Revista 16 de abril. 2023; 62:e1747
Original article

Anthropometric indices for the estimation of obesity in young university students

Índices antropométricos para la estimación de obesidad en jóvenes universitarios

Ela María Céspedes Miranda [1], Reison Adalberto Olivero Betancourt [1], Roger Rodríguez Guzmán [1], Genny Mercedes Rojas Palacios [1], Niurelkis Suárez Castillo [1], Daysi Sofía Martínez Alvarado [1]

[1] Universidad de Ciencias Médicas de La Habana. Facultad de Ciencias Médicas "Calixto García", Departamento de Ciencias Básicas Biomédicas. La Habana, Cuba.

ABSTRACT

Introduction: obesity is one of the factors with the highest incidence of vascular risk. Early detection by means of inexpensive, easily accessible and manageable tools is relevant for its prevention and control. Objective: to analyze anthropometric indicators to estimate body fat distribution and obesity in young university students. Method: observational, descriptive, cross-sectional study, from October 2015 to January 2018. Body mass index, waist/height ratio, taper index and body adiposity index were calculated. Results: overweight (n = 23; 10,7 %) and obese (n = 9; 4,2 %) students were identified. In relation to waist circumference, 16,3 % (n = 35) of the students were found to be at risk, with a predominance in females in relation to males. An elevated waist/height ratio was identified in 19,5 % (n = 42) of the young people. It was observed that 10,1 % (n = 16) of normal-weight young people (n = 158) were at risk according to waist circumference, body adiposity index (n = 31; 19,6 %) and taper index (n = 14; 8,9 %). Conclusions: most of the students presented low vascular risk, according to anthropometric indicators. However, the identification of overweight and obese students should be done not only with the body mass index, but should be complemented with at least one of the indicators that allow us to study the distribution of body fat.

Keywords: Body Mass Index; Waist Circumference; Obesity.

RESUMEN

Introducción: la obesidad es uno de los factores de mayor incidencia en el riesgo vascular. La detección temprana mediante herramientas económicas, de fácil acceso y manejo, resulta relevante para la prevención y control del mismo. Objetivo: analizar indicadores antropométricos para estimar la distribución de grasa corporal y la obesidad en jóvenes universitarios. Método: estudio observacional, descriptivo y transversal, desde octubre de 2015 hasta enero del 2018. Se calculó el índice de masa corporal, el índice cintura/estatura, el índice de conicidad y el índice de adiposidad corporal. Resultados: se identificaron estudiantes sobrepeso (n = 23; 10,7 %) y obesos (n = 9; 4,2 %). En relación con la circunferencia de la cintura, el 16,3 % (n = 35) de los estudiantes se encontró en riesgo, con predominio en las hembras en relación con los varones. En el 19,5 % (n = 42) de los jóvenes se identificó un índice cintura/estatura elevado. Se observó que el 10,1 % (n = 16) de los jóvenes normopesos (n = 158) presentaron riesgo atendiendo a la circunferencia de la cintura, el índice de adiposidad corporal (n = 31; 19,6 %) y el índice de conicidad (n = 14; 8,9 %). Conclusiones: la mayoría de los estudiantes presenta bajo riesgo vascular, atendiendo a los indicadores antropométricos. Sin embargo, la identificación de estudiantes sobrepeso y obesos debe realizarse no solo con el índice de masa corporal, sino que debe complementarse con, al menos, uno de los indicadores que permita estudiar la distribución de la grasa corporal.

Palabras clave: Índice de Masa Corporal; Circunferencia de la Cintura; Obesidad.

