Metabolic syndrome and associated factors in a population-based sample of schoolchildren in Colombia: The FUPRECOL Study

By

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Abstract

In contrast to the definition of metabolic syndrome (MetS) in adults, there is no standard definition of MetS in pediatric populations. We aimed to assess the differences in the prevalence of MetS in children and adolescents aged 9–17 years in the city of Bogota (Colombia) using four different operational definitions for these age groups and to examine the associated variables. A total of 673 children and 1,247 adolescents attending public schools in Bogota (54.4% girls; age range 9–17.9 years) were included. The prevalence of MetS was determined by the definitions provided by the International Diabetes Federation (IDF) and three published studies by Cook et al., de Ferranti et al., and Ford et al. The prevalence of MetS was 0.3%, 6.3%, 7.8%, and 11.0% according to the IDF, Cook et al., Ford et al., and de Ferranti et al. definitions, respectively. The most prevalent components were low high-density lipoprotein cholesterol and high triglyceride levels, whereas the least prevalent components were abdominal obesity and hyperglycemia. Overall, the prevalence of MetS was higher in obese than in non-obese schoolchildren. In conclusion, MetS diagnoses in schoolchildren strongly depend on the definition chosen. These findings may be relevant to health promotion efforts for Colombian youth to develop prospective studies and to define which cut-offs are the best indicators of future morbidity.

Key words: Prevalence; Inflammation; Obesity; Cardiovascular disease.

Introduction

Cardiometabolic risk factors that originate in childhood and increase the risk of early morbidity and mortality, such as obesity, elevated blood pressure, insulin resistance, abnormal glucose metabolism and dyslipidemia (elevated triglyceride levels and low HDL cholesterol), can be traced from childhood into adulthood (Selassie et al. 2011; Von Eyben et al. 2003). This cluster of findings in youth is identical to the characteristics of adult metabolic syndrome (MetS) (Despres 2003). The prevalence of MetS is common in overweight youth, affecting approximately 30% of overweight (BMI $\geq 95^{th}$ percentile) children and adolescents in the United States (Cook et al. 2003). The presence or absence of MetS in an individual is determined by genetic components that predispose the subject to the disorder as well as environmental factors, such as physical inactivity and poor eating habits, that enhance its development (Agudelo et al. 2014).

The diagnosis of MetS in children and adolescent depends *de facto* on the chosen definition, with higher rates of MetS identification when insulin is part of the definition and when child-specific cut-off points for metabolic indicators are used (Ice et al. 2009). Ford et al. (2008) published a systematic review on 27 publications about MetS in children and adolescents. In these 27 publications, 40 unique definitions of MetS were used, generally following adaptations of the definitions provided by the World Health Organization (WHO 2008), the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) (Grundy et al. 2009), the European Group for the study of Insulin Resistance (EGIR) (Balkau et al. 1999) adult guidelines and the International Diabetes Federation (IDF) (Zimmet et al. 2007). Other definitions have included more liberal cut-off points, such as the ones proposed by de Ferranti et al. (2004), Cook et al.

(2003), and Ford et al. (2008), as well as other components to evaluate, such as obesity, as in Agudelo et al. (2014).

Currently, there is no gold standard definition of MetS in children and adolescents; however, a description of the prevalence of MetS according to the few proposed pediatric definitions is necessary for different populations around the world (Suárez-Ortegón et al. 2013). MetS develops progressively with age according to changes in puberty, and its prevalence increases with obesity (Celik et al. 2010). Additionally, in children and adolescents, low-grade systemic inflammation has been shown to be associated with MetS (Lambert et al. 2004). Because persistently increased inflammation in youth may provide an early warning for later risk of cardiovascular disease, it is important to precisely characterize the relationship between this inflammation, excess weight, and metabolic syndrome in pediatric populations. However, few studies in low- and middle-income countries have investigated cardiovascular risk factors in youth (Cook et al. 2003; Lopez-Jaramillo et al. 2011; Ramírez-Vélez et al. 2011a; Ramírez-Vélez et al. 2011b). Such early detection would enable the introduction of targeted interventions aimed at reducing cardiometabolic risk in youth and subsequent morbidity. By applying definitions to our preexisting dataset of Latin American youth, we aimed to assess the differences in prevalence of MetS in adolescents aged 9–17 years in Bogota, Colombia, using four different definitions for this age group and to examine the associated variables.

