stages, the first, the school and the second, the class. A prevalence of 50% of cardiovascular risk factors was considered, a sampling error of 5%, a correction factor for a simple random cluster sample of 1.5 and an increase of 1.3 for possible losses. Individuals with illnesses or using medications that interfered with the lipid or glucose profile, pregnant women or those unable to perform the exam were excluded. All participants provided an informed consent form signed by them or their guardians when under 18 years of age. During data collection, adolescents responded to a form that included questions about age, sex, race and economic class. Skin color was self-declared as white, brown, black, indigenous and later categorized as white or non-white. To assess the economic class, the Brazilian Criteria for Economic Classification of Brazil from ABEP (Brazilian Association of Research Companies) was used (Oliveira *et al*., 2020). Maternal education was assessed in years, based on the last year completed, with approval. Classified into two categories: ≤ 8 years of study; >8 years of study. For smoking, the "smoker" category was defined as individuals who reported smoking at least one cigarette per day for a minimum period of six months. Anthropometric data (weight, height and WC) were collected in duplicate, considering the average value of the two measurements. To categorize nutritional status, BMI was used, considering the BMI z-score of adolescents aged 10 to 18 years old, the following cut-off points were used: < z-score -2 = thinness, ≥ z-score -2 and ≤score +1 = eutrophy, > z-score+1 and ≤ z-score+2 = overweight, > z-score +2 = obesity (Cavalcante *et al*., 2020). Those aged 19 years, underweight (<17.5), eutrophic (≥17.5 and <25.0), overweight (≥25.0 and <30), obese (≥30.0) (Barroso *et al*., 2021). To obtain the weight, a Tanita® digital scale was used. Height was measured using a Tonelli® portable stadiometer. The measurement procedures followed the Brazilian Arterial Hypertension Guideline (Barroso *et al*., 2021). Abdominal adiposity was assessed by AC and the AC/E ratio. Students whose values, according to sex and age, were equal to or greater than the 90th percentile (Haddad *et al*., 2021) were considered to have high WC, but with a limit equal to or greater than 102 cm for men and 88 cm for women (Moraes *et al*., 2021). AC was assessed with an inelastic Cardiomed® brand measuring tape, at the midpoint between the upper edge of the iliac crest and the last costal margin, with the patient standing, arms positioned along the body and in the expiratory phase of breathing. For the CA/E Ratio, the CA/E ratio > 0.5 was considered increased (Barroso *et al*., 2021). Cardiovascular risk assessment was carried out using the PDAY risk score, which assigns a score to each variable. Risk classification was defined as low for a PDAY score ≤ 0, intermediate for a score of 1 to 4, and high for a score of 5 or more as high risk. Laboratory parameters were collected in the morning after 12 hours of fasting in schools, by specialized technicians. The samples were sent for analysis at a contracted laboratory to evaluate lipids (total cholesterol and HDL cholesterol), fasting blood glucose; glycated hemoglobin A1c and HbA1C To measure blood pressure (BP), the recommendations of the Brazilian Guideline on Arterial Hypertension (Barroso *et al*., 2021) were followed, f Elevated BP was defined as values equal to or greater than the 95th percentile for age, sex and height percentile, according to specific tables for children and adolescents. Values between the 90th percentile and the 95th percentile (or 120/80 mmHg, but below the 95th percentile) are also considered high blood pressure (Eburneo, 2021). For statistical analysis, the Statistical Package for the Social Sciences (SPSS, version 22.0) was used, with the chi-square test for distribution by sex. The comparison of the means of the variables of the PDAY components between the groups with or without changes in AC and AC/E was carried out using the Student's t test. The agreement between CA and CA/E was assessed using the Kappa coefficient. To determine the confidence interval, sensitivity and specificity of the CA and CA/E method, the ROC curve was evaluated. The positive and negative predictive value of the two adiposity assessment methods for detecting cardiovascular risk was calculated. A 95% confidence interval was adopted for all analyses.