OPEN ACCESS **Published:** February 15th, 2023 || **Received:** December 12sd, 2022 || **Accepted:** January 27th, 2023

Cite as:
Céspedes Miranda EM, Olivero Betancourt RA, Rodríguez Guzmán R, Rojas Palacios GM, Suárez Castillo N, Martínez Alvarado DS. Índices antropométricos para la estimación de obesidad en jóvenes universitarios. Revista 16 de abril [Internet]. 2023 [cited: date of access]; 62:e1747. Available from: http://www.rev16deabril.sld.cu/index.php/16_04/article/view/1747

INTRODUCTION

The prevention and control of chronic non-communicable diseases is a priority in Cuba. In this context, obesity is identified as a health problem given its alarming increase since childhood and adolescence and the risk it represents for the development of type 2 diabetes mellitus, dyslipidemias and cardiovascular diseases[1,2]. Obesogenic environments based on changes in eating styles and a decrease in physical activity, given the increase in technological and sedentary activities, favor an increase in body weight and obesity.

Anthropometric and biochemical indicators are used to identify the risk of obesity and its complications based on the study of the quantity and distribution of adipose tissue. Many of the methods are complicated in clinical practice. Anthropometric methods allow measurement of body dimensions and are simple, fast, non-invasive and inexpensive[4]. The size of the fat and lean compartments is estimated and methods include: body mass index (BMI), waist circumference (WC), hip circumference (HC), waist-to-height ratio (WHtR) and waist-to-hip ratio[5,6,7].

BMI is widely used in epidemiological studies to characterize nutritional status, but has limited predictive value for estimating adiposity[8,9]. WC allows the identification of individuals with abdominal obesity and high risk of vascular risk comorbidity - given its association with metabolic alterations that lead to insulin resistance -, and does not determine total body fat[10,11]. In some studies[12,13,14,15] it has been confirmed to be a better predictor of cardiovascular disease risk than BMI. However, it is recognized that it can be highly variable if height or BMI is taken into account[1].

The WHtR, a valuable method for determining abdominal obesity, is proposed as a better indicator than BMI and WC in the assessment of the risk of type 2 diabetes mellitus, coronary heart disease, and the risk of metabolic syndrome. However, divergent results have also been observed with these anthropometric measurements[16,18].

Other indices have been proposed to define more accurately fat distribution and body composition, which are important for the control of overweight and obesity. In this context, the taper index (TI), the body adiposity index (BAI) and the abdominal volume index (AVI) have been proposed[2,13,19]. It is suggested that the efficacy of these indicators should be demonstrated in terms of cardiovascular health from early stages of life.

The objective of the present study was to analyze anthropometric indicators to estimate body fat distribution and obesity in young university students.

METHOD

Type of study and context: an observational, descriptive and cross-sectional study was conducted between October 2015 and January 2018, with first-year medical students enrolled at the "Calixto García" Faculty of Medical Sciences.

Population and sample: the population consisted of students aged between 18 and 19 years, from the capital municipalities of Centro Habana, Habana Vieja and Habana del Este. Exclusion criteria were foreign students, a history of hypertension, diabetes mellitus or obesity of secondary cause. A non-probabilistic sampling technique was used, so that the sample consisted of 215 students who agreed to participate voluntarily in the study and completed it.

Variables: the following variables were studied: sex, classification according to BMI, WC, WHtR, body adiposity index (BAI) and CI.

Height (m) and weight (kg) were measured to calculate BMI. Participants were weighed and measured without footwear and in light clothing, on a calibrated graduated scale, in a standing position, in the Frankfort plane. Measurements were performed by a specialist trained for this purpose. The calculation of BMI, according to the Quetelet formula: BMI (kg/m^2) = weight(kg)/ [height (m)]^2, allowed us to define the student as underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2) and obese (≥30 kg/m^2).

The measurement of WC as an indicator of central obesity was performed at the level of the average distance between the costal flange of the last rib and the upper edge of the iliac crests, with a flexible tape measure, with the student in a standing position, without footwear, with a relaxed abdomen, arms hanging down and in full expiration. The result was expressed in centimeters and was defined as classification in females: no risk (<80 cm), moderate risk (80-87.99 cm), high risk (≥88 cm); and in males: no risk (<94 cm), moderate risk (94-101.99 cm) and high risk (≥102 cm).

The WHtR is the ratio between WC and height; a WHtR≥0.5 indicates risk due to the presence of abdominal fat[1].

