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Original article

Association between body fat mass and cardiometabolic risk in children and adolescents in Bucaramanga, Colombia

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ABSTRACT

Background: Obesity is common among children and teenagers and is associated with cardiometabolic risk factors in the adult age. The objective of this paper was to evaluate the association between the percentage of body fat and cardiometabolic risk factors in children and adolescents in the city of Bucaramanga, Colombia.

Material and Methods: About 494 children and adolescents aged 10–20 years were studied. Laboratory tests were made for analyzing cardiovascular risk factors and anthropometric measurements. Percentage body fat was determined with Slaughter equation. Lineal regression analyses were conducted to evaluate the association between cardiometabolic risk factors and the percentage body fat.

Results: Prevalence of percentage body fat (>26%) was 46.1%. Variables associated with percentage body fat were HOMA-IR – insulin resistance, HDL, LDL, triglycerides, and total cholesterol levels, and high blood pressure.

Conclusions: Increase in percentage body fat is significantly associated with cardiometabolic risk factors in children and adolescents in Bucaramanga. Early identification and intervention of this population at risk is fundamental.

1. Introduction

The World Health Organization (WHO) has grouped insulin resistance (IR), high blood pressure (HBP), obesity, high level of low density lipoproteins (LDL), low level of high density lipoproteins (HDL), and/or increase in the triglycerides level as mediating cardiometabolic risk factors (CMRF) as a result of an inappropriate lifestyle characterized by a diet rich in saturated fats and carbohydrates, physical inactivity, smoking, and excessive alcohol consumption [1,2].

Obesity is one of the most important health concerns worldwide. It is considered, from an epidemiologic model, a major risk factor of various life-threatening diseases [3]. Child obesity is a worldwide concern. The incidence of child obesity is rising rapidly, thereby increasing the development of numerous chronic diseases in adulthood, especially cardiovascular diseases (CVDs) [4].

Obesity is an independent predictor of some adverse cardiovascular events, thereby increasing mortality compared to individuals with normal weight [5,6]. In children and adolescents, obesity is associated with CMRF such as high blood pressure, hyperlipidemia, insulin resistance, and type-2 diabetes, which may lead to the development of cardiometabolic diseases in the adult age [7,8]. This association implies the need to identify easier, low-

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cost, reliable methods to identify the children population at risk.

The issue of child obesity is not new to Colombia. Health indicators developed by governmental and private entities show that one in six children and adolescents are overweight or obese in the country [9]. In Santander, the situation is of concern. The results of the National Survey on the Situation of Nutrition in Colombia (ENSIN-2015) show that excess weight increased by 2.4%, from 15.5% in 2010 to 17.9% in 2015 [10], possibly due to the lifestyle adopted by this population group nowadays.

Therefore, it is necessary to identify the children at risk by means of noninvasive, low-cost, easy to use tools, such as anthropometric measurements whose results could allow the health practitioner to identify nutritional and cardiometabolic alterations [11]. Currently, the anthropometric measurements most used in school-age and adolescent populations are the body mass index (BMI), the weight-to-height ratio calculated by z scores, and the measurement of body fat percentages (%BF) using skinfold thickness. Body fat percentage (%BF) has gained significance over the last years in the clinical environment; however, there are other measurements developed to determine whether high %BF is associated with both cardiometabolic risk factors and cardiovascular alterations in pediatric population. The aim of this study is to evaluate the association between body fat percentage and cardiometabolic risk factors in children and adolescents in the city of Bucaramanga, Colombia.

2. Material and methods

2.1. Study design

Cross-sectional survey nested on a population-based cohort (SIMBA) [12].

2.2. Population and sample

About 494 participants aged 10–18 years were surveyed. This population corresponded to children and adolescents recontacted from the baseline sample of the cohort study (n = 1282). The statistical power of the simple size (n = 494) was between 70% and 75% ($Z_{1\text{-}\beta} = 0.5417$), which corresponds to the application of a bilateral test ($Z_{1\text{-}\alpha/2}$) [13].