RESULTS

Of the total number of people evaluated, the majority were females aged between 15 and 16 years old (86.8%) and non-whites (79.5%). The girls' mothers or guardians had more years of schooling (56.6%). The most frequent economic class was C, D and E (92.5%) (Table 1). Among the PDAY variables, low HDL (57.9%) and high SBP (35.3%) were associated with male gender. Abdominal adiposity was more prevalent when assessed by the AC/E ratio (28.9%) when compared to the AC method (3.3%), with AC/E being associated with the female sex (33.8%) (Table1). The level of agreement between the AC assessed by the cutoff point found in the literature and the AC/E, had low agreement between the two parameters, kappa=0.155; p< 0.001, with greater agreement with CA in the 75th percentile of the sample (Table 2). A high CA/E ratio was associated with a high mean BMI (26.0)(±3.9) (p<0.001); high SBP (113)(±10.9)(p<0.001); high DBP (69.4)(±6.6) (p<0.001); high cardiovascular risk, assessed by PDAY 1.7(±3.1)(p<0.001); of normal HDL 42.3(±8.5)(p=0.044), and of high N-HDL (117.97)(±28.9)(p<0.001) (Table 3). The high WC percentile was associated with the high mean BMI (33.4) (±3.1) (p<0.001); high SBP (118.7) (±7.9) (p=0.001); high DBP (74.3) (±6.1) (p=0.001); high cardiovascular risk, assessed by PDAY (5.1%) (±4.0) (p<0.001), and high HDL-N (140.2%) (±36.4) (p<0.001) (Table 4). The best method to assess abdominal adiposity was CA, at the 75th percentile, which presented a greater balance between sensitivity 63% and specificity 81%, although it presents a lower PPV than CA assessed using the 90th percentile of the population (Table 5).

DISCUSSION

The assessment of abdominal adiposity can be carried out using several parameters, including the measurement of AC and the AC/E ratio, which have been very useful for identifying cardiovascular risk (Barroso *et al*., 2021). However, to date, there is divergence in the literature regarding the best method and cutoff points (Rumbo-Rodríguez, *et al*. 2021). In the present research, CA/E was associated with the female sex. As in another study carried out with children and young people, CA/E was also higher in girls (Tornquist *et al*., 2022). This can be attributed to hormonal changes resulting from puberty, since girls have a greater accumulation of fat compared to boys (Gonçalves *et al*., 2021). There was an association between low HDL cholesterol and increased SBP with male sex, a result also found in other research (Sirtori *et al*., 2019). During adolescence, sexual maturation causes a gradual reduction in HDL in boys. As HDL is protective against heart disease, this decrease can result in the accumulation of fatty plaques in the arteries, increasing blood pressure (Alan, 2021). In this study, abdominal adiposity was more prevalent when assessed by the AC/E ratio, compared to AC. Authors report that AC/E is the most effective measure to measure abdominal obesity (Buenanõ, Cueva, 2020). Previous studies report that AC/E is, in isolation, the best anthropometric index to identify abdominal fat (Pourghazi *et al*., 2022). This is due to the fact that the (CA/E) ratio has a single cutoff point that is applicable to the general population, regardless of gender, age and ethnicity (Carvalho, 2022). Studies conducted in Brazil and Mexico, with adolescents, suggest that the use of CA/E is the best predictor of cardiovascular risk, as it is easily calculated, does not require specific cutoff points for age and sex and can convey the message that the ideal is keep the WC less than half the height (Santos, *et al*., 2019; Hendges, 2020; López *et al*., 2022). Furthermore, in this study, high WC/E and WC were associated with mean BMI; from PAS; PAD; of high cardiovascular risk, assessed by PDAY and N-HDL, with low HDL associated only with CA, that is, CA/E was more associated with the average of cardiovascular risk factors, compared to CA. Compensatory hyperinsulinemia can activate the sympathetic nervous system and promote sodium reabsorption in the renal tubules, being a key mechanism in increasing blood pressure (Conceição, Souza, 2021). Another explanation would be that the fat stored in this region has a higher rate of lipolysis and is close to important blood vessels (Barroso *et al*., 2021). Due to a scientific divergence regarding the best parameter to evaluate abdominal adiposity, the agreement between AC and AC/E was analyzed in this study, with low agreement being obtained between them, being higher in the 75th percentile of AC/E. Furthermore, Taylor *et al*. (2000) suggest a lower cutoff point for WC, defining high-risk obesity as WC ≥ 80th percentile, adjusted for age and sex. It is noticeable that in the literature there is no consensus on the ideal cutoff point to identify altered WC in adolescents.