The BAI was determined by the ratio between HC and height. A healthy population was considered healthy in women when the BAI ranged between 21 and 33 (acceptable), greater than 33, elevated; in men, between 8 and 21 (acceptable), greater than 21, elevated.

The TI was calculated using the equation proposed by Valdés *et al.*[18], which incorporates WC (m), body weight (kg) and height (m); in addition to a constant that represents the conversion of volume and mass units to length

units. This equation was: . It was considered acceptable in women when it was less than 1.23; for men, less than 1.28. For higher figures, in both cases, the TI was classified as high.

Statistical processing: a data collection model obtained from the primary data collection model published by the Atherosclerosis Research and Reference Center of Havana was used. These data were incorporated into a Microsoft Excel worksheet. The distribution of frequencies and percentages were obtained from the analysis of the data in contingency tables using the IBM SPSS 20.0 statistical package.

Ethical aspects: the participants were provided with the information corresponding to the purpose of the research and informed consent was obtained, as well as the approval of the institution's ethics committee. The II Declaration of Helsinki was complied with.

RESULTS

Table 1 shows that overweight (n = 23; 10.7%) and obese (n = 9; 4.2%) students were identified.

Table 1. Students according to sex and BMI classification.

Classification according to BMI	Females		Males		Total	
	No.	%	No.	%	No.	%
Underweight	22	10,2	3	1,4	25	11,6
Normal weight	101	47,0	57	26,5	158	73,5
Overweight	10	4,7	13	6,0	23	10,7
Obese	6	2,8	3	1,4	9	4,2
Total	139	64,7	76	35,3	215	100

In relation to WC, 28 students (13 %) were found to be at moderate risk and 7 (3.3 %) at high risk; in both cases females predominated (75 % and 71.4 %, respectively). On the other hand, 19.5 % (n = 42) young people were identified as having an at-risk WHtR (Table 2).

Table 2. Students according to WC and WHtR

Sex	WC						WHtR			
	No risk (n = 180; 83,7 %)		Moderate risk (n = 28; 13 %)		High risk (n = 7; 3,3 %)		No risk (n = 173; 80,5 %)		At risk (n = 42; 19,5)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Females (n = 139)	113	62,8	21	75	5	71,4	115	66,5	24	57,1
Males (n = 76)	67	37,2	7	25	2	28,6	58	33,5	18	42,9

It was observed that 45.7% (n = 16) of the young people with risk WC were normal weight. In 7 of the 9 obese students risk was identified according to WC. The same occurred in 12 of the 33 overweight students (Table 3).

Table 3. Students according to sex, CC and classification according to BMI

Classification according to BMI	CC											
	Females (n = 139)				Males (n = 76)				Total			
	No risk (n = 113; 81,3 %)		At risk* (n = 26; 18,7 %)		No risk (n = 67; 88,2 %)		At risk* (n = 9; 11,8 %)		No risk (n = 180; 83,7 %)		At risk* (n = 35; 16,3 %)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Underweight	22	19,5	0	0	3	4,5	0	0	25	13,9	0	0
Normal Weight	86	76,1	15	57,7	56	83,6	1	11,1	142	78,9	16	45,7
Overweight	3	2,6	7	26,9	8	11,9	5	55,6	11	6,1	12	34,3
Obese	2	1,8	4	15,4	0	0	3	33,3	2	1,1	7	20

*Legend: *Moderate risk and high risk were grouped.*

Table 4 shows that, of the normal-weight subjects, 31 were identified as having an elevated CAI, predominantly in females.

Table 4. Students according to sex, BAI and BMI classification.

Classification according to BMI	BAI											
	Females (n = 139)				**Males** (n = 76)				**Total**			
	Acceptable		**High**		**Acceptable**		**High**		**Acceptable**		**High**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Underweight	22	20,9	0	0	3	5,3	0	0	25	15,5	0	0
Normal weight	79	75,2	22	64,7	48	85,7	9	45	127	78,9	31	57,4
Overweight	4	3,8	6	17,6	4	7,1	9	45	8	5	15	27,7
Obese	0	0	6	17,6	1	1,8	2	10	1	0,6	8	14,8

In both females (n = 91; 72.8 %) and males (n = 53; 79.1 %) with acceptable TI, normal weight predominated. There were 10.7% (n = 23) of students with high TI (Table 5).

