Validity and reliability of the International FItness Scale (IFIS) in a population-based sample of schoolchildren in Bogota, Colombia: The FUPRECOL Study

By

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Abstract

The International FItness Scale (IFIS) is a self-reported measure of physical fitness that could easily. This scale has been validated in children, adolescents, and young adults; however, it is unknown whether the IFIS represents a valid and reliable estimate of physical fitness in Latino-American youth population. In the present study we aimed to examine the validity and reliability of the IFIS on a population-based sample of schoolchildren in Bogota, Colombia. Participants were 1,875 Colombian youth (56.2% girls) aged 9 to 17.9 years old. We measured adiposity markers (body fat, waist-to-height ratio, skinfold thicknesses and BMI), blood pressure, lipids profile, fasting glucose, and physical fitness level (self reported and measured). Also, a validated cardiometabolic risk index was used. An age- and sex-matched sample of 229 Schoolchildren originally not included in the study sample fulfilled IFIS twice for reliability purposes. Our data suggest that both measured and self-reported overall fitness were associated inversely with adiposity indicators and a cardiometabolic risk score. Overall, schoolchildren who self-reported "good" and "very good" fitness had better measured fitness than those who reported "very poor" and "poor" fitness (all $p<0.001$). Test–retest reliability of IFIS items was also good, with an average weighted Kappa of 0.811. Therefore, our findings suggest that self-reported fitness, as assessed by IFIS, is a valid, reliable, and health-related measure, and it can be a good alternative for future use in large studies with Latin-schoolchildren from Colombia.

Keywords: Youth population; physical fitness; questionnaires; risk factors; self-report.

Introduction

Physical fitness is a multi-dimensional construct that includes skill- and health-related components in which cardiorespiratory fitness (CRF) and muscular fitness, in particular, are powerful determinants of health in youth[1]. Previous large cohort studies have shown physical fitness (i.e CRF) as an independent risk factor of cardiovascular disease (CVD) risk[2], exceeding even that of other classic factors regarding CVD such as dyslipidaemia, hypertension, smoking or obesity[3,4]. Likewise, muscular strength in both men and women represents a different and independent predictor of cardiometabolic disease[5] in young people adolescents[6,7]. In addition, Ruiz et al.[8] reported in a systematic review the relationship between neuromotor fitness (measures of muscular strength, flexibility, speed of movement and coordination) and health outcomes. For example, in children and adolescents neuromotor fitness was positively related to systolic blood pressure and inversely to the sum of four skinfolds.

Nevertheless, either due to the level of complexity involved in estimating physical fitness or the testing team, the accessories for taking metabolic rate, ventilation and cardiovascular function measurements and the specialized technical handling, several authors have described easily-administered instruments which do not require sophisticated material, have a good confidence level and are/have been validated by self-report scales or questionnaires[9]. This methodological issue has been approached by researchers working on the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study who developed a self-report questionnaire regarding physical fitness called the International FItness Scale (IFIS)[10]. The IFIS, a short and simple scale, available in nine different languages, including Spanish, has shown good reliability and validity in adolescents from nine European countries[10], and recently also in Spanish young adults (18–30 years)[11] and Spanish children (9–12 years)[12]. Moreover, the IFIS questionnaire has shown to be strongly associated with CVD risk factors[10,11] even in Spanish women with fibromyalgia[13]. Therefore, the studies shown that IFIS is a valid and reliable instrument to measure physical fitness levels in several populations.

However, the lack of instruments and studies in Spanish for evaluating physical fitness hampers establishing the current status of this important health indicator regarding the Latin population, especially in Colombia. Although the studies noted above have previously shown the validity of IFIS questionnaire, the authors claimed that there is a need to investigate the validity and reliability of this instrument of self-reported physical fitness in other countries and populations[14]. To the best of our knowledge, no studies have evaluated validity and reliability of the IFIS questionnaire outside Europe. Therefore, the present study expands the knowledge regarding the application of IFIS questionnaire in Latin populations[15] examine the validity and reliability of the IFIS on a population-based sample of schoolchildren from Bogota, Colombia.

Materials and methods

Study design and main study sample (FUPRECOL Study)

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)[15,16] and examine the relationships between physical fitness levels and cardiometabolic risk factors[17].

The FUPRECOL study assessments were conducted during the 2014–2015 school year. The sample consisted of children and adolescents (boys n= 4000 and girls n= 4000) ages 9–17.9 years. In a subgroup of 2,144 schoolchildren, IFIS, anthropometric and adiposity variables 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 IFIS, 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[18]. A convenience sample of volunteers was recruited and grouped by sex and age based on 1-year intervals (9 groups). 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.