2.3. Study variables

Dependent variables correspond to the following cardiometabolic risk factors:

- *Impaired fasting glucose:* ≥ 100 mg/dL, Diabetes: ≥ 126 mg/dL (Standards of Medical Care in Diabetes, ADA 2016).
- *HOMA-IR:* Obtained from a mathematical model using the formula ([IF*GF]/22.5), where IF represents insulin levels at fasting in UL/L and GF represents fasting glucose levels. Cut-off point cardiovascular risk ≥90th percentile [14].
- *High blood pressure:* (systolic blood pressure (SBP) and diastolic blood pressure (DBP) ≥ 95 percentile for age, sex, and sized measured in three or more opportunities. (The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents)
- *Dyslipidaemia:* *Triglycerides alteration: 10–19 years of age: ≥ 130 mg/dL *Alteration in total cholesterol: ≥ 200 mg/dL *Alteration in HDL cholesterol: 40 mg/dL *Alteration in LDL cholesterol: ≥ 130 mg/dL (Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents. National Heart, Lung, and Blood Institute, NHI. USA, 2012).

Independent variables: Percentage of total body fat. The Slaughter equation [15] was used with the tricipital and subscapular skinfolds to determine the percentage of fat mass with a cut-off point for alteration >26% (see supporting information-S1). Two examiners, a nurse and a physician, performed the skinfold measurements. The two examiners received training from a nutritionist for performing the appropriate technique using these skinfolds and standardizing the measurements. Each examiner made two measurements of each skinfold for each participant in the same hours according to the scheduled appointment. The values of each skinfold were blinded among the examiners. The triceps skinfold (PTC) and subscapular skinfold (PSE) were measured with a Harpenden calibrator and with a standard technique [16].

Other independent variables that were taken into account were sex, age, socioeconomic level (according to the socioeconomic stratification in Colombia), duration of breastfeeding, smoking, alcohol consumption, screen time, physical activity determined for American Association of Pediatrics-2011 (vigorous 1 to 2 times/week; vigorous 3 to > 7 times/week) [17], weight, length, body mass index for age (BMI/A) for participants under 18 years old [18] and body mass index (BMI) for 18 years old or more, waist circumference, hip circumference, waist-hip ratio, and waist-length ratio.

2.4. Data collection

This process was carried out for 16 months; participants in the survey visited a health institution specialized in the attention of cardiovascular diseases, for the collection of information related to socio-demographic, anthropometric variable, and blood samples, besides a complete clinical assessment. Data collection was carried out by physicians and nurses previously trained in standardized techniques for that purpose. The description of the process for collecting information of all variables has been described in detail previously, as they are the same participants of the cohort yet adolescent age [12].

2.5. Data quality

Double typing of data was done on Excel software (Microsoft Corp., Redmond, WA). Data were compared using *Epi-Info* 2000. Incompatibilities found were corrected by corroboration with the original printed forms.

2.6. Statistical analysis

A descriptive analysis was made initially, where categorical values were presented as proportions, and the continuous variables as means and interquartile range, according to the distribution they displayed. Mann-Whitney *U* test was used to establish differences per sex. The association between dependent and independent variables in this study was evaluated using multiple linear regression models with their corresponding goodness of fit assessment. Variables that obtained a $p = 0.20$ in the bivariate analysis were maintained in the multivariate models. All of the *p* values were considered to be two waves, considering $p = 0.05$ as a statistical significance. To establish the variability of intra and inter observer skinfolds, a complementary analysis was performed using Technical Error of Measurement (TEM) [19] (Supporting Information-S2). All of the data were analyzed in the statistical software Stata version 14.0 (Stata Corporation, College Station, TX).

2.7. Ethical considerations

The Research Ethics Committee (CER) of the *Fundación Cardiovascular de Colombia* reviewed and approved the present study. Written informed consent was obtained from parents or legal guardians for participants below the age of 18 years. All minors were asked to give their verbal assent, and for those above the age of 14 years of age, written assent is required. Participants of legal age (above 18 years) gave their written informed consent directly.

3. Results

3.1. General characteristics

A total of 494 participants were evaluated, of which 48.5% (n = 240) corresponded to male sex and 51.4% (n = 254) to female sex. The median age was 16.6 years. With regard to alcohol consumption, at least once in lifetime, there was a statistically significant difference per sex (Table 1).

With regards to cardiometabolic risk factors considered, statistically significant differences were found per sex in systolic and diastolic blood pressure, in anthropometric variables such as waist circumference, hip circumference, as well as the hip-waist ratio, waist-length ratio, and the four skinfolds evaluated. When analyzing biochemical variables, differences were found per sex in HDL cholesterol (mg/dL) and fasting glucose (mg/dL) (Table 1).