Table 5. Students according to sex, TI and BMI classification.

Classification according to BMI	TI											
	Females (n = 139)				**Males** (n = 76)				**Total**			
	Acceptable (n = 125; 89,9 %)		**High** (n = 14; 10,1 %)		**Acceptable** (n = 67; 88,1 %)		**High** (n = 9; 11,9 %)		**Acceptable** (n = 192; 89,3 %)		**High** (n = 23; 10,7 %)	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Underweight	20	16	2	14,3	3	4,5	0	0	25	12	0	0
Normal weight	91	72,8	10	71,4	53	79,1	4	44,5	144	75	14	60,9
Overweight	8	6,4	2	14,3	10	14,9	3	33,3	18	9,4	5	21,7
Obese	6	4,8	0	0	1	1,5	2	22,2	7	3,6	2	8,7

DISCUSSION

The estimation of body size and composition by using anthropometric indicators is relevant for the study of obesity and vascular risk. The highest percentage of students, in this research, turned out to be in the lowest risk groups, taking into account the anthropometric indicators of the study. However, overweight and obese students were identified, with alterations in body fat distribution.

This result is in correspondence with the apparently healthy young population, despite the fact that the university academic environment can produce changes in habits and lifestyles that can have repercussions on the state of health. The increased risk in female students is striking when taking into account WC and WHtR, the greater number of females in relation to males with normal BMI and WC with risk values, as well as elevated BAI and TI, reflecting the increase in abdominal fat.

BMI continues to be a useful indicator for anthropometric studies of vascular risk in different health area populations, although it is not a true indicator of adiposity. This index does not allow us to distinguish between fat-free mass and fat mass, a fact that limits the study of body fat distribution in children and adolescents, as well as the assessment of abdominal fat in metabolic and vascular risk[16,20].

Nevertheless, the association between BMI and other anthropometric indicators, such as WC, WHtR[8], BAI and TI, is recognized[21]. Consequently, the use of these indicators that allow a more accurate assessment of body fat is suggested.

The results presented here correspond to the studies of Díaz-Salazar[22], who determined cardiovascular risk factors in 34 students at the University of Chiclayo, Peru, and 50% of them were normal weight, 38.23% were overweight and obese. Alcívar *et al*.[14] also reported 54 % of people with normal nutritional status according to their BMI after studying 433 university students. In 100 nursing students at the Universidad Francisco de Paula Santander, in Chile, 57% corresponded to the normal BMI group and 35% were overweight and obese[23].

The association of WC with TI and BAI has been reported by Molano *et al*.[5]. These indices allow estimation of fat located in the central region with the use of simple measurements, which offers a criterion for the evaluation of metabolic disease risk and a useful option in the university population.

Beck *et al*.[24] conducted a study involving 660 adolescents, in which they identified the accuracy of the anthropometric indicators WC, WHtR and TI for the prediction of variations in lipid profile. These authors found that the anthropometric indicators were good predictors of elevated total cholesterol in children.

In the study of anthropometric indicators by Pelegrini *et al*.[25], which was conducted with 1197 adolescents, the authors diagnosed excess body fat using TI, WHtR and ICC. The WHtR and ICC were shown to have better discriminatory power for body fat than the TI. Segura *et al*[21] concluded that the TI was the indicator that presented the best predictive association with cardiovascular risk in the men in the study. Likewise, Caitano *et al*[26] consider that TI is not the most suitable indicator for predicting cardiometabolic risk. Nevertheless, for Hernández *et al*,[18] TI is a useful ratio to determine the existence of abdominal obesity and has good predictive power for dysglycemia in women.

