Cardiorespiratory fitness and cardiometabolic risk factors in schoolchildren from Colombia: The FUPRECOL Study

By

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Abstract

The objectives of this study are to investigate the association between cardiorespiratory fitness and cardiovascular risk factors in schoolchildren and to evaluate the degree of association between overall and abdominal adiposity and cardiorespiratory fitness. A total of 1,875 children and adolescents attending public schools in Bogota, Colombia (56.2% girls; age range of 9–17.9 years). A cardiovascular risk score (Z-score) was calculated and participants were divided into tertiles according to low and high levels of overall (sum of the skinfold thicknesses) and abdominal adiposity. Schoolchildren with a high level of overall adiposity demonstrated significant differences in seven of the 10 variables analyzed (i.e. systolic and diastolic blood pressure, triglycerides, triglycerides/HDL-c ratio, total cholesterol, glucose and cardiovascular risk score). Schoolchildren with high levels of both overall and abdominal adiposity and low cardiorespiratory fitness had the least favorable cardiovascular risk factors score. These findings may be relevant to health promotion in Colombian youth.

Keyword

Cardiorespiratory fitness, adiposity, cardiovascular risk, schoolchildren

Cardiovascular risk factors that originate in childhood and increase the risk of early morbidity and mortality such as obesity, hypertension, insulin resistance and dyslipidaemia track from childhood into adulthood (Selassie & Sinha, 2011; Von Eyben et al., 2003; Kagawa et al., 2008; Despres 2012). Previous epidemiological cross sectional studies have suggested that individuals with a large accumulation of body fat in the abdominal region are at greater risk of development of the metabolic syndrome (Kaur 2014; Ashwell et al., 2014; González-Ruíz et al., 2015). Furthermore, the levels of cardiovascular risk in children and adolescents have increased over recent years, with the majority of studies associating this with the prevalence of obesity which has reached pandemic levels (Martínez-Gómez et al., 2010).

Health-related fitness and diet have been shown to be the main factors in the prevention of cardiovascular illnesses and obesity (Mozaffarian et al., 2015). Cardiorespiratory fitness (CRF) is a key determinant of health, and emerging evidence describes a direct relationship between poor CRF and increased cardiovascular risk in children (Díez-Fernández et al., 2014; Lobelo et al., 2010). There are a number of cross-sectional studies showing that low CRF in youth is independently associated with a higher cardiovascular risk (Andersen et al., 2006; Lobelo et al., 2010; Ruiz et al., 2006). In addition, longitudinal studies have shown that a healthy CRF in childhood and adolescence is associated with a healthier cardiovascular profile later in life (Ortega et al., 2008; Shah et al., 2016). These findings have been replicated in clinical adult populations with diabetes mellitus, hypertension, metabolic syndrome, and several types of cancer (LaMonte & Blair, 2006). In light of this evidence, it is of great concern that in recent decades, CRF appears to have declined in children and adolescents worldwide (Catley & Tomkinson, 2013; Garber et al., 2014). These trends have been observed against a background of increased, decreased or stable body mass index (BMI) within the same populations (Olds et al., 2006). Therefore, the prevention of infant obesity has become a priority in public health policies in many countries (Brown et al., 2015).

In this line, lower levels of health-related fitness may be related to unfavorable cardio-metabolic blood profiles (Machado-Rodrigues et al., 2014; Díez-Fernández et al., 2014; Lobelo et al., 2010; Martínez-Gómez et al., 2010). Recent studies that have attempted to evaluate how sedentary lifestyles are related with obesity and cardiovascular risk factors in children and adolescents have found contradictory results (Shah et al., 2016; Machado-Rodrigues et al., 2014; Houston & Boddy 2013). Nevertheless, few studies in low and middle income countries have investigated CRF and cardiovascular risk factors in children and adolescents (Gualteros et al., 2015; Machado-Rodrigues et al., 2014). Such early detection would allow the introduction of targeted interventions aimed at reducing cardiovascular risk in children and subsequent morbidity. Therefore, the objectives of this study are 1) to investigate the association between cardiorespiratory fitness and cardiovascular risk factors in schoolchildren, and 2) to evaluate the degree of association between overall and abdominal adiposity and cardiorespiratory fitness.