Tabela 1. Distribuição das variáveis sóciodemográficas, clínicas e bioquímicas, conforme o sexo, entre os adolescentes escolares do município de Campina Grande, Paraíba, Brasil, 2013

Variável	Total	Sexo		*p*	RP(IC95%)
		Masculino n(%)	Feminino n(%)		
Idade (anos)					
17-18 anos	76 (13,2)	32 (16,8)	44 (11,4)	0,071	1,6(0,96-2,57)
15-16 anos	499 (86,8)	158 (83,2)	341(86,6)		
***Cor**					
(Não Branco/	443(78,8)	144(77,4)	299 (79,5)	0,566	0,9(0,58-1,35)
Branco)	119(21,2)	42 (22,6)	77(20,5)		
****Escolaridade materna (anos)**					
≤8 anos	238(42,0)	74 (39,2)	164 (43,4)	0,336	0,8(0,59-1,20)
>8 anos	329 (58)	115 (60,8)	214 (56,6)		
Classe Social					
C, D e E	532 (92,5)	168 (88,4)	364(94,5)	0,009	0,4(0,24-0,82)
A, B	43 (7,5)	22 (11,6)	21 (5,5)		
Estado Nutricional					
Sobrepeso/Obesidade	107(18,6)	32(16,8)	75(19,5)	0,444	0,8(0,53-1,32)
(Baixo peso/Eutrófico)	468(81,4)	158(83,2)	310(80,5)		
Tabagismo					
Fumante/					
Não fumante	11(1,9)	05(2,6)	06 (1,6)	0,578	1,7(0,51-5,65)
Hemoglobina Glicada	563(98,1)	185(97,4)	378(98,4)		
Alterada					
Normal					
Glicemia	00	-	-		
Alterada	574(100)	189(100)	385(100)	-	-
Normal					
N- HDL (mg/dL)	00	-	-		
Alterado	575(100)	190(100)	385(100)	-	-
Normal					
HDL (mg/dL)	97(16,9)	25(13,2)	72(18,7)		
Alterado/	478(83,1)	165(86,8)	313(81,3)	0,095	0,6(0,40-1,08)
Normal					
PAD (mmHg)	238(41,4)	110(57,9)	128(33,2)		
	337(58,6)	80(42,1)	257(66,8)	<0,001	2,8(1,93-3,95)
Alterado	23 (4,0)	07 (3,7)	16 (4,2)		
Normal	552 (96,0)	183 (96,3)	369 (95,8)	0,964	0,9(0,36-2,18)
PAS (mmHg)					
Alterado/	112 (19,5)	67 (35,3)	45 (11,7)		
Normal	463 (80,5)	123 (64,7)	340 (88,3)	<0,001	4,1(2,68-6,33)
IMC (kg/m^2)					
>30	24 (4,2)	06 (3,2)	18 (4,7)		
≤30	551 (95,8)	184 (96,8)	367 (95,3)	0,526	0,7(0,26-1,70)
CA/Estatura (cm)					
Alterado/	166 (28,9)	36 (18,9)	130 (33,8)		
Normal	409 (71,1)	154 (81,1)	255 (66,2)	<0,001	0,4(0,30-0,69)
CA (cm)					
Alterado/	19 (3,3)	06 (3,2)	13 (3,4)		
Normal	556 (96,7)	184 (96,8)	372 (96,6)	1,000	0,9(0,35-2,49)

PAD- Pressão Arterial Diastólica; PAS- Pressão Arterial Sistólica; IMC- Índice de Massa Corporal; CA/E- Razão entre Circunferência Abdominal e Estatura CA- Circunferência Abdominal; I *Chi-square *n=562 **n=567.*

Tabela 2. Concordância entre dois critérios de avaliação do risco cardiovascular, entre os adolescentes escolares do município de Campina Grande, Paraíba, Brasil, 2013

Variáveis	CA/E		p	Kappa
	Alterado n(%)	Normal n (%)		
CA				
Alterado/	19 (11,4)	0 (0)	<0,001	0,155
Normal	147 (88,6)	409 (100)		
CA percentil 90 da amostra				
Alterado/	57(98,3)	01(1,7)	<0,001	0,423
Normal	109(21,1)	408(78,9)		
CA percentil 75 da amostra				
Alterado/	118(81,9)	26(18,1)	< 0,001	0,674
Normal	166(28,9)	409(71,1)		

CA- Circunferência Abdominal; CA/E- Razão entre Circunferência Abdominal e Estatura.