3.2. Prevalence of percentage body fat and cardiometabolic risk factors

About 46.1% of the studied population had greater %BF estimated by Slaughter equations (>26%), with a higher prevalence in women, 62.6% versus 28.7% in men; this difference being statistically significant (<0.001).

The prevalence of overweight and obesity according to BMI/A for children under 18 years of age (BMI/A, equal or greater than 1 SD) was 28.8% with significant difference between sex. For 18 years old or more, the prevalence of obesity was 9.6%. About 10.7% had altered fasting glucose, the male sex being the one with greater prevalence (13.7%). About 18.9% had alteration in fasting insulin.

Table 1
Sociodemographic and anthropometric characteristics and cardiometabolic risk factors in schoolchildren and adolescents.

Characteristics	Total (n = 494) n (%) Median [IQR]	Men (n = 240) n (%) Median [IQR]	Women (n = 254) n (%) Median [IQR]	*P* value
Sociodemographic variables				
Age in years	16.6 (3.0)	16.6 (2.9)	16.5 (3.2)	.469†
Socioeconomic level				
Low	296 (59.9)	140 (58.3)	156 (61.4)	.714‡
Middle	193 (39.0)	97 (40.4)	96 (37.8)	
High	5 (1.0)	3 (1.2)	2 (0.79)	
Background				
Duration of maternal breastfeeding (months)	12 (18.0)	12 (18.0)	12 (18.0)	.262†
Having smoked at least once in lifetime	188 (38)	128 (68)	60 (32)	.312‡
Having consumed alcohol at least once in lifetime	355 (72.1)	207 (58)	148 (42)	.043‡
Screen time (hours/day)				
Less than 4 h	324 (65.5)	158 (65.8)	166 (65.3)	.911‡
4 h or more	170 (34.4)	82 (34.2)	88 (34.6)	
Physical activity AAP-2011				
Vigorous 1 to 2 times/week	251 (56,1)	116 (50,3)	135 (62,4)	.038‡
Vigorous 3 to > 7 times/week	196 (43,8)	114 (49,6)	82 (37,5)	
Blood pressure				
Systolic blood pressure (mmHg)	107.3 (13.6)	114 (15)	103.3 (10)	<.001†
Diastolic blood pressure (mmHg)	63.6 (10.6)	64.1 (11.7)	63.3 (9.7)	.024†
Anthropometric variables				
Length (cm)	163.0 [12.9]	169.9 [8.6]	158.5 [7.5]	<.001†
Weight (kg)	56.8 [(17.7]	60.4 [17.1]	53.1 [14.2]	<.001†
Children under 18 years of age	*n = 360*	*n = 175*	*n = 185*	
Z score Height for Age	0.03 [0.29]	0.04 [0.42]	0.03 [0.17]	.409†
BMI for children over 18 years of age	*n = 134*	*n = 65*	*n = 69*	
Body Mass Index (BMI) kg/m^2	23.1 [5,7]	23.3 [6.1]	22.9 [5.8]	.3951†
Waist circumference (cm)	74.8 [12.1]	75.7 [13.2]	73.7 [11.1]	.003†
Hip circumference (cm)	92 [12.35]	91.2 [13]	93.3 [11]	.007†
Waist-hip ratio	0.81 [0.11]	0.83 [0.09]	0.79 [0.11]	<.001†
Waist-length ratio	0.45 (0.07)	0.44 (0.07)	0.46 (0.07)	<.001†
Bicipital skinfold (mm)	7.7 [5.7]	5,7 [4]	10 [5.2]	<.001†
Tricipital skinfold (mm)	15.5 [10]	11 [8]	18.5 [7]	<.001†
Scapular skinfold (mm)	12.7 [7]	11 [6]	14 [7]	<.001†
Abdominal skinfold (mm)	21.5 [13.5]	17 [17]	23 [8]	<.001†
% Body fat Slaughter	25.4 [9.9]	19.9 [11.0]	28.0 [5.9]	<.001†
Biochemical variables, median (IQR)				
Total cholesterol (mg/dL)	156.6 [36.3]	155.4 [34.5]	158.1 [37.8]	.074†
LDL cholesterol (mg/dL)	94.0 [26.6]	89.2 [32]	93.8 [32]	.215†
HDL cholesterol (mg/dL)	47.7 [15.1]	44.4 [14.6]	50.5 [14.9]	<.001†
Triglycerides (mg/dL)	79.1 [49.5]	81 [52.6]	78.1 [45.0]	.223†
Fasting glucose (mg/dL)	91.3 [6.7]	93 [9.0]	89.2 [8.4]	<.001†
Fasting insulin (μU/mL)	9.8 [6.1]	8.7 [6.3]	10.7 [5.6]	<.001†
HOMA − IR(UI/mL)	2.0 [1.5]	2.1 [1.6]	2.0 [1.4]	.679†