Study design and sample of the reliability study (Engativa, Bogota)

The test–retest study was conducted in a separate age-matched sample of Colombian children and adolescents from Engativa district, north of Bogota. A total of 229 participants (boys n= 124 and girls n= 105) aged 9 to 17.9 years old successfully completed

IFIS on two occasions (1 week apart) and were included in the reliability study. In addition, after the retest of IFIS was done, physical fitness was measured in this sample from FUPRECOL Study battery fitness. The sample size for both validation and reliability was enough according to estimations of several studies[10-13].

Self-reported fitness

Self-reported fitness was assessed by IFIS, originally validated in nine European countries and languages (HELENA study)[10] (http://www.helenastudy.com/IFIS). IFIS consists of a Likert-type scale (range 1–5) with five response options (very poor, poor, average, good, and very good) about perceived overall fitness, and its main components: cardiorespiratory fitness (CRF), muscular strength, speed and agility, and flexibility. IFIS showed “high” validity and “moderate” to “good” reliability in young adults[11,14] and scholarchildren from Spain[10,12].

Anthropometric and adiposity variables

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[19]. 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. For bioelectrical impedance analysis (BIA) measurements, a classical bipolar technique was used to estimate body fat (%) using a BIA-TANITA® Model BF689 (Tanita, Tokyo, Japan; TEM = 0.639) according to the manufacturer's instructions. The mean of two readings taken in the morning under controlled temperature and humidity conditions, after urination and a 15-minute rest with the child being shoeless and fasting was used.

Physical fitness

These parameters were measured as described previously and specific aspects regarding the validity and reliability have been reported elsewhere[15,20]. CRF, was assessed by the 20-m shuttle run test[20]. Participants 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 per minute. The test was finished when the participant failed to reach the end lines keeping pace with the audio signals on two consecutive occasions or when the subject stopped because of fatigue. The results were recorded to the nearest stage (minute) completed. Muscular fitness was assessed using two tests: a) the standing broad jump (lower limb explosive strength assessment). The schoolchildren stood behind the starting line and was instructed to push off vigorously and jump as far as possible. The participant had to land with the feet together and stay upright. The test was repeated twice, and the best score was retained to the nearest 0.1 cm, as the distance between toes at take-off and heels at landing or whichever body part landed nearest to the take-off spot, and b) handgrip test (maximum handgrip strength assessment) using a standard adjustable handle analogue handgrip dynamometer T-18 TKK SMEDLY III® (Takei Scientific Instruments Co., Ltd, Niigata, Japan). Pupils were given a brief demonstration and verbal instructions for the test and if necessary the dynamometer was adjusted according to the child's hand size according to predetermined protocols. Handgrip strength was measured with the subject in a standing position with the shoulder adducted and neutrally rotated and arms parallel but not in contact with the body. The participants were asked to squeeze the handle for a maximum of 3-5 seconds, but no verbal encouragement was given during the test. Two trials were allowed in each limb and the average score recorded as peak grip strength (kg). Thus, the values of handgrip strength presented here combine the results of left- and right-handed subjects, without consideration of hand dominance[21].

Speed-agility test (speed of movement, agility and coordination assessment), were measured using the 4 × 10 shuttle run test. The participant ran as fast as possible from the starting line to the other line and returned to the starting line, crossing each line with both feet every time. This was performed twice, covering a distance of 40 m (4x10 m). Every time the schoolchildren crossed any of the lines, he/she should pick up (the first time) or exchange (second and third time) a sponge that had earlier been placed behind the lines. The stopwatch was stopped when the adolescent crossed the end line with one foot. The time taken to complete the test was recorded to the nearest tenth of a second. A slip-proof floor, four cones, a stopwatch and three sponges were used to perform the test.

Flexibility was assessed by sit and reach test. Participants were asked to sit on the floor with legs out straight ahead. Feet with shoes off were placed with the soles flat against the test device and shoulder-width apart. Both knees were held flat against the floor. With hands on top of each other and palms facing down, the patient reached forward along the measuring line as far as possible. The measuring stick on the device has the zero mark at 25 cm before the feet. The result was recorded directly from the meter on the device.

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 condition was confirmed by the child and 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 a Cardiocheck analyzer. The fraction of cholesterol linked to low-density lipoproteins (LDL-c) was calculated using the Friedewald formula[22]. The precision performance of these assays was within the manufacturer's specifications.

Cardiometabolic risk assessment

We calculated a cardiometabolic risk index (CMRI) as the sum of the age-sex standardized scores of WC, TG, HDL-c, glucose, systolic and diastolic blood pressure. The HDL-c value was then multiplied by -1 as this is inversely related to cardiovascular risk. An age adjusted continuous cardiometabolic risk score (composite z-score) was calculated for each participant as follows:

Composite z-score= z- WC+z-triglycerides+z-iHDL-C+z-glucose+z-SBP+zDBP

The components of the score were selected on the basis of the International Diabetes Federation[23] and the modified De Ferranti et al.[24] definitions of metabolic syndrome. The higher the value in the CMRI, the higher the cardiovascular risk. All cut-off values were based on data international school children[25,26,27].