Although some authors consider it altered from the 90th percentile, others from the 85th or 75th. Thus, this highlights the need to determine an appropriate cutoff point for detecting altered WC in adolescents (Gonçalves, *et al*., 2021; Aranha, *et al*., 2020; Welser, *et al*., 2023). In order to evaluate the best performance of the proposed parameters and cutoff point, the ROC curve was calculated in this study. This type of analysis makes it possible to measure the sensitivity (true positive rate) and specificity (false positive rate) of the tests, and thus detect which of the two methods and cutoff point for AC was more effective in evaluating abdominal adiposity. Although AC/E has a stronger association with the averages of cardiovascular risk factors, it was observed through the ROC curve that the most accurate method to assess abdominal adiposity in this population was AC at the 75th percentile, due to its greater sensitivity of identify individuals who actually presented high abdominal adiposity.

Tabela 3. Valores médios e desvio padrão das variáveis de acordo com a CA/E, entre os adolescentes escolares do município de Campina Grande, Paraíba, Brasil, 2013

Variáveis	CA/E ≥0,5 X(DP)	CA/E<0,5 X(DP)	*p*
IMC	26,0(± 3,9)	19,7(±1,9)	<0,001
Glicemia	76,6(±7,1)	75,8(±7,1)	0,236
HBA1AC	5,2(±0,3)	5,2(±0,3)	0,992
Idade	16,9(±1,0)	16,8(±1,0)	0,382
PAS	113(±10,9)	109,7(±10,1)	<0,001
PAD	69,4(±6,6)	66,4(±6,9)	<0,001
PDAY	1,7(±3,1)	0,5(±1,8)	<0,001
HDL	40,7(±8,4)	42,3(±8,5)	0,044
N-HDL	117,97 (±28,9)	100,6(±22,1)	<0,001

CA/E – Razão entre Circunferência Abdominal e Estatura; IMC- Índice de Massa Corporal; HBA1AC- Hemoglobina Glicada; PAS- Pressão Arterial Sistólica; PAD- Pressão Arterial Diastólica

Tabela 4. Valores médios e desvio padrão das variáveis de acordo com a CA avaliada por percentis, entre os adolescentes escolares do município de Campina Grande, Paraíba, Brasil, 2013

Variáveis	CA ≥90 X(DP)	CA<90 X(DP)	*p*
IMC	33,4 (±3,1)	21,1(±3,2)	<0,001
Glicemia	77,7 (±6,9)	76,0(±7,1)	0,299
HBA1AC	5,3 (±0,2)	5,2(±0,3)	0,112
Idade	16,5 (±0,9)	6,8(±1,0)	0,145
PAS	118,7(±7,9)	110,6(±10,5)	<0,001
PAD	74,3 (±6,1)	67,0(±6,8)	<0,001
PDAY	5,1 (±4,0)	0,7(±2,1)	<0,001
HDL	38,0 (±6,8)	41,9(±8,6)	0,052
N-HDL	140,2(±36,4)	104,4(±24,3)	<0,001

CA- Circunferência Abdominal; IMC- Índice de Massa Corporal; HBA1AC- Hemoglobina Glicada; PAS- Pressão Arterial Sistólica; PAD- Pressão Arterial Diastólica.

Tabela 5. Área, intervalo de confiança, ponto, sensibilidade, especificidade, valor preditivo positivo, valor preditivo negativo da CA/E e do percentil 75 e 90 da CA para triagem de risco cardiovascular em adolescentes

RCV(PDAY)	Área	IC (95%)	Ponto	Sensibilidade	Especificidade	VPP	VPN
CA/E	0,67	(0,59-0,65)	05	58%	74%	20%	94%
CA P75	0,79	(0,73-0,85)	75	63%	81%	26%	95%
CA P90	0,79	(0,73-0,85)	83	36%	94%	38%	93%

RCV- Risco Cardiovascular; IC- Intervalo de Confiança; VPP- Valor Preditivo Positivo; VPN - Valor Preditivo Negativo; CA/E- Razão entre Circunferência Abdominal e Estatura; CA - Circunferência Abdominal; P75-Percentil 75; P90- Percentil 90.