IQR: Inter quartile range. † Value p determined by Mann-Whitney *U* test. ‡ Value p determined by chi square. **AAP:** American Academy of Pediatrics. **BMI:** Body Mass Index. **LDL:** low-density lipoprotein. **HDL:** high-density lipoprotein. **HOMA-IR:** homeostatic model assessment − insulin resistance.

With regards to alterations of the lipid profile, 23.8% of the surveyed population had triglycerides ≥100 mg/dL; 14.7% had total cholesterol ≥150 mg/dL; 23.2% HDL <40 mg/dL; and 13.5% LDL ≥100 mg/dL. When making the comparison per sex, the female population had greater prevalence in the variables of lipid profile with 24.4% altered triglycerides, 16.9% with high total cholesterol, 24.0% with alteration of HDL cholesterol, and 14.5% with high levels of LDL cholesterol (Table 2).

3.3. *Association between total percentage body fat and cardiometabolic risk factors*

After adjusting for sex and age, an inverse relationship was found between %BF and HDL cholesterol levels. This means that for every percentage unit increased in fat, HDL cholesterol is reduced by 0.15 mg/dL. A positive relationship was also found between %BF and cardiometabolic factors of insulin resistance, total cholesterol, triglycerides, LDL cholesterol, and high blood pressure; that is, the levels of these factors increase per very percentage unit that increases body fat. No statistically significant relationship was found between percentage body fat and alteration of fasting glucose (see Table 3).

3.4. *Complementary analysis using the technical error of measurement (TEM)*

The intra-observer technical error of measurement (TEM) was 0.038 mm tricipital skinfold and 0.24 mm subscapular skinfold by the nurse and 0.04 mm and 0.05 mm by the physician, respectively. Intra-observer reliability was 96.9% (PTC) and 97.6% (PSE) for skinfold thickness (triceps and subscapular) by nurse and 92.0% and 96.7% by the physician. Inter-observer TEMs for skinfold thicknesses were between 2.8 mm and 1.3 mm. Inter-observer agreement as assessed by the coefficient of reliability for repeated measurements of skinfold thickness was on average 95.6%.

4. Discussion

Cardiometabolic diseases rank first in morbidity and mortality worldwide as noncommunicable chronic diseases [20]; therefore, the identification and early intervention in the child and adolescent population are vital. There is a high association between the body fat percentage and cardiometabolic risks analyzed in this study; the variables with which it was significantly associated were HDL and LDL cholesterol, triglycerides, total cholesterol, high blood pressure, and insulin resistance levels, where the increase in fat percentage units is directly proportional to the alteration of those factors. Results obtained in this study are similar to those published in countries such as Brazil [21], Chile [22], and Portugal [6], wherein they conclude that adiposity has a clear impact on cardiometabolic risk factors; therefore, the more adipose tissue, the greater is the cardiometabolic risk.

4.1. *Lipid profile*

The association is directly proportional to the percentage of body fat, increasing to 0.04 mg/dL of triglycerides levels, 0.04 mg/dL of LDL cholesterol, and total (TC) cholesterol, as well as a decrease of 0.15 mg/dL in HDL levels for every unit of increase in %BF. Women had higher prevalence compared to men, which is consistent with studies developed in Chile (women 36.2% vs. men 27.4%) [23], Brazil (women 66.1% vs. men 43.4%) [24], and Korea [25]. At the national level, prevalence in altered lipid profile found in this study (LDL 13.5%, TC 14.7%, and HDL 23.2%) compared with cities of Andean or central Colombian cities such as Medellin (LDL 17.0%, TC 13.5%, and HDL 19.1%) behave in a similar manner [26]. On the other hand, coastal cities such as Cartagena manage to triple the prevalence of those variables (LDL 57.2%, TC 53.2%, and HDL 46.8%) [27]. Alterations in the lipids concentration have a fundamental role in the development of atherosclerosis. Several clinical, epidemiologic, pathologic, metabolic, and genetic trials clearly indicate that the origin of atherosclerosis is during childhood and that treatment should begin in the early stages [28,29].