Sexual maturation

Sexual maturation was classified based on Tanner staging[28], which uses self-reported puberty status to classify participants into stages I to V[29]. 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.

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 test–retest reliability of the IFIS was examined by weighted Kappa coefficient, which is more appropriate when dealing with ordered categorical data[30] and internal consistency of scales was assessed by calculating Cronbach's alpha. The ratings system developed by Landis and Koch[31] was used to interpret reliability and internal consistency results, where 0.81 to 1.00 represents almost perfect agreement/consistency, 0.61 to 0.80 represents substantial agreement/consistency, 0.41 to 0.60 represents moderate agreement/consistency, 0.21 to 0.40 represents fair agreement/consistency, 0.00 to 0.20 represents slight agreement/consistency, and <0.00 represents poor agreement/consistency. The capacity of the IFIS to correctly rank Colombian youths into appropriate physical fitness levels was determined by means of analysis of variance without any adjustment and after adjustment [analysis of covariance (ANCOVA)] for sex, age and sexual maturation. Measured fitness variables were entered as dependent variables and self reported fitness variables as fixed factors. We studied the association of self-reported with body fat and

CMRI by means of ANCOVA after adjustment for sex, age and sexual maturation. All the analyses were carried out using the IBM SPSS 21 (SPSS, Inc., Chicago, Illinois, USA). The level of statistical significance was established in $p<0.05$.

Results

The distribution of the answers of the IFIS for the five question responses were shifted to the right in both genders, with a low percentage of participants reporting to have a very poor or poor fitness level (Figure 1). Schoolchildren reporting average, good, and very good CRF, muscular fitness, speed and agility, and flexibility had a better measured CRF, muscular fitness, speed and agility, and flexibility, respectively, compared with participants reporting very poor or poor fitness levels (Table 1).

Table 2 shows the test–retest reliability statistics in children and adolescents from Engativa, Colombia for the five items that compose the IFIS, i.e., overall fitness and four main fitness components: CRF, muscular strength, speed and agility, and flexibility. Weighted Kappa ranged from 0.775 (handgrip) to 0.847 (standing long jump), and the averaged weighted Kappa was 0.811.

Figure 2 shows a dose–response relationship between self-reported and measured CRF, speed and agility, flexibility and muscular fitness. Participants reporting high level self-reported had a better measured CRF, MF, speed and agility, and flexibility, respectively, compared with schoolchildren reporting very poor and poor fitness levels (all $P<0.001$).

Figure 3 shows the association of self-reported fitness with CMRI and body fat. We observed an inverse association of CRF, muscular fitness, speed and agility, and flexibility with body fat (Figure 3a). Lastly, the CMRI score Figure 3b shows that a high level of self-reported is related to a lower CVD risk.

Discussion

The purpose of the present study was to examine the validity and reliability of the IFIS questionnaire on a population-based sample of schoolchildren in Bogota, Colombia. The main finding of this study was that IFIS demonstrated substantial validity and test-retest reliability for ranking among schoolchildren assessed according to their objectively measured physical fitness level. Also, CRF, muscular fitness, speed and agility, and flexibility self-reported by IFIS were negative associated with lower CVD and adiposity risk in the schoolchildren investigated.

Regarding the examination of the validity of IFIS in schoolchildren, our results showed significant differences in the measured physical components (CRF, muscular fitness, speed and agility, and flexibility) between schoolchildren reporting poor and very poor levels and those reporting average, good, and very good levels. These results are in agreement with the studies of HELENA project, which demonstrated that IFIS self-report questionnaire has good validity in different populations [10-12]. In this sense, Ortega et al.[10] in 3528 adolescents aged 12.5 - 17.5 years from nine European countries showed that youths that reporting good or very good fitness had better measured fitness compared with those reporting poor and very poor fitness level. In this study, in general, a linear dose-response relationship between self-reported and measured fitness was observed[10]. In another study of 276 young adults (18-30 years), Ortega et al.[11] observed that participants reporting good/very good cardiorespiratory fitness, muscular fitness and flexibility had a better measured CRF, muscular fitness and flexibility, respectively, compared with participants reporting poor/very poor fitness[11].