Methods

Study population

The schoolchildren selected for this study participated in the FUPRECOL study (*in Spanish* ASOCIACIÓN DE LA **FU**ERZA **PRE**NSIL CON MANIFESTACIONES DE

RIESGO CARDIOVASCULAR TEMPRANAS EN NIÑOS Y ADOLESCENTES **COL**OMBIANOS). The FUPRECOL study seeks to establish the general prevalence of cardiovascular risk factors (anthropometric, metabolic and genetic markers) in the study population (children and adolescents aged 9 to 17.9 years living in Bogota, Colombia) (Ramírez-Vélez et al. 2015; Prieto-Benavides et al. 2015) and to examine the relationships between physical fitness levels and cardiometabolic risk factors (Rodríguez-Bautista et al. 2015).

FUPRECOL study assessments were conducted during the 2014–2015 school year. The sample consisted of children and adolescents (n = 4000 boys and n = 4000 girls) aged 9–17.9 years. In a subgroup of 2,775 schoolchildren, parameters of biomarkers were also assessed, and a more comprehensive health and lifestyle assessment was conducted. From this subgroup, 1,922 schoolchildren (54.4% girls, n=675 children and n=1,247 adolescents) had valid data for the anthropometric and blood parameter assessments and were consequently included in this study. All schoolchildren were of a low-middle socioeconomic status (SES, 1–3 on the scale of 1-6 defined by the Colombian government) and were enrolled in public elementary and high schools (grades 5 through 11) in the capital district of Bogota, in the Cundinamarca Department in the Andean region. This region is located at approximately 4°35′56″N 74°04′51″W and at an elevation of approximately 2,625 meters (min: 2,500; max: 3,250) above sea level. Bogota is considered an urban area, with approximately 7,862,277 inhabitants (DANE 2007). A convenience sample of volunteers was recruited and grouped by sex and age based on 1-year intervals (9 groups total). Exclusion factors included a clinical diagnosis of cardiovascular disease or diabetes mellitus 1 and 2, pregnancy, use of alcohol or drugs, and not having lived in Bogota for at least 1 school year. Exclusion from the study was

made effective *a posteriori*, without the students being aware of their exclusion to avoid any undesired situations.

Measurement anthropometrics

Anthropometric variables were measured by a Level 2 anthropometrist who was certified by the International Society for the Advancement of Kinanthropometry (ISAK) in accordance with the ISAK guidelines (Marfell-Jones et al. 2007). Variables were collected at the same time in the morning, between 7:00 and 10:00 a.m., following an overnight fast. Subjects' body weight was measured when they were in underwear and did not have shoes on, using electronic scales (Tanita® BC544, Tokyo, Japan) with a low technical error of measurement (TEM = 0.510). Height was measured using a mechanical stadiometer platform (Seca® 274, Hamburg, Germany; TEM = 0.019). BMI was calculated as the body weight in kilograms divided by the square of the height in meters. Waist circumference was measured at the midpoint between the last rib and the iliac crest using a tape measure (Ohaus® 8004-MA, New Jersey, USA; TEM = 0.086). Fat mass percentage was estimated using a BC-418 bioimpedance analysis system (Tanita Corp., Tokyo, Japan, TEM = 0.639). The mean of two readings obtained in the morning was used; the measurements were conducted under controlled temperature and humidity conditions after urination and a 15-minute rest, with children shoeless and in fasting condition. The obesity phenotype was determined according to the cut-offs used to define BMI percentiles by the International Obesity Taskforce (Cole et al. 2000).

Resting blood pressure

After the tests and blood draw, diastolic and systolic blood pressure (DBP; SBP) were determined as the average of two measurements separated by a five-minute interval,

with the child resting for at least five minutes before the first measurement. Children were seated in a quiet, calm environment with their right arm in a semi-flexed position at heart level. Blood pressure was measured automatically using the Tanita® BC544 (Tanita, Tokyo, Japan, TEM = 0.598).

Pubertal stage

Sexual maturation was classified based on Tanner staging (Tanner and Whitehouse 1976), which uses self-reported puberty status to classify participants into five stages (I to V) (Matsudo and Matsudo 1994). The volunteers individually entered an isolated room where they categorized the development of their own genitalia (for boys), breasts (for girls), armpits (for boys) and pubic hair (for both genders) using a set of images exemplifying the various stages of sexual maturation. The data were recorded on paper by the FUPRECOL evaluators.

