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Adiposity markers and cardiovascular risk in urban Colombian adolescents: Heterogeneity in association patterns

Milton Fabian Suárez-Ortegón[a,b,*], José Guillermo Ortega-Ávila[a,b], Jenny Elizabeth Ordóñez-Betancourth[c,d], Cecilia Aguilar-de Plata[a,b]

[a] Department of Physiological Sciences, Universidad del Valle, Cali-Colombia
[b] Nutrition Group, Universidad del Valle, Cali-Colombia
[c] School of Public Health, Universidad del Valle, Cali-Colombia
[d] Epidemiology and Population Health Group, Universidad del Valle, Cali-Colombia

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ABSTRACT

Objective. The aim of this study was to evaluate the relationship of tricipital (TS), abdominal (AS), subscapular (SS), and suprailiac (SIS) skinfolds, Body Mass Index (BMI), and Waist Circumference (WC) with 1) variables related to cardiovascular risk (CVR) and 2) the clustering of cardiovascular risk factors (CVRF) – referenced pediatric cut-off points – in a multivariate analysis.

Materials/Methods. The sample was 1672 adolescents. Glucose, lipid profile, blood pressure and anthropometric variables were measured.

Results. Adjusting for age, gender, and caloric intake, the highest quartile (Q4) of adiposity markers was associated to Q4 of biochemical and blood pressure variables. However, the association was not found for WC, SS and TS with glucose, and for diastolic blood pressure (DBP) with TS, SS, and SIS. Triglycerides Q4 was related to Q4 of SS, AS, and SIS after further adjustments, as well as HDL cholesterol (HDL-C) Q1 with Q4 of SS and AS. Glucose Q4 was associated to BMI, AS (Not adjusting for BMI and SIS), and SIS Q4 (Not adjusting for BMI and TS). LDL-Cholesterol (LDL-C) Q4 was associated to TS and SS Q4. The associations of LDL-C Q4 and HDL-C Q1 with WC Q4 were not significant after further adjustments. All the adiposity markers, except WC and TS, were associated to CVRF clustering in all the adjustments.

Conclusions. In the adolescents, subcutaneous fat from the trunk (SS, AS, SIS) was better and independently associated to CVR variables and with CVRF clustering than visceral fat (WC). Further research is required to explain the specificity in the described associations.

Abbreviations: BMI, Body mass index; WC, Waist circumference; DBP, Diastolic blood pressure; SBP, Systolic blood pressure; LDL-C, LDL cholesterol; HDL-C, HDL cholesterol; TG, Triglycerides; SS, Subscapular skinfold; SIS, Suprailiac skinfold; AS, Abdominal skinfold; TS, Tricipital skinfold; CVR, Cardiovascular risk; CVRF, Cardiovascular risk factors; Q4, Highest quartile; Q1, Lowest quartile.

* *Corresponding author*. Universidad del Valle (San Fernando). Calle 4B 36-00, Edificio 116, Quinto piso, Oficina 5003, Cali, Colombia. Tel.: +57 2 5185603.
E-mail address: fabian.suarezuv@gmail.com (M.F. Suárez-Ortegón).

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1. Introduction

Obesity is one of the main causes of increased risk of developing cardio-metabolic diseases and, currently, represents a public health problem [1]. The importance of this condition is particularly more critical during childhood because cardiovascular risk (CVR) and metabolic syndrome are increasingly more prevalent in pre-pubertal and pubertal populations, as well as overweight populations [2,3].

Adiposity parameters are well related to cardio-metabolic disease. Indirect adiposity indicators like body mass index (BMI) and waist circumference (WC) have shown prediction capacity for cardiovascular disease and type-2 diabetes, among other alterations and related disorders [4–6]. Likewise, total fat mass has been associated with the risk of these diseases [7]. However, exploration of the independent contribution of fat distribution or localized fat to CVR during early stages of life is equally necessary to characterize possible specific association profiles.

Studies evaluating the relationship between skinfolds and CVR markers are scarce and more so in pediatric populations; therefore, the aim of this study was to evaluate the relationship of skinfolds (tricipital, abdominal, subscapular, and suprailiac), and also of BMI and WC with 1) clinical and biochemical parameters related to cardio-metabolic risk and 2) the clustering (two or more) of cardiovascular risk factors (criteria for children and adolescents), in a multivariate analysis that included adjustment by each skinfold, BMI, and WC.