Methods

Study population

The schoolchildren selected for this study participated in the FUPRECOL study (*in Spanish* ASOCIACIÓN DE LA FUERZA PRENSIL CON MANIFESTACIONES DE RIESGO CARDIOVASCULAR TEMPRANAS EN NIÑOS Y ADOLESCENTES

COLOMBIANOS). 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; Rodríguez-Bautista et al., 2015; Prieto-Benavides et al., 2015) and examine the relationships between physical fitness levels and cardiometabolic risk factors.

The FUPRECOL study assessments were conducted during the 2014–2015 school year. The sample consisted of children and adolescents (boys n = 4,000 and girls n = 4,000) ages 9–17.9 years. In a subgroup of 2,775 schoolchildren, biomarkers parameters were also assessed and a more exhaustive health and lifestyle assessment was carried out. From this subgroup 1,875 schoolchildren (56.2% girls) showed valid data from the CRF, anthropometric and blood parameter assessments, and were consequently used in this study. All schoolchildren were of low-middle socioeconomic status (SES, 1–3 in a scale 1-6 defined by the Colombian government) and enrolled in public elementary and high schools (grades 5 through 11) in the capital district of Bogota, 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 clinical diagnosis of cardiovascular disease, diabetes mellitus 1 and 2, pregnancy, use of alcohol or drugs, 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 certified by the International Society for the Advancement of Kinanthropometry (ISAK) in accordance with the ISAK guidelines (Marfell-Jones et al. 2006). Variables were collected at the same time in the morning, between 7:00-10:00 a.m., following an overnight fast. Body weight of the subjects was measured when the subjects 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). Skinfold thicknesses were measured at the left side of the body to the nearest 0.1 mm using a Holtain skinfold caliper at the following sites: (1) triceps, halfway between the acromion process and the olecranon process (TEM = 0.598), and (2) subscapular, approximately 20 mm below the tip of the scapula, at an angle of 45º to the lateral side of the body (TEM = 0.607). Sexual maturation was classified based on Tanner staging (Tanner and Whitehouse, 1976), which uses self-reported puberty status to classify participants into stages I to V (Matsudo & Matsudo, 1994). Each volunteer 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 paediatric phlebotomists after at least 12 hours fasting. Before the extraction, fasting was confirmed by the child and his parents. Blood samples were obtained from an antecubital vein, and analyses were subsequently completed within 1 day from 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 using an Cardiocheck analyser. The fraction of cholesterol linked to low density lipoproteins (LDL-c) was calculated using the Friedewald formula (Friedewald et al., 1972). The C- reactive protein (hsCRP) were obtained using the turbidimetric method with SMART, Spain analysing equipment.

Cardiovascular risk assessment

We calculated a cardiovascular risk index (CVRI) as the sum of the age-sex standardized scores of WC, TG, HDL-c, systolic and diastolic blood pressure. The HDL-c value was then multiplied by -1 as this is inversely related to cardiovascular risk and finally, the standardised remainders (Z-score) of the 5 variables were added together. The higher the value in the CVRI, the higher the cardiovascular risk. The validity of this similar index has been previously tested using confirmatory factor analysis (Martínez-Vizcaíno et al., 2010) and these variables are used as criteria for the metabolic syndrome in youth (Steene-Johannessen et al., 2009).