Biochemical assessments

Blood samples were collected between 6:00 and 8:00 am by two experienced pediatric phlebotomists after at least 12 hours of fasting. Before sampling, fasting was confirmed by the child and his or her parents. Blood samples were obtained from an antecubital vein, and analyses were subsequently completed within 1 day of collection. The levels of triglycerides (TG), total cholesterol (TC), cholesterol linked to high-density lipoproteins (HDL-c) and glucose were measured using colorimetric enzymatic methods with a CardioChek analyzer. The fraction of cholesterol linked to low-density lipoproteins (LDL-c) was calculated using the Friedewald formula (Friedewald et al. 1972). High-sensitivity C-reactive Protein (CrP) was obtained using the turbidimetric method with SMART, a Spanish analyzing tool.

Diagnosis of MetS

The prevalence of MetS and its components were evaluated according to four definitions provided by Cook et al. (2003), de Ferranti et al. (2004), Ford et al. (2007), and IDF (2007). The IDF defines MetS as the presence of abdominal obesity plus two other components, whereas the other four groups of authors defined it as the presence of three or more components out of five possible that combine the criteria and cut-off points of the WHO (2008) and the National Cholesterol Education Program Adult Treatment Panel III (Grundy et al. 2009). The characteristics and cut-off points for the diagnosis of MetS are in Table 1.

**** Insert Table 1 ****

Ethics Statement

The Review Committee for Research on Human Subjects at the University of Rosario [Code Nº CEI-ABN026-000262] approved all of the study procedures. A comprehensive verbal description of the nature and purpose of the study and its experimental risks was provided to the participants and their parents/guardians. This information was also sent to parents/guardians by mail. Written informed consent was obtained from parents and subjects before participation in the study. The protocol was in accordance with the latest revision of the Declaration of Helsinki and current Colombian laws governing clinical research on human subjects (Resolution 008430/1993 Ministry of health).

Statistical Analysis

The results are presented as the mean (standard deviation) or relative frequency as a percentage. Differences between sex and/or pubertal stage were assessed by analysis

of variance (ANOVA) with the use of Bonferroni's correction for *post hoc* multiple comparisons when significant differences were found. The prevalence of MetS was calculated for each definition in the total sample by gender, age, pubertal stage, and weight status; the associations between these factors were conducted by the chi-squared test (X^2). We further examined the associations between each MetS definition in the total sample and individual risk factors using robust multiple linear regression adjusted for gender, age, pubertal stage and weight status in all participants. All analyses were conducted using IBM SPSS 21 (SPSS, Inc., Chicago, Illinois, USA). The level of statistical significance was established at $p<0.05$.

Results

The descriptive characteristics of the participants are presented in Table 2. The ANOVA analysis showed that girls had higher levels of BMI and fat mass than boys, whereas males had higher levels of abdominal obesity. Regarding cardiometabolic risk factors, boys had higher SBP and glucose levels than girls, whereas females showed higher levels of HDL-c, LDL-c, TC and TG ($p<0.05$). Lastly, no significant differences were found between sexes in the TG/HDL-c ratio or CrP levels.

**** Insert Table 2 ****

Table 3 describes the study population in terms of the anthropometric variables and prevalence of MetS. The prevalence of MetS was 0.3%, 6.3%, 7.8%, and 11.0% according to the IDF, Cook et al., Ford et al., and de Ferranti et al. definitions, respectively. Few youth fulfilled the five MetS criteria (0.2% using Cook et al.'s and Ford et al.'s definitions and 0.6% using de Ferranti et al.'s and IDF's definition), and 42.6% (Cook et al.), 30% (de Ferranti et al.), 36.2% (Ford et al.), and 53.4% (IDF) met no criteria at all.

**** Insert Table 3 ****

Based on gender, in boys, the prevalence of high blood pressure (according to all four definitions), fasting glucose and low HDL-c levels (all definition) were significantly higher, whereas high triglycerides levels were more prevalent in girls. Moreover, obese youth had higher prevalence rates in all components by different cut-off points. Lastly, no significant differences were found between pubertal stage specific cut-off points for MetS components, except in WC (Ferranti et al. definition) and high blood pressure (Cook et al., Ford et al., and Ferranti et al. definition) (Table 4).