2. Material and methods

The sample consisted of adolescents from both genders aged 10–17 years from a cross-sectional population survey, the IFRECNTEC Study (Identification of risk factors for adult non-communicable chronic disease in schooled population)[8]. Informed written consent was obtained from both the parent and child. The study was reviewed and approved by the Ethics Committee at Universidad del Valle.

Blood was collected via venipuncture after an overnight fast. Fasting glucose, high-density lipoprotein cholesterol (HDL-C), and triglycerides were determined by using commercial kits (Biosystems Inc., Spain) in an automatic Biosystems analyzer (Biosystems Inc., Spain). Blood pressure was measured using mercury sphygmomanometers with an appropriately sized cuff in a sitting position after 15 min of rest. Phase I and V (disappearance) Korotkoff sounds were used to identify systolic blood pressure (SBP) and diastolic blood pressure (DBP)[9]. Body weight and height were measured using standard techniques and instruments [10]. Body mass index was calculated as weight/height^2 [11]. Waist circumference was measured from the midpoint between the lateral iliac crest and the lowest rib using a flexible steel tape measure [12]. The triceps skinfold, subscapular skinfold, abdominal skinfold and the supra-iliac skinfold were measured using skinfold calipers in the specific locations [10]. Normal BMI was estimated as a value below 85th percentile in tables from the Centers for Disease Control and Prevention (CDC) [13]. Nutritional intake was assessed by using a 24-h recall survey and dietary intake information was processed by using the CERES Software (Version 1.02, FAO 1997).

2.1. Cardiovascular risk factors (CVRF)

High levels of elevated blood pressure, LDL cholesterol (LDL-C), triglycerides and glucose, and low levels of HDL cholesterol (HDL-C) were part of the cardiovascular risk clustering. For lipid profile variables, the cutoff points used were the following: HDL-C < 35 mg/dL [14], LDL-C and triglycerides ≥ 130 mg/dL [15]. The cutoff point for high levels of fasting glucose was taken from guidelines by the International Diabetes Federation (≥ 100 mg/dL) [16]. Elevated systolic and/or diastolic blood pressure was defined as a value at or above the 90th percentile for age, gender, and height according to the National Heart Lung and Blood Institute (NHLBI) tables [17].

2.2. Data analysis

The majority of the variables presented an abnormal distribution. Study variables were described as median and their interquartile range and difference by gender were estimated via a Mann–Whitney U test. A first analysis consisted of logistic regressions to assess associations of upper quartiles of anthropometric/adiposity variables with upper quartiles of blood pressure and metabolic measurements (except HDL-C, lowest quartile (Q1)). Similarly, logistic regression was used for a second analysis to assess associations between upper quartiles of anthropometric/adiposity variables and the fact of having two or more CVRF (cut off points mentioned above). In both analyses, each association was adjusted for predetermined model (age, gender, caloric intake) and for each adiposity marker added to that model. For associations with diastolic (DBP) and systolic blood pressure (SBP), the adjustment also included height. Likewise, prevalence by gender of the number of risk factors was assessed and differences were estimated by χ^2. All analyses were processed by using STATA 11.0 software.

3. Results

In Table 1, variables of the study population are described in the whole group and by gender. Via Mann–Whitney U test, values of WC, caloric intake, fasting glucose, and of both blood pressures were significantly higher in boys, while all values of skinfold thickness, BMI, triglycerides, LDL-C, and HDL-C were higher in girls. A total of 14.5% (243 subjects) had a BMI above the normal range. No difference was found in the proportion of individuals by age groups between genders. Individuals with more than three CVR factors were not observed and no difference by gender was found in the number of CVR factors (Fig. 1).

Adjusting for age, gender, and caloric intake, the highest quartile (Q4) of adiposity markers was associated to the same quartile of biochemical and blood pressure variables, except for WC, SS and TS with fasting glucose, and for DBP with TS, SS and SIS (Table 2). When adiposity markers were added to the