Cardiorespiratory fitness

Testing procedures were consistent with international guidelines for school-based fitness assessment (https://sites.google.com/site/alphaprojectphysicalactivity/). At each school, a team of trained FUPRECOL evaluators administered the tests in partnership with the school´s physical education instructor. Testing was conducted in the school gymnasium or in areas where a hard surface was available. The CRF was assessed via the 20 m shuttle–run test (ml•kg^{-1}•min^{-1}) (Leger et al., 1988). Participants jogged or ran in a straight line between two lines 20 m apart while keeping pace with pre-recorded audio signals. The initial speed was 8.5 km/hour and increased by 0.5 km/hour each minute. The test was terminated if the participant failed to reach the end lines in time with the audio signals on two consecutive occasions or when the subject stopped because of self-reported fatigue. The results were recorded to the nearest stage (minute) completed. The equation of Leger et al. (Leger et al., 1988) was used to estimate the VO_{2peak}. To calculate the VO_{2peak} from the result of the 20 m shuttle-run test score, age (A; in years) and the final speed (S; corresponding to the stage speed = 8 + 0.5 per stage number, in km/h) were entered into the following formula (r = 0.7; for children and adolescents, from 8–19 years) VO_{2peak} (ml•kg^{-1}•min^{-1}) = 31.025 + 3.238 x S - 3.248 x A + 0.1536 x S x A. The reliability and validity of this test has been widely documented (Liu et al., 1992; Leger et al., 1984) and is considered a test of choice for population-based CRF assessments for Colombian schoolchildren (Ramírez-Vélez et al., 2015). All tests were conducted by a trained research team that provided standardized encouragement for participants during all test phases. The systematic error when the CRF assessments were performed twice (*n* = 229) was 0.217 SD of bias 0.811 [95% CI= -1.808% to 1.373%; *n* = 207] (Ramírez-Vélez et al., 2015). All standard operating procedures and protocols for CRF testing are available in the manual and videos on the ALPHA project website (https://sites.google.com/site/alphaprojectphysicalactivity/). Additionally, the evaluators provided visual models and examples before performing the test when necessary. Participants did not receive previous training on these tests.

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 given 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 mean (standard deviation) or relative frequency in percentage. Normality was assessed for all the variables and in those cases in which a normal distribution was not seen, a logarithmic transformation was carried out (ln). Differences between sex and tertiles were assessed by analysis of variance (ANOVA) with the use of Bonferroni's correction for *post hoc* multiple comparisons when significant differences were found, except for the CRF which was analysed using analysis of covariance (ANCOVA), adjusting it by sexual maturation. No significant interactions were seen between sex and the other variables used in the study so the analysis for boys and girls was carried out together to achieve better statistical strength. The associations between the CRF and adiposity with the cardiovascular risk factors (WC, SBP, DBP, TC, TG, HDL-c, LDL-c, glucose and usCRP) were assessed using ANCOVA dividing the sample according to CRF cut-off values for children and adolescents that were known as the healthy fitness zones (healthy, needs improvement and health risk) (Welk et al., 2011). The FITNESSGRAM® (Welk et al., 2011) has been shown to have cardiometabolic health predictive value (Welk et al., 2011), and

VO_{2peak} cut-off points were validated against the presence of metabolic syndrome using nationally representative U.S. data (Lobelo et al., 2010). In addition, tertiles (T3, high) of general adiposity (sum of 2 skinfolds) and abdominal adiposity (waist circumference) adjusting the differences for age, sex and sexual maturation. The associations of CRF and adiposity with the CVRI were assessed using ANOVA. In this case, there were no adjustments made as this index was previously standardized for the confounding variables. The combined influence of CRF and the level of adiposity in the CVRI was analysed by dividing the sample into 4 groups (2 groups for adiposity x 2 groups according to healthy fitness zones by CRF), obtaining the differences between the groups using ANOVA. All the analyses were carried out using the IBM SPSS 21 (SPSS, Inc., Chicago, Illinois, USA). The level of statistical significance was established in $p < .05$.

Results

The descriptive characteristics for the adolescents are presented in Table 1. The ANOVA analysis showed that girls had generally higher levels of adiposity and BMI than boys, whilst males had higher levels of abdominal obesity. With cardiovascular risk factors, boys had higher SBP and glucose levels than girls, whilst females showed higher levels of HDL-c, LDL-c, TC and TG. No significant differences were found between sexes for the cardiovascular risk index, TG/HDL-c ratio or usCRP levels. Lastly, shuttles and VO_{2peak} were higher in boys than in girls and the proportion of subjects with a low CRF, suggestive of future cardiometabolic risk (health risk/need improve FITNESSGRAM category) was 39.1% (39.6% for boys and 39.3% for girls; χ^2 $p = .503$).