**** Insert Table 4 ****

Figure 1 shows the results of the adjusted logistic regression analysis (the IDF definition was not included because of the limited number of subjects who met the criteria). Once the adjustment was performed (by age, gender, pubertal status and CrP), the predisposing specific cut-off points for MetS components included obesity in all definitions and age (9-12 years old) using the Ford et al.'s definition.

**** Insert Figure 1 ****

Discussion

The use of different definitions has led to significant discrepancies in the overall MetS prevalence in youth and also hinders comparisons across studies. Our study revealed that the prevalence of MetS ranged between 0.3% and 11.4% depending on the definition employed. The most prevalent components were low HDL-c and high TG levels. Additionally, obesity predicted higher prevalence of MetS in all definitions.

Comparing our results with a similar Colombian study on adolescents from Medellin, the prevalence was generally similar, with a slightly higher prevalence in Cook

et al.'s (6.2% vs 3.8% in adolescents from Medellin) and Ford et al.'s (7.8% vs 4.1% in adolescents from Medellin) definitions (Agudelo et al. 2014). The number of children and adolescents who were diagnosed with MetS was significantly lower according to the IDF definition, whereas the de Ferranti et al. and Ford et al. definitions identified the highest prevalence. The IDF criteria use a cut-off that is normally used in adults, which may explain their lower estimate of MetS prevalence. In our population, between 30.0% and 53.4% had none of the five metabolic risk factors. Additionally, confirming the findings of other Latin studies, regardless of the definition used, the most prevalent components of MetS were hypertriglyceridemia and low HDL-C, and the least frequent were hyperglycemia and high abdominal obesity (Suárez-Ortegón et al. 2013; Rodriguez-Moran et al. 2004). On the other hand, a study that included Latino adolescents residing in the United States showed a greater prevalence of abdominal obesity and low HDL-C (Ventura et al. 2008), which would suggest that the environmental characteristics of each population may account for the differences between the findings (Jones 2006).

Evidence suggests a higher prevalence of MetS in older children compared to younger children (Friend et al. 2013). Our results conflict with most of the prevailing epidemiologic evidence, as children (9-12 years) had a higher prevalence of MetS than adolescents (13-17 years) using Ford et al.'s definition. Confirming our results, another study on Mexican youth reported a higher prevalence in the group of individuals aged 7–14 years compared with the prevalence in 15–24 year olds. Additionally, Reinehr et al. (Reinehr et al. 2007) found that the relationship between age and MetS was only observed in boys and not girls. The findings of the present study could be due to the group of 9–12 year olds who had a higher prevalence of overweight-obesity (6.3%) than the group of 13–17 years (2.8%).

Published studies have shown that obesity (particularly abdominal obesity) and related comorbid conditions are the most predominant correlates of cardiometabolic risk, regardless of the definition used; it is not surprising that the increasing prevalence of MetS is consistent with the dramatic increase in obesity among youths (Reinehr et al. 2007). Our results found that youth with obesity were more likely to have MetS compared to their non-obese peers, independent of the definition. However, MetS is not simply a consequence of obesity; it should be noted that lean individuals also had at least one risk factor (6.2% to 7.7%). As suggested by Falkner et al. (2002), the presence of one metabolic risk factor should prompt screening for additional clinical abnormalities. Therefore, not only the obese population but the lean young population should also be included in policies for early detection and prevention of MetS.

Finally, most studies on youth have not conclusively confirmed that CrP is associated with cardiovascular disease risk factors (Ford 2003), especially if corrected for BMI (Moran et al. 2005). A study in 403 Chinese children revealed that higher levels of CrP were related with MetS and lipid metabolism (Chen et al. 2014), but the relationship weakened when the analysis was adjusted for BMI. Our findings showed that a higher level of CrP did not predict MetS in any definitions after adjusting for age, gender, pubertal stage, and weight status. Therefore, the present results together with other studies may suggest that inflammation, as assessed by CrP, is not an independent parameter related to MetS.

The present study was limited by the lack of data regarding ethnicity, physical activity, physical fitness and family history of cardiometabolic disease, which could have enabled more robust adjustments. A second limitation of this study was it is a cross-sectional design, which does not establish evident cause-effect relationships. The third

limitation was that no measurements were taken of other components of metabolic health, such as diet (micronutrients and macronutrient intake in particular) and birth weight, which may contribute to cardiometabolic risk factors. The strengths of our study include that it presents a possible first evaluation of a population of schoolchildren and that it used a multivariate analysis to verify independence in the evaluated associations.