Studies on WC assessment in adolescents are still scarce, leading us to use curves from other populations, which may result in errors in estimating the real prevalence of abdominal obesity. Therefore, the indication proposed by this study for public health is the use of WC at the 75th percentile to assess abdominal obesity in Brazilian adolescents, due to the greater sensitivity presented in detecting changes in nutritional status assessed based on abdominal adiposity.

CONCLUSION

The WC/E ratio was more accurate in detecting high abdominal adiposity and greater association with cardiovascular risk factors, but the most accurate parameter to evaluate abdominal adiposity in this population was WC at the 75th percentile.

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REFERENCES

Anchundia, B. S.S., *et al*. 2020. Prevalência de síndrome metabólica e fatores de risco associados em uma amostra de adultos do Equador. Monografia de Conclusão de Curso. Faculdade de Ciências. Universidade de Guayaquil, Equador.

Aranha, L.N, Oliveira, G.M.M. de. 2020. Circunferência da Cintura, uma Medida Simples para a Obesidade Infantil? Arquivos Brasileiros de Cardiologia. Disponível online em: https://doi.org/10.36660/abc.20200031.

Barroso, W.K.S, *et al*. 2020. Diretrizes Brasileiras de Hipertensão Arterial. Arq. Bras. Cardiol. 116, 3, pp. 516-658. Disponível online em: https://abccardiol.org/article/diretrizes-brasileiras-de-hipertensao-arterial-2020/.

Caixeta, H. C. V., Amato, A. A. (2020) Factors associated with overweight and abdominal obesity in Brazilian school-aged children: a comprehensive approach. Archives of Endocrinology and Metabolism. doi:10.20945/2359-3997000000239.

Carvalho, W.R.C. (2022). Pontos de corte da relação cintura estatura e circunferência do pescoço em adolescentes: predição da obesidade, risco cardiovascular e relação com marcadores inflamatórios. Tese de Doutorado em Saúde Coletiva. Universidade Federal do Maranhão, Brasil.

Cavalcante, A. A., *et al.* (2020). Associação entre índices antropométricos e marcadores de risco cardiovascular em adolescentes. desafios - Revista Interdisciplinar Da Universidade Federal Do Tocantins, 7(Especial), pp. 96–106. Disponível online em: https://doi.org/10.20873/uftsuple2020-8844.

Conceição, R. dos S. da. e Souza, I. L. L. de. (2021). Arterial hypertension in childhood: a literature review. Research, Society and Development.10(11), e484101119935.

Eburneo, B.M. (2021). Relação entre a obesidade, inatividade física e pressão arterial em educandos nas cidades de Bauru, Ibitinga, Jaú e São Sebastião-SP. Monografia de Conclusão de Curso. Universidade Estadual Paulista Júlio de Mesquita Filho, Bauru, Brasil.

Favarato, D. (2021). Obesidade, Gordura Corporal e Desfecho Cardiovascular: Além do Índice de Massa Corporal. Arq. Bras. Cardiol. 116, 5, pp. 887–888. doi: 10.36660/abc.20210074.

Gonçalves, L. G .O. Santos, J. P. dos, Farias, E. S. F. dos. (2021) Circunferência da cintura como preditor de risco cardiovascular em adolescentes: Estudo Erica no Município de Porto Velho (RO). Revista de Atenção à Saúde. 19(68). Disponível online em: https://doi.org/10.13037/ras.vol19n68.7495

Gonçalves, L.G.O., Santos, J.P., Farias, E.S. (2021) Circunferência da cintura como preditor de risco cardiovascular em adolescentes: estudo Erica no município de Porto Velho (RO). Revista de Atenção à Saúde. 19 (68), pp. 35-49.

Haddad L.S.P. *et al*. (2021) Determinantes antropométricos da pressão arterial elevada em escolares do ensino fundamental. Revista Brasileira de Medicina de Família e Comunidade. 16, 43, pp. 2779. doi:10.5712/rbmfc16(43)2779.

Hendges, M.G. (2020). Condições sociodemográficas, parâmetros antropométricos e perfil metabólico de escolares nascidos prematuros e a termo. Dissertação de Mestrado. Universidade Estadual do Oeste do Paraná.Cascavel, Paraná, Brasil.