The ANOVA analysis showed significant differences ($p = .050$) in the CVRI and CRF zones. Nevertheless, there were no significant differences in the cardiometabolic risk factors, degree of general adiposity and abdominal adiposity between CRF zones. Table 3 shows the differences in cardiovascular risks depending on the level (tertil) of general adiposity and abdominal adiposity. The ANCOVA analysis showed how schoolchildren with a higher level of general adiposity (Tertile 3) have higher levels of SBP, DBP, LDL-c, HDL-c, TG, TG/HDL-c ratio, glucose and CVRI. Furthermore, schoolchildren with a high adiposity adiposity demonstrated significant differences in nine of the 10 variables analyzed (i.e. SBP, DBP, HDL-c, LDL-c, TC, TG, TG/HDL-c ratio, glucose, usCRP and CVRI).

INSERT TABLE 2 HERE

Upon dividing the sample into 2 groups according to the level of general adiposity (tertile), and into 2 groups according to the CRF zones (healthy and needs improvement/health risk), significant differences were seen (F=5.458; $p<.001$) in the CVRI value (Figure 1A). Similarly, when the sample was divided into 2 groups in keeping with the abdominal adiposity and CRF zones, significant differences were also observed (F=4.569; $p<.001$) in the CVRI (Figure 1B). In both sets of analysis it was seen that amongst the schoolchildren with high levels of both overall and abdominal adiposity and low CRF had the least favorable CVRI.

INSERT FIGURES 1

Discussion

The results obtained in this study reflect a marked sexual dimorphism in the body composition of the boys and girls in our study with significant differences in regards to adiposity levels. Whereas the girls showed a more general adiposity, the boys were more inclined to upper abdominal adiposity. These results agree with the findings of Wijnhoven et al. (2013) and Cadenas-Sanchez et al. (2015). The mean BMI values of the girls were higher than those of the boys, which coincides with previous research (Cousminer et al., 2016). As also observed by Prenkert and Ehnfors (2016), these differences in BMI values could be explained by the fact that physical and sexual development occurs earlier in girls than in boys.

In regards to weight, significant differences were found between sexes. There was a higher prevalence of normal weight in the boys. In contrast, the girls had higher rates of underweight and overweight. These results differ from those of Mladenova and Andreenko (2015), who studied a population of 878 Bulgarian children and adolescents. Their study found higher levels of overweight and obesity in boys in comparison to girls who had a higher prevalence of underweight. These differences could be due to different eating habits (typical of each population group), different ethnic origin, different inclusion criteria, or differences in the criteria used to define underweight, normal weight, overweight, and obesity.

On the other hand, low cardiorespiratory fitness is regarded as a major risk factor for cardiovascular disease (Kodama et al. 2009). The results of the ANCOVA analysis revealed that the girls had higher levels of LDL-c, TC and TG. In combination with lower VO_2 peaks and lower shuttle-run scores, this resulted in a lower metabolic and capacity of adaptation to the programmed activity. Cardiorespiratory fitness thus had to be more frequently improved in girls than in boys, as shown in the FITNESSGRAM® evaluation. These findings contrast with the results obtained by Elmaoğulları & Demirel (2015) in their research on a population of 823 Turkish adolescents. Despite the fact that this study found a higher proportion of dyslipidemia among male adolescents, boys obtained higher values for the variable Health

Risk in this evaluation, which coincides with the results of other studies (Stabelini et al., 2011; Agostinis et al., 2015).

The extent to which CRF influences lipid metabolism is similar to that of general adiposity. Overweight and obesity is generally associated with an increased risk for cardiovascular disease, whereas cardiorespiratory fitness has a beneficial effect on the cardiovascular system. Significant differences were observed between the CVRI and CRF of the subjects in the variables, Healthy, Health Risk, and Needs Improvement. Nevertheless, there were no significant differences in the factors of general adiposity, abdominal adiposity, and the different CRF zones. These results differ from those of Bailey et al. (2015) in their study of 147 school children, 10-14 years of age, in which an association was found between CRF and cardiometabolic risk mediated by abdominal adiposity.