In summary, our study suggests that the prevalence of MetS differs depending on the proposed definitions. Additionally, the results showed the importance of obesity as a determinant of pediatric MetS in Colombian youth independent of the pubertal stage and inflammation in all definitions. However, although the prevalence of MetS was higher in obese individuals, it is also necessary to include non-obese peers in policies that target the early detection and prevention of MetS.

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Table 1. Components and cutoff points for the diagnosis of MetS among children and adolescents

Components	Cook et al. 2003	de Ferranti et al. 2004	Ford et al. 2007	IDF consensus definition 2007
Abdominal obesity (waist circumference)	≥ 90th percentile (age and sex specific)	≥ 75th percentile (age and sex specific)	≥ 90th percentile (age and sex specific)	≥ 90th percentile (age and sex specific)
High triglyceride Levels	> 110 mg/dL	> 100 mg/dL	> 110 mg/dL	> 150 mg/dL
Low HDL-C Levels	≤ 40 mg/dL	< 50 mg/dL	≤ 40 mg/dL	≤ 40 mg/dL
High fasting glucose levels	≥ 110 mg/dL	≥ 110 mg/dL	≥ 100 mg/dL	≥ 100 mg/dL
High blood pressure (mmHg)	≥ 90th percentile (age and sex specific)	≥ 90th percentile (age and sex specific)	≥ 90th percentile (age and sex specific)	SBP ≥ 130 mmHg *or* DBP ≥ 85 mmHg
MetS definition	Presence of three or more criteria	Presence of three or more criteria	Presence of three or more criteria	High waist circumference + two other criteria

IDF, International Diabetes Federation; HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index.

Table 2. Physical and anthropometric characteristics and lipid profile in the sample

Variable	Boys (n=877)	Girls (n=1045)	P value
Age, y	13.3 (2.4)	13.4 (2.3)	0.717
Height, cm	155.5 (14.2)	150.7 (9.4)	0.001
Weight, kg	47.7 (12.6)	46.2 (10.5)	0.003
BMI, kg/m^2	19.4 (2.9)	20.2 (3.2)	0.001
Fat mass (%)	15.8 (6.8)	23.8 (6.2)	0.001
Weight status %, (n)			
Underweight	13.4 (114)	15.6 (159)	0.001
Normal weight º	68.4 (583)	55.0 (562)	0.001
Overweight	12.8 (109)	23.0 (235)	0.006
Obese	5.4 (46)	6.4 (65)	0.820
Waist circumference, cm	65.4 (7.4)	63.5 (7.2)	0.001
Pubertal stage, % (n)			
I-II	33.5 (286)	35.5 (363)	0.305
III	36.5 (311)	37.4 (382)	0.304
IV-V	30.1 (256)	27.1 (277)	0.152
SBP, mm Hg	116.7 (18.4)	111.9 (15.1)	0.001
DBP, mm Hg	69.6 (13.0)	69.2 (11.8)	0.450
HDL-c, mg/dL	47.2 (12.2)	48.4 (12.1)	0.030
LDL-c, mg/dL	77.1 (27.1)	83.4 (26.1)	0.001
TC, mg/dL	141.5 (31.2)	150.7 (30.1)	0.001
TG, mg/dL	84.9 (38.1)	93.4 (42.6)	0.001
TG/HDL-c ratio, mg/dL	2.0 (1.3)	2.1 (1.4)	0.060
Glucose, mg/dL	85.4 (17.3)	83.0 (17.7)	0.003
CrP, mg/dL	1.3 (2.4)	1.1 (2.2)	0.148

Data are shown in mean (SD)
Significant between-sex differences (ANOVA one way test or χ^2)
BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure; HDL-c, cholesterol linked to high density lipoproteins; LDL-c, cholesterol linked to low density lipoproteins; TC, total cholesterol; TG, triglycerides; CrP, C-reactive protein

Table 3. Anthropometric description of the Colombian schoolchildren according to MetS definitions