4.2. *High blood pressure (HBP)*

HBP was highly associated with body fat percentage, increasing by 0.16 mm Hg per each body fat percentage unit. About 17% of children and adolescents had increased blood pressure, prevalence higher than the given by population based studies in children and adolescents in Europe and the United states which ranges between 1% and 5%, although in some geographical areas it reaches 10% [30]. Similarly, studies on the national level report prevalence of HBP lower than the ones found in this paper (15%) versus. 2.5% in Bogotá [31], 3.2% in Cali [32], and 15.7% in Barranquilla [33]. Sedentary lifestyle and overweight have been identified as the greater risk

Table 2
Prevalence of alterations of cardiometabolic risk factors.

Variables	Both sexes n (%)	Men n (%)	Women n (%)	*P* value
% Body fat Slaughter (>26%)	228 (46.1)	69 (28.7)	159 (62.6)	<.001‡
Nutritional status according to BMI/A for children under 18 years of age	*n = 360*	*n = 175*	*n = 185*	
Low weight (<−2 SD BMI/A)	44 (9.8)	18 (8.2)	26 (11.3)	.004‡
Normal weight (-2-0.99 SD BMI/A)	273 (61.2)	137 (62.8)	136 (59.1)	
Overweight (1−1.99 SD BMI/A)	52 (11.6)	30 (13.8)	22 (9.5)	
Obesity (≥2 SD BMI/A)	77 (17.2)	36 (16.5)	41 (17.8)	
Nutritional status according to BMI for children over 18 years of age	*n = 134*	*n = 65*	*n = 69*	
Low weight (<20 kg/m2)	12 (2.4)	8 (3.3)	4 (1.5)	.366‡
Normal weight (20−25 kg/m2)	74 (14.9)	31 (12.9)	43 (16.9)	
Overweight (>25 kg/m2)	34 (6.8)	17 (7.0)	17 (6.6)	
Obesity (≥30 kg/m2)	14 (2.8)	9 (3.7)	5 (1.9)	
Glucose (≥100 mg/dL)	50 (10.7)	31 (13.7)	19 (7.9)	.046‡
HOMA-IR mmol/L (≥90th)	84 (18.7)	48 (22.6)	36 (15.3)	.048‡
Triglycerides (≥100 mg/dL)	117 (23.8)	55 (23.2)	62 (24.4)	.592‡
Total cholesterol (≥150 mg/dL)	73 (14.7)	30 (12.5)	43 (16.9)	.166‡
HDL cholesterol (<40 mg/dL)	109 (23.2)	51 (22.4)	58 (24,0)	.682‡
LDL cholesterol (≥100 mg/dL)	67 (13.5)	30 (12.5)	37 (14.5)	.502‡

‡ Value p determined by chi square. SD: Standard Deviation. **BMI/A:** Body Mass Index/Age. **LDL:** low-density lipoprotein. **HDL:** high-density lipoprotein. **HOMA-IR:** homeostatic model assessment − insulin resistance.

Table 3
Multiple Linear regressions between percentages body fat and cardiometabolic risk factors.

Characteristics	Crude model			Fitted model*		
	Coefficient beta	CI 95%	*P* value	Coefficient beta	CI 95%	*P* value
Fasting glucose (mg/dl)	−0.11	−0.20 to −0.02	.014	0.04	−0.07 to 0.16	.487
HOMA-IR index (mmol/L)	0.061	0.04 to 0.07	<.0001	0.07	0.04 to 0.00	<.0001
High blood pressure (mmHg)	−0.004	−0.05 to −0.04	.860	0.14	0.06 to 0.21	<.0001
Triglycerides (mg/dL)	0.04	0.02 to 0.05	<.0001	0.04	0.03 to 0.06	<.0001
Total cholesterol (mg/dL)	0.03	0.01 to 0.05	<.0001	0.02	0.001 to 0.04	.037
HDL cholesterol (mg/dL)	−0.09	−0.14 to −0.03	.001	−0.15	−0.20 to −0.09	<.0001
LDL cholesterol (mg/dL)	0.04	0.02 to 0.06	<.0001	0.02	0.002 to 0.05	<.030

CI 95%: Confidence interval of 95%. **p:** p-value. **LDL:** low-density lipoprotein. **HDL:** high-density lipoprotein. **HOMA-IR:** homeostatic model assessment – insulin resistance. * Multiple linear regression models fitter sex, age, and physical activity.

factors for high blood pressure in the child population [34]. These factors are the most common in overweight adolescents and the main mortality risk in adulthood, attributable to approximately 12.8% of deaths worldwide [35]. Pediatric blood hypertension has a growing prevalence, elevated comorbidity in the mid and long term, and is frequently underdiagnosed.