In reference to cardiovascular risk, depending on the degree of general and abdominal adiposity, our results showed that the school children with a higher level of general adiposity (tertile 3) also had higher levels of SBP, DBP, LDL-c, HDL-c, TG, TG/HDL-c ratio, glucose, and CVRI. Similar results were obtained by Gishti et al. (2015), who studied a population of 6,523 schoolchildren and concluded that higher levels of general adiposity were associated with an increased cardiovascular risk at young ages, independently of BMI. Moreover, children with a high level of abdominal adiposity showed significant differences in 9 of the 10 variables analyzed (SBP, DBP, HDL-c, LDL-c, TC, TG, TG/HDL-c ratio, glucose, usCRP, and CVRI). This coincides with Toemen & Jaddoe (2015), who studied these same variables in a population of 4338 schoolchildren in Rotterdam (the Netherlands).

Furthermore, when the sample was divided into two groups, based on the level of general and abdominal adiposity and in two groups, depending on the CRF zones, significant differences were observed in the CVRI values. As in Reilly & Kelly (2011), these differences could be due to the worse values obtained for the cardiometabolic risk factors studied. These results coincide with Araújo et al. (2015), whose study of 719 subjects found that there was a close relation between general and abdominal adiposity levels and both current and previous cardiometabolic risk profiles. Thus, results might be influenced by factors related to age and puberty.

Other studies that applied FITNESSGRAM® categorized subjects according to sex- and age-dependent criterion reference standards, either being within the healthy fitness zone or not (Welk et al. 2011 and Garber et al. 2014). These standards were derived from a large US sample (Welk et al. 2011). To avoid bias due to different ethnical and social backgrounds, we decided to treat FITNESSGRAM® results as continuous variables. Mentioned studies by Morrow et al. (2013) and Marques et al. (2015) report a between time spent in moderate to vigorous physical activity and higher odds to achieve the healthy fitness zone. In our study, CVRI tasks were inversely correlated with cardiorespiratory fitness and also with body dimensions. It is likely that children with high levels of cardiorespiratory fitness participate in activities that train both, aerobic capacity as well as strength, both of which lower cardiovascular risk.

This study had some limitations. First, this study includes participants from only a single region in Colombia; therefore, inferences to all Colombian children and adolescents should be made cautiously. According to the ethics guidelines, study participation was voluntary, which may lead to a bias in the selection of study participants. Second, we have not considered the potential impact of recognized determinants such as socio-economic, dietary and ethnic factors that modulate growth and levels of adiposity and CRF. The third limitation of the existing research was that no measurements were taken of other components of metabolic health, such as diet [particularly, micronutrients and macronutrient intake], birth weight which may contribute to cardiovascular risk factors. This is an area for future research. However, such limitations do not compromise the results obtained when validating our results. The strengths of our study concern a possible first evaluation in a population of schoolchildren the use of a combined influence of abdominal adiposity analysis to verify independence in the CRF.

In conclusion, the schoolchildren with a high degree of general and abdominal adiposity, as well as a low cardiorespiratory capacity, were those who obtained the worst scores for the different cardiovascular risk factors analyzed. As cardiovascular disease begins in childhood, prevention should start as early in life as possible with a focus on CRF. The results of this study reflect the relevance and impact that fat deposits can have on the health of the Columbian population of children and adolescents in our study.

Declaration of Conflicting Interests

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Table 1. Physical and anthropometric characteristics, lipid profile, and cardiorespiratory fitness in the sample.