Components	Cook et al. 2003	de Ferranti et al. 2004	Ford et al. 2007	IDF consensus definition 2007
Total	6.2 (119)	11.0 (211)	7.8 (150)	0.3 (6)
Gender				
Boys	5.6 (49)	9.8 (86)	7.9 (69)	0.1 (1)
Girls	6.8 (71)	12.0 (125)	7.7 (80)	0.5 (5)
Age (years)				
9-12	6.4 (43)	12.8 (86)	10.0 (67)	0.4 (3)
13-17	6.2 (74)	9.9 (119)	6.6 (79)	0.2 (2)
Pubertal stage				
I-II	6.6 (46)	12.4 (87)	8.5 (59)	0.3 (2)
III	5.6 (40)	9.6 (69)	8.3 (59)	0.4 (3)
IV-V	6.5 (31)	10.9 (52)	6.5 (31)	0.2 (1)
Weight status				
Underweight	4.9 (13)	9.0 (24)	2.7 (7)	0.1 (1)
Normal weight	5.5 (64)	9.6 (112)	6.2 (72)	0.4 (5)
Overweight	9.9 (33)	15.3 (51)	12.5 (42)	0.6 (2)
Obese	5.5 (8)	17.4 (27)	29.4 (45)	0.6 (1)
Number of components (%)				
0	42.6	30.0	36.2	53.4
1	33.2	34.5	35.7	30.7
2	17.0	23.5	19.5	12.2
3	6.0	8.8	7.1	3.4
4	1.0	2.5	1.4	0.3
5	0.2	0.6	0.2	0.1

Data are shown in % (n)

Significant difference between groups with same letter (test χ^2)

Table 4. Prevalence of MetS and its components by gender, obesity, pubertal stage and C-reactive protein in children and adolescents

Components[a]	Gender				Obesity			Sexual maturation (stage)				C-reactive protein		
	Total	Boys	Girls	P-value	Yes	No	P-value	I-II	III	IV-V	P-value	Percentile $< 75^{th}$	Percentile $\geq 75^{th}$	P-value
WC percentile														
$\geq 75^{th}$	3.6 (69)	4.8 (42)	2.6 (27)	0.009	13.7 (67)	0.4 (6)	<0.001	5.3 (37)	2.7 (20)	2.8 (13)	0.017	48.9 (705)	51.1 (245)	<0.001
$\geq 90^{th}$	0.5 (10)	0.8 (7)	0.3 (3)	0.087	2.1 (10)	0.1 (1)	<0.001	0.9 (6)	0.4 (3)	0.2 (1)	0.088	0.6 (9)	1.3 (6)	0.214
High fasting glucose levels														
≥ 100 mg/dL	7.1 (136)	7.7 (68)	6.6 (69)	0.336	7.5 (37)	6.8 (98)	0.671	6.2 (43)	7.2 (54)	8.2 (39)	0.184	3.4 (49)	1.5 (7)	0.281
≥ 110 mg/dL	15.7 (302)	17.5 (153)	14.3 (149)	0.060	16.6 (81)	15.4 (221)	0.552	16.1 (112)	13.8 (103)	17.9 (86)	0.487	10.0 (144)	3.7 (18)	0.214
High triglyceride levels														
> 100 mg/dL	26.5 (509)	21.8 (191)	30.4 (318)	<0.001	42.3 (206)	21.4 (307)	<0.001	25.6 (179)	26.6 (198)	27.5 (131)	0.476	5.3 (76)	18.1 (87)	0.221
> 110 mg/dL	20.5 (394)	16.4 (144)	23.9 (250)	<0.001	34.1 (166)	16.2 (232)	<0.001	20.5 (143)	20.1 (150)	20.9 (100)	0.902	4.5 (65)	14.4 (69)	0.410
> 150 mg/dL	8.1 (156)	6.4 (56)	9.5 (99)	0.016	14.6 (71)	6.1 (87)	<0.001	9.0 (63)	8.0 (60)	6.8 (33)	0.165	4.1 (59)	5.9 (28)	0.151
Low HDL-c levels														
≤ 40 mg/dL	28.2 (542)	31.2 (247)	25.7 (269)	0.009	36.3 (177)	25.8 (370)	<0.001	21.1 (147)	30.5 (228)	34.1 (163)	<0.001	14.9 (215)	8.3 (40)	<0.001
≤ 50 mg/dL	51.0 (980)	52.1 (457)	50.2 (525)	0.424	63.1 (308)	47.4 (680)	<0.001	49.3 (344)	52.2 (389)	51.7 (247)	0.395	34.6 (499)	14.4 (69)	<0.001