Lizardo, L.M. (2022). Indicadores de saúde de escolares dos anos iniciais de uma escola pública participante PIBID no município de Porto Velho- RO. Monografia de Conclusão de Curso. Fundação Universidade Federal de Rondônia Núcleo de Saúde - NASAU. departamento de educação física -DEF, Porto Velho, Brasil.

López, G.R. *et al*. (2022) Diámetros óseos y su relación con el IMC y porcentaje grasa en deportistas universitarios mexicanos. Retos. 46, pp. 1114–1122. doi:10.47197/retos.v46.94317.

Magalhães, A.A.,Teixeira R.B., Domingues S.F, Oliveira P.B.S.D, Júnior R.J.M. (2021) Obesidade geral e abdominal e sua relação com o nível de atividade física em universitários. Revista Científica UNIFAGOC - Multidisciplinar. Disponível online em: https://revista.unifagoc.edu.br/index.php/multidisciplinar/article/view/583/639.

Mestre T.D, Caldeira, E, Almeida, I. (2021) Prevalência de sobrepeso e obesidade em adolescentes: a realidade e a percepção dos pais. Revista Ibero-Americana de Saúde e Envelhecimento, 7, 2.

Moraes C, Alves E, Bezerra G, Bandeira C. (2021) Medidas Antropométricas: Saberes e Parâmetros aos Profissionais de Saúde. Editora Appris.

Oliveira D. P., Monteiro, É. E., Alves, A. L. S. (2020) Associação entre relações familiares e comportamento alimentar de risco em adolescentes. RBONE - Revista Brasileira de Obesidade, Nutrição e Emagrecimento, v. 14, n. 84, pp. 59–65. Disponível online em: http://www.rbone.com.br/index.php/rbone/ article/ view/1169/933.

Pourghazi F. *et al*. (2022) Valor de corte ideal da relação circunferência da cintura/altura para prever obesidade central em crianças e adolescentes: uma revisão sistemática e meta-análise de estudos diagnósticos. Front Nutr. Disponível online em: doi:10.3389/fnut.2022.9853192.

Ross, R. *et al.* (2020) Waist circumference as a vital sign in clinical practice: A consensus statement from the IAS and ICCR working group on visceral obesity. Nature Reviews Endocrinology, 16, 3, pp. 177–189. Disponível online em: doi:10.1038/s41574-019-0310-7.

Rumbo-Rodríguez L. *et al.* (2021) Comparação de scanner corporal e medidas antropométricas manuais da forma corporal: uma revisão sistemática. Jornal Internacional de Pesquisa Ambiental e Saúde Pública. 18, 12, pp. 6213. Disponível online em: https://doi.org/10.3390/ijerph18126213.

Santos E.G.R. *et al.*(2019) Prevalência de risco cardiovascular a partir de parâmetros antropométricos em crianças e adolescentes. Rev. Atenção à Saúde, 17, 60. Disponível online em: doi:10.13037/ ras.vol17n60.5640.

Sirtori, C. R. *et al.* (2019) HDL therapy today: from atherosclerosis, to stent compatibility to heart failure. Annals of medicine, 51, 7-8, pp. 345–359. Disponível online em: doi:10.1080/ 07853890. 2019.1694695.

Tall, R. Alan. (2021) HDL in Morbidity and Mortality: A 40+ Year Perspective, Clinical Chemistry. Issue 1. 67, pp. 19–23. Disponível online em: https://doi.org/10.1093/clinchem/hvaa148.

Tornquist, L. *et al*. (2022) Risco Cardiometabólico em Crianças e Adolescentes: O Paradoxo entre Índice de Massa Corporal e Aptidão Cardiorrespiratória. Arquivos Brasileiros de Cardiologia, 119, pp. 236–243. doi:10.36660/abc.20210593.

Welser, L. *et al.* (2023) Incidência de Hipertensão Arterial está Associada com Adiposidade em Crianças e Adolescentes. Arquivos Brasileiros de Cardiologia, 120, 2. Disponível online em: doi:10.36660/abc.20220070.

World Health Organization [WHO]. (2020) Obesity and overweight. Disponível online em: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.

World Health Organization. (2022) WHO European Regional Obesity Report 2022.Copenhagen: WHO Regional Office for Europe, 2022. Disponível online em: https://apps.who.int/iris/bitstream/ handle/10665/353747/9789289057738-eng.pdf.

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