The BAI is a good predictor of obesity and cardiometabolic risk. Recommendations regarding the usefulness of this index for determining fat mass were made by Gómez-Campos *et al*.[27]. In this context, García *et al*.[28] carried out a study with 527 men in the educational and automotive sectors in Colombia; they concluded that higher values of the BAI are related to alterations in the lipid profile and clinical signs consistent with vascular risk.

Faced with the dilemma of approaching the study of obesity with anthropometric indicators and given the diversity of methods that are described and that are easy to use, the combination of BMI, WC and BAI can provide relevant information.

CONCLUSIONS

Most of the students presented low vascular risk, according to the anthropometric indicators. However, the identification of overweight and obese students should be done not only with the BMI, but should be complemented with at least one of the indicators that allow the study of body fat distribution.

The epidemiological behavior of obesity continues to enrich the scientific work that supports the need for its systematic evaluation and control from primary care.

REFERENCES

1. Vento Pérez RA, Hernández Rodríguez Y, León García M, Miranda Blanco LC, de la Paz Rodríguez O. Relación del Índice cintura/talla con la morbilidad y el riesgo cardiometabólico en adultos pinareños. Rev Cienc Méd Pinar del Río [Internet]. 2021 [cited 09/01/2021]; 25(4):e4977. Available from: http://revcmpinar.sld.cu/index.php/publicaciones/article/view/4977
2. Górnicka M, Szewczyk K, Białkowska A, Jancichova K, Habanova M, Górnicki K, *et al*. Anthropometric indices as predictive screening tools for obesity in adults; The need to define sex-specific cut-off points for anthropometric indices. Appl Sci [Internet]. 2022 [cited 09/01/2021]; 12(12):6165. DOI: 10.3390/app12126165
3. Alemañy Díaz-Perera C. Señales ateroscleróticas tempranas en adolescentes entre 10 y 19 años aparentemente sanos. Rev Cub Med Gen Integ [Internet]. 2020 [cited 09/01/2021]; 36(2):e1148 Available from: https://revmgi.sld.cu/index.php/mgi/article/view/1148
4. Pozo Pozo D, del Toro Cámbara A, Cuba Pasos Y, Monzón Tamargo MJ, Pita Valdés AC, Díaz Calzada M. Estado nutricional y variables antropométricas en adolescentes del Policlínico Universitario "Luis Augusto Turcios Lima". Rev Cienc Méd Pinar del Río [Internet]. 2021 [cited 09/01/2021];25(4):e5091. Available from: http://revcmpinar.sld.cu/index.php/publicaciones/article/view/5091
5. Molano Tobar NJ, Chalapud Narváez LM, Villaquirán Hurtado AF. Estimación de obesidad desde índices de adiposidad en universitarios de Popayán, Colombia. Cultura, Ciencia y Deporte[Internet]. 2021 [cited 09/01/2021];16(48):301-9. DOI: 10.12800/ccd.v16i48.1753
6. Zaragoza García O, Gutiérrez Pérez IO, Delgado Floody P, Parra Rojas I, Jerez Mayorga D, Campos Jara C, *et al*. Emergent anthropometric indices in differential prediction of prehypertension and hypertension in mexican population: Results according to age and sex. Int J Hypertension [Internet]. 2022 [cited 09/01/2021]; 2022:4522493. DOI: 10.1155/2022/4522493
7. Shukohifar M, Mozafari Z, Rahmanian M, Mirzaei M. Performance of body mass index and body fat percentage in predicting metabolic syndrome risk factors in diabetic patients of Yazd, Iran. BMC Endocrine Disorders [Internet]. 2022 [cited 10/02/2022]; 22:216. DOI: 10.1186/s12902-022-01125-0
8. Suárez Carmona W, Sánchez Oliver AJ. Índice de masa corporal: ventajas y desventajas de su uso en la obesidad. Relación con la fuerza y la actividad física. Nutr Clin Med [Internet]. 2018 [cited 10/02/2022]; XII(3):128-39. DOI:

10.7400/NCM.2018.12.3.5067
9. Adhikari A. Reliability of BMI as an index for fattiness and obesity in active population in comparison to Endomorphy component as an index. Int J Kinanthrop [Internet]. 2021 [cited 10/02/2022]; 1(1):78-81. DOI:10.34256/ijk21111
10. Zhang FL, Ren JX, Zhang P, Jin H, Qu Y, Yu Y, *et al*. Strong association of waist circumference, body mass index, waist-to-heigh ratio, and waist-to-hip ratio with diabetes: A population-based cross-sectional study in Jilin Province, China. J Diabetes Res [Internet]. 2021 [cited 10/02/2022]; 2021:8812431. DOI: 10.1155/2021/8812431
11. Mardali F, Naziri M, Sohouli MH, Fatahi S, Sadat Hosseini-Baharanchi F, Gaman MA, *et al*. Predictors of central and general obesity in iranian preschool children: which anthropometric indices can be used as screening tools? BMC Pediatr [Internet]. 2022 [cited 10/02/2022]; 22(1):320. DOI: 10.1186/s12887-022-03365-4
12. Ross R, Neeland IJ, Yamashita S, Shai I, Seidell J, Magni P, et al. Waist circumference as a vital sign in clinical practice: a Consensus Statement from the IAS and ICCR Working Group on Visceral Obesity. Nat Rev Endocrinol. 2020 [cited 10/02/2022]; 6(3):177-89.DOI: 10.1038/s41574-019-0310-7
13. Gažarová M, Bihari M, Lorková M, Lenártová P, Habánová, M. The use of different anthropometric indices to assess the body composition of Young women in relation to the incidence of obesity, sarcopenia and the premature mortality risk. Int J Environ Res Public Health [Internet]. 2022 [cited 10/02/2022]; 19:12449. DOI: 10.3390/ijerph191912449
14. Alcívar Alcívar JE, Campos Vera N, Plua Marcillo W, Peña García M, Anderson Vásquez HE. Riesgo cardiovascular antropométrico de estudiantes universitarios. Rev Cub Cardiol Cir Cardiovasc [Internet]. 2020 [cited 10/02/2022]; 26(1):1-9. Available from: https://revcardiologia.sld.cu/index.php/revcardiologia/article/view/921
15. Lee S, Kim Y, Han M. Influence of Waist Circumference Measurement Site on Visceral Fat and Metabolic Risk in Youth. J Obes Metab Syndr. [Internet]. 2022 [cited 01/04/2023]; 31(4):296-302. DOI: 10.7570/jomes22046
16. Dang AK, Truong MT, Le HT,Nguyen KC, Le MB, Nguyen LT, *et al*. Anthropometric cut-off values for detecting the presence of Metabolic Syndrome and its multiple components among adults in Vietnam: The role of novel indices. Nutrients [Internet]. 2022 [cited 01/04/2023]; 14(19):4024. DOI:10.3390/nu14194024
17. Oumer A, Ale A, Tariku Z, Hamza A, Abera L, Seifu A. Waist-to-hip circumference and waist-to-height ratio could strongly predict glycemic control tan body mass index among adult patients with diabetes in Ethiopia: ROC analysis. PLoSOne [Internet]. 2022 [cited 01/04/2023]; 17(11):e0273786. DOI: 10.1371/journal.pone.0273786
18. Hernández Rodríguez J, Mendoza Choqueticlla J, Domínguez Alonso E, Díaz Díaz O, Arnold Domínguez Y, Martínez Montenegro I, *et al*. Valor de corte del índice de conicidad como predictor independiente de disglucemias. Rev Cub Endocrinol [Internet]. 2019 [cited 01/04/2023]; 30(2):e171. Available from: https://revendocrinologia.sld.cu/index.php/endocrinologia/article/view/171
19. Hernández Rodríguez J, Choqueticlla JM, Jimbo PD. Índice de conicidad y su utilidad para detectar riesgo cardiovascular y metabólico. Rev Cub Endocrinol. [Internet]. 2017 [cited 01/04/2023]; 28(1):1-13. Available from: https://revendocrinologia.sld.cu/index.php/endocrinologia/article/view/63