High blood pressure (mmHg)														
≥ 90th percentile, SBP	20.2 (388)	22.8 (200)	18.0 (188)	0.006	26.8 (131)	17.9 (257)	<0.001	26.2 (183)	18.2 (136)	15.4 (74)	<0.001	16.5 (328)	6.0 (29)	0.252
≥ 90th percentile, DBP	15.5 (298)	15.2 (133)	15.8 (165)	0.668	21.7 (106)	13.6 (195)	<0.001	16.2 (113)	15.0 (112)	15.5 (74)	0.733	11.9 (171)	4.4 (21)	0.260
IDF cut points, SBP ≥ 130	12.4 (238)	16.6 (146)	8.8 (92)	<0.001	16.2 (79)	11.1 (159)	0.003	11.7 (82)	12.2 (91)	13.5 (65)	0.331	9.7 (140)	3.4 (16)	0.395
IDF cut points, SBP ≥ 85	6.7 (129)	8.3 (73)	5.3 (55)	0.008	9.4 (46)	5.9 (85)	0.008	4.0 (28)	7.1 (53)	9.3 (44)	<0.001	4.3 (62)	2.0 (10)	0.126

[a] % (n)

WC, waist circumference; HDL-c, high-density lipoprotein cholesterol

Significant difference between groups with same letter (test χ^2)

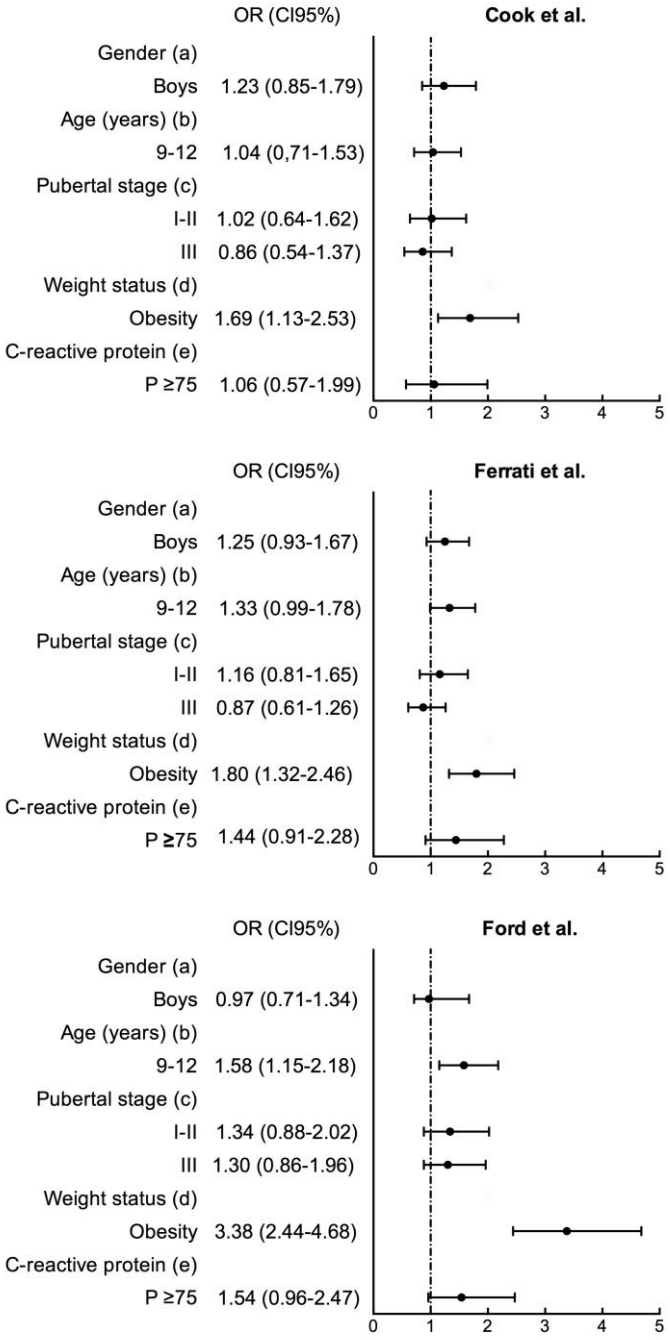

Figure 1. Factors associated with MetS components in Colombian children and adolescents. Reference groups were girls, 13-17 years old youths, normal weight youths, and <75 percentile of C-reactive Protein. OR, odds ratios; CI, confidence interval.