Similarly to previous findings, there was a dose-response association between self-reported and measured CRF and flexibility, whereas the dose-response association between self-reported and measured muscular fitness was lineal only when muscular fitness was expressed in absolute values[11]. In addition, in Spanish children aged 9-12 years, Sánchez-López et al.[12] observed that participants reporting average, good and very good CRF, muscular fitness, speed and agility, and flexibility had better measured CRF, muscular fitness, speed and agility, and flexibility respectively, compared with those reporting very poor and poor fitness level. Also, dose-response associations between self-reported and measured CRF, speed and agility, flexibility as well as muscular fitness when expressed in absolute terms were observed [12]. Moreover, even in a very specific population, such as women with fibromyalgia, the IFIS has shown good validity[13]. The test-retest reliability of the IFIS observed in the present study, weighted Kappa ranged from 0.775 to 0.847 (averaged weighted Kappa= 0.811) could be considered good agreement in our population. The reliability of IFIS observed in our results is higher when compared to test-retest coefficients observed in previous studies which analyzed Spanish children (9-12 years) (average Kappa= 0.70), adolescents from different European countries (Kappa coefficients ranging from 0.54 to 0.65), Spanish young adults (18-30 years) (average Kappa= 0.70), and Spanish women with fibromyalgia (average Kappa= 0.45). Differences between studies may have been due to population characteristics, meaning that it would be interesting to replicate the study in other populations and carry out future confirmatory studies analyzing the scale's validity and reliability. Therefore, the present results suggest that IFIS is a very reliable tool to be used in Latin-schoolchildren from Bogota, Colombia.

It has been shown that physical fitness (i.e. CRF) as an independent risk factor of cardiovascular disease (CVD) risk[2]. In addition, it has been also demonstrated that neuromotor fitness is also associated with health outcomes, such as systolic blood pressure and sum of four skinfolds[8]. Therefore, the feasibility of physical assessment in environments in which time, equipment or qualified personnel are not available is crucial in order to identify CDV risk factors[1]. In this context, physical fitness questionnaires, such as IFIS may be very useful because self-reported fitness levels has been associated with CDV risk factors in different populations[10,11,12]. Thus, our study shows that measured and reported very good CRF fitness was inversely associated with CMRI and percentage of body fat, confirming previous studies in children[12], young adults[11], and adolescents[10] that also used IFIS questionnaire. In study of Ortega et al.[10], self-reported fitness were inversely associated with adiposity parameters (BMI, waist-to-height and fat mass index). These authors also showed that very good overall, CRF and speed and agility fitness were inversely associated with lower levels of total cholesterol, HDL cholesterol, triglycerides, HOMA, mean blood pressure and C-reactive protein. Taking together these results suggest that IFIS can be considered a useful method to investigate cardiometabolic risk accordingly with self-reported physical fitness.

It can be noted that, to date, one of this study's strengths has been that it is one of the first validity studies concerned with a Latin population, explicitly describing the conceptual framework from which IFIS was applied, together with measuring its metric properties. The present study has limitations. Although we investigated the validity and reliability of IFIS in schoolchildren in a Latin country, more studies are need for additional cross-validation testing in different ethnics of South-America and other regions. In addition, the present data can be affected by average fitness level of the region since all the schoolchildren assessed were recruited from the same region of Colombia. Although the instrument is not removed from the problems inherent in all self-report instruments, such as their sensitivity to social prejudice, convenience and coherence, it has been shown that the IFIS questionnaire is reliable in terms of estimating youth physical fitness. However, it is important to point out that the present study advanced the current knowledge regarding the validity and reliability of IFIS because we investigated these issues in a very large sample from a different country than those where IFIS was previously investigated.

In summary, our results show that IFIS has validity for ranking Latin-schoolchildren according to their directly measured physical fitness level. In addition, the present study also showed that IFIS has good test-retest reliability in this population. Furthermore, a high level of self-reported physical fitness was associated to a lower CVD and adiposity risk in schoolchildren from Bogota, Colombia.

Figure legend

Figure 1. Distribution of the answers for the five questions of the International FItness Scale (IFIS) of schoolchildren in Bogota, Colombia: The FUPRECOL Study, (n= 2144, 979 boys and 1165 girls). CRF, cardiorespiratory fitness; MF, muscular fitness; SP-AG, speed and agility; FLEX, flexibility; and Overall, overall physical fitness.

Figure 2. Validity of objective measured physical fitness according to self-reported physical fitness categories (IFIS) in schoolchildren in Bogota, Colombia: The FUPRECOL Study. Data represented means and 95% confidence intervals. All z-scores were sex and age specifically computed. a p=0.050 "good" vs "very good", b p=0.001 "average" vs "very good", c "poor" vs "very good" p=0.001, d p=0.001 "very poor" vs "very good". All z-scores were sex and age specifically computed.

Figure 3. Comparison between self-reported fitness and measured fitness for cardiorespiratory fitness, flexibility, muscular strength (Upper and lower body) and speed-agility in schoolchildren in Bogota, Colombia: The FUPRECOL Study. Data represented means and 95% confidence intervals. $^{\neq}P<0.01$ for all.

Table 1. Means and standard error (SE) of measured physical fitness by self-reported physical fitness categories in Colombian children and adolescents, The FUPRECOL Study (n= 2,144)