Variables	**Boys (*n* = 853)**	**Girls (*n* = 1022)**	***p***
Age, y	13.3 (2.4)	13.4 (2.3)	.717
Height, cm	155.5 (14.2)	150.7 (9.4)	.001
Weight, kg	47.7 (12.6)	46.2 (10.5)	.003
BMI, kg/m^2	19.4 (2.9)	20.2 (3.2)	.001
Weight status n,(%)*			
Underweight	114 (13.4)	159 (15.6)	.001
Normal weight	583 (68.4)	562 (55.0)	.001
Overweight	109 (12.8)	235 (23.0)	.006
Obese	46 (5.4)	65 (6.4)	.820
Waist circumference, cm	65.4 (7.4)	63.5 (7.2)	.001
Triceps skinfolds, mm	14.8 (5.6)	19.7 (6.0)	.001
Subscapular skinfolds, mm	13.1 (6.2)	17.1 (7.3)	.001
Sum of 2 skinfolds, mm	28.0 (11.0)	36.8 (12.5)	.001
Sexual maturation (tanner stage) I/II/III/IV/V, %	5/37/28/23/7	16/21/30/29/5	
SBP, mm Hg	116.7 (18.4)	111.9 (15.1)	.001
DBP, mm Hg	69.6 (13.0)	69.2 (11.8)	.450
HDL-c, mg/dL	47.2 (12.2)	48.4 (12.1)	.030
LDL-c, mg/dL	77.1 (27.1)	83.4 (26.1)	.001
TC, mg/dL	141.5 (31.2)	150.7 (30.1)	.001
TG, mg/dL	84.9 (38.1)	93.4 (42.6)	.001
TG/HDL-c ratio, mg/dL	2.0 (1.3)	2.1 (1.4)	.060
Glucose, mg/dL	85.4 (17.3)	83.0 (17.7)	.003
usCRP, mg/dL	1.3 (2.4)	1.1 (2.2)	.148
Cardiometabolic risk index, Z-score	-0.911 (0.873)	-0.977 (0.811)	.067
VO_{2peak} ($ml \bullet kg^{-1} \bullet min^{-1}$)[a]	44.5 (5.1)	39.4 (4.6)	.001
Shuttles (total count)	40.4 (21.6)	23.4 (12.4)	.001
Running speed at last completed shuttle ($km \bullet h^{-1}$)	10.7 (1.2)	9.8 (0.8)	.001
Complete stage (number)	5.4 (2.4)	3.5 (1.5)	.001
FITNESSGRAM (CRF fitness zones) n,(%)*[b]			
Healthy	515 (60.4)	620 (60.7)	.393
Needs improvement	164 (19.2)	215 (21.0)	.387
Health risk	174 (20.4)	187 (18.3)	.503

Data are shown as mean (standard deviation) and frequencies* in brackets represent the proportion of the total sample with data for each variable.
Significant between-sex differences (ANOVA one way test or Chi-square; *$p < .001$; **$p < .01$).
[a] VO_{2peak} ($ml \bullet kg^{-1} \bullet min^{-1}$) predicted using the Leger et al equation (1988).
[b] To classify VO_{2peak}, we used the 2011 FITNESSGRAM® standards and Healthy Fitness Zones (Welk et al., 2011)
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; usCRP, C-reactive protein.

Table 2. Difference in cardiovascular risks depending on the level (tertil) of general adiposity and abdominal adiposity.

Variables	General Adiposity (Sum of 2 Skinfolds, mm)				Abdominal Adiposity (Waist circunference, cm)			
	Tertile 1 (*n* = 626)	**Tertile 2 (*n* = 614)**	**Tertile 3 (*n* = 635)**	***p***	**Tertile 1 (*n* = 626)**	**Tertile 2 (*n* = 614)**	**Tertile 3 (*n* = 635)**	*p*
SBP, mm Hg	112.7 (16.9)	114.5 (17.1)	115.4 (16.8)	.012	110.4 (15.7)	113.9 (17.0)	117.9 (17.4)	.001
DBP, mm Hg	67.1 (10.7)	69.6 (12.4)	71.9 (13.7)	.001	66.6 (10.6)	69.4 (12.0)	72.2 (13.7)	.001
HDL-c, mg/dL	50.1 (12.2)	47.8 (12.0)	45.4 (11.8)	.001	52.6 (12.5)	46.8 (11.4)	44.3 (11.0)	.001
LDL-c, mg/dL	85.3 (16.3)	82.5 (17.5)	84.3 (18.9)	.017	83.2 (25.5)	78.1 (25.9)	80.3 (28.8)	.003
TC, mg/dL	145.3 (30.2)	145.5 (31.5)	149.0 (31.2)	.067	152.5 (29.0)	142.8 (29.4)	144.2 (33.3)	.001
TG, mg/dL	79.5 (33.6)	89.1 (37.3)	101.5 (48.1)	.001	81.3 (33.6)	89.1 (37.3)	98.0 (48.3)	.001
TG/HDL-c ratio, mg/dL	1.75 (1.12)	2.06 (1.28)	2.45 (1.54)	.001	1.70 (1.06)	2.09 (1.27)	2.42 (1.56)	.001
Glucose, mg/dL	79.1 (26.1)	79.7 (27.9)	83.1 (26.5)	.015	83.6 (16.6)	84.1 (18.1)	84.7 (17.8)	.523
usCRP, mg/dL	1.12 (2.71)	1.06 (2.03)	1.28 (1.94)	.479	0.97 (2.44	1.05 (2.24)	1.41 (2.25)	.031
Cardiometabolic risk index, Z-score	-0.982 (0.474)	-0.809 (0.519)	-0.576 (0.577)	.001	-1.138 (0.427)	-0.794 (0.450)	-0.464 (0.529)	.001