4.3. Insulin resistance (IR)

The prevalence of IR in this study was 18.7% lower than the one reported in other studies of Latin American countries in similar populations (e.g., 23% in Chile [23] and between 32.3% and 41.7% in Brazil [24]). The relationship between IR and high percentages of body fat matches a study conducted by Gonzalez J et al. [34], where it was determined that individuals with abnormal HOMA-IR values had a significantly higher content of body fat than those with normal values [36]; however, another study claims that there is no correlation between these two variables [36]. However, it has been documented that the increase in adipose tissue is related to an increased production of pro-inflammatory cytokines, which, together with fatty acids, seem to be responsible for the development of insulin resistance.

4.4. Body fat mass percentage (>26%)

Prevalence adjusted per sex matches with results of similar studies, where women have the highest body fat percentage (34.6%) in comparison with men (14.6%) [19,20], but it is contradictory with studies such as the one developed in Mexico where percentage body fat was higher in men (17.5%), much lower than that found in this study (46.1%). One of the most common causes related to the increase in body fat is inadequate nutritional diets. Epidemiological studies have shown that from the age of 3 years begins an increase in the consumption of unhealthy processed foods, refined sugars, non-nutritive beverages, and foods with high caloric density, probably conditioned to the consumption of foods outside home and independence of the child when selecting them. A study carried out in the city of Medellin (Colombia) shows that 48% of children consumed food with high fat content, whereas 47% consumed excess of carbohydrates [24].

The estimation of the body fat mass percentage was done by Slaughter's equation, which some authors consider as an excellent alternative to measure the fatty component in the pediatric population as it is designed for children and adolescents aged 8–17 years old, with an estimation error of 3.8%. On the contrary, others claim that it leads to biased estimations; however, the evaluation of body composition in children and adolescents is complex and changing as they are chemically immature. This produces changes in the proportions and densities of the components (water, minerals, and proteins) of the fat-free mass.

Risk factors in adolescence tend to persist in the adult age, contributing to the establishment of coronary disease in increasingly younger age groups. Moreover, as this study was able to establish that the prevalence of cardiometabolic risk factors is increasing, and it is an issue that is affecting children and adolescents worldwide, irrespective of developed or industrialized countries.

5. Conclusion

The results of this study show that high levels in body fat percent are associated to cardiometabolic risk factors in children, adolescents, and young adults in the city of Bucaramanga, Colombia. An appropriate anthropometric evaluation can identify individuals at risk, allowing to begin an early intervention to promote healthy lifestyles that include an increase in physical activity, decrease of practices that demand inactivity time (use of videogames, electronic devices, computers, TV, etc), balanced diets with nutritional content that is appropriate according to the age, adaptation of public areas for healthy recreation, and improvement in the access to health services that allow to diagnose and treat the pathologies derived from those risks during the early stages.

One of the limitations of this study was the lack of cut-off points established for the pediatric and adolescent population. Having personnel trained in measurement of skinfolds was identified as strength. This allowed the reduction of biases in those measurements as a poor technique might cause erroneous data and figures. Studies about cardiometabolic risk factors related to percentage body fat in pediatric and adolescent population are scarce; therefore, this paper may be considered as a contribution to the literature related to children's health.

Declarations

Ethics approval and consent to participate

The research was conducted in accordance with guidelines established by the Declaration of Helsinki. Consent for participation in the surveys was obtained by contact center prior to enrollment (Fundación Cardiovascular de Colombia–FCV). The ethics committee in health research at the Fundación Cardiovascular de Colombia determined that the analyses of these de-identified data were exempt from review.

Consent for publication

Not applicable.

Availability of data and materials

All data analyzed during this study are available and can be requested from the main author by request.

Competing interests

The authors declare that they have no real or potential conflicts.

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Authors' contributions

NCS, DPS, ARS co-designed the study, EGD, DCQL co-prepared the databases and co-performed the statistical analyzes. DCQL, EGD and NCS interpreted the results and prepared, wrote and reviewed the submitted final draft of the manuscript. All authors reviewed the manuscript and approved the final version.

Authors' information

Does not apply.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijpam.2019.06.004.

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