20. Khanna D, Peltzer C, Kahar P, Parmar MS. Body mass index (BMI): A screening tool analysis. Cureus [Internet]. 2022 [cited 01/04/2023]; 14(2):e22119. Available from: https://pubmed.ncbi.nlm.nih.gov/35308730/
21. Segura Fragoso A, Rodríguez Padial L, Alonso Moreno FJ, Villarín Castro A, Rojas Martelo, Rodríguez Roca GC, *et al*. Medidas antropométricas de obesidad general y central y capacidad discriminativa sobre el riesgo cardiovascular: estudio RICARTO. Semergen [Internet]. 2019 [cited 01/04/2023]; 45(5):323-32. Available from: https://www.elsevier.es/es-revista-medicina-familia-semergen-40-articulo-medidas-antropometricas-obesidad-general-central-S1138359319301030
22. Díaz-Salazar W. Factores de riesgo cardiovascular en estudiantes de la universidad particular de Chiclayo. Rev Cub Tecnol Salud [Internet]. 2021 [cited 01/04/2023]; 12(1):155-61. Available from: https://revtecnologia.sld.cu/index.php/tec/article/view/2257
23. Mendoza Silva YO, Moreno Rodríguez AR, Zambrano Plata GE, Ruiz Roa SL. Jóvenes universitarios estilos de vida y biología humana. ¿predisponen al desarrollo de enfermedad cardiovascular? Rev Chilena Enfermería [Internet]. 2021 [cited 01/04/2023]; 3(2):56-78. DOI: 10.5354/2452-5839.2021.65590
24. Beck CC, Lopes A, Pitanga FJG. Indicadores antropométricos de sobrepeso e obesidade como preditores de alterações lipídicas em adolescentes. Rev Paul Pediatr [Internet]. 2011 [cited 01/04/2023]; 29(1):46-53. DOI: 10.1590/S0103-05822011000100008
25. Pelegrini A, Silva DAS, de Lima Silva JMF, Grigollo L, Petroski EL. Anthropometric indicators of obesity in the prediction of high body fat in adolescents. Rev Paul Pediatr [Internet]. 2015 [cited 01/04/2023]; 33(1):56-62. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4436957/
26. Caitano P, Roseli E, Nazario PR. Study of conicity index, body mass index and waist circumference as predictors of coronary artery disease. Rev Port Cardiol [Internet]. 2017 [cited 01/04/2023]; 36(5):357-64. Available from: https://pubmed.ncbi.nlm.nih.gov/28449975/
27. Gómez Campos R, Vidal Espinoza R, Castelli Correia de Campos LF, Marques de Moraes A, Lázari E, Cossio Bolaños W, *et al*. Estimación de la masa grasa por medio de indicadores antropométricos en jóvenes con síndrome de Down. Nutr Hosp [Internet]. 2021 [cited 01/04/2023]; 38(5):1040-6. DOI: 10.20960/nh.03524
28. García AI. Utilidad del índice de adiposidad corporal como indicador de obesidad y predictor de riesgo cardiovascular en adultos de Bogotá, Colombia. Endocrinol Nutr [Internet]. 2015. [cited 01/04/2023]; 62(3):130-7. Available from: https://www.elsevier.es/es-revista-endocrinologia-nutricion-12-articulo-utilidad-del-indice-adiposidad-corporal-S1575092214003003

CONFLICT OF INTERESTS
The authors declare that there is not conflict of interest.

AUTHORSHIP
Ela María Céspedes Miranda: conceptualization, formal analysis, research, methodology, project management, writing, revising and editing.
Reison Adalberto Olivero Betancourt: data curation, research.
Roger Rodríguez Guzmán: formal analysis, research.
Genny Mercedes Rojas Palacios: resources, research.
Niurelkis Suárez Castillo: research.
Daysi Sofía Martínez Alvarado: research.

FUNDING
None.