Data are shown as mean (standard deviation).
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; usCRP, C-reactive protein.

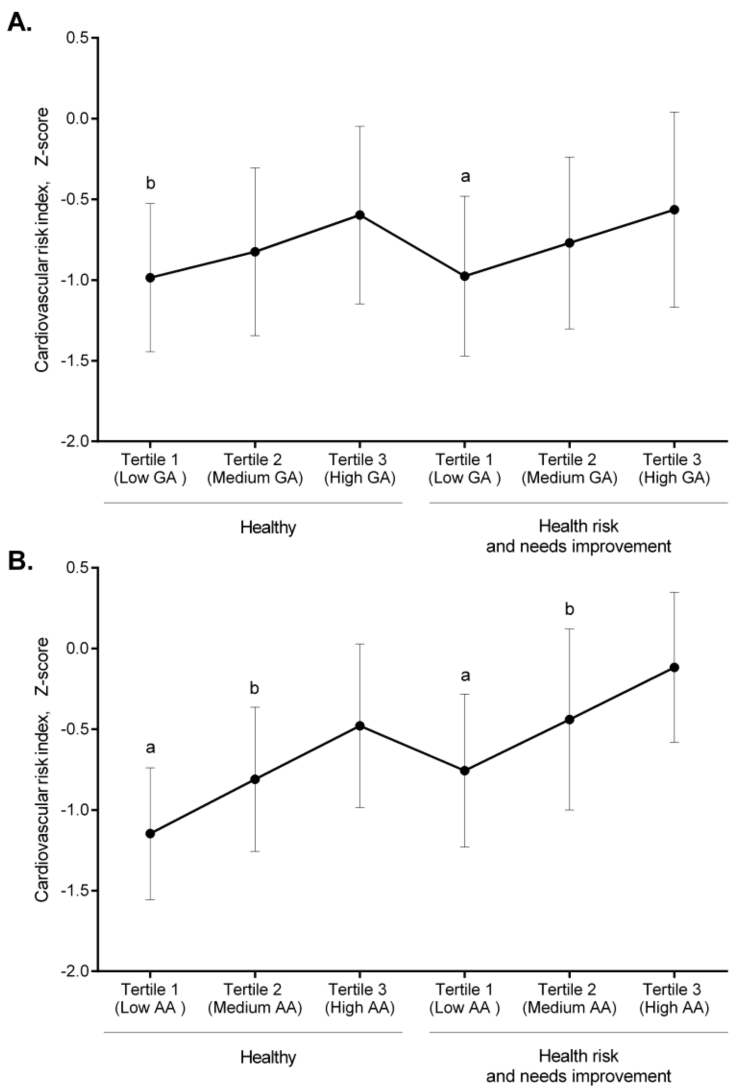

Figure 1. A) Combined influence of general adiposity (sum of 2 skinfolds) and CRF zones over cardiovascular risk index (Z-score) in schoolchildren. The significant differences express with regards the group with a CRF healthy and general adiposity. The error bars represent a SD in the measuring. B) Combined influence of general adiposity (sum of 2 skinfolds) and CRF zones over cardiovascular risk index (Z-score) in schoolchildren. The significant differences express with regards the group with a CRF healthy and general adiposity. The error bars represent a SD in the measuring. $^{a}p < .01$ $^{b}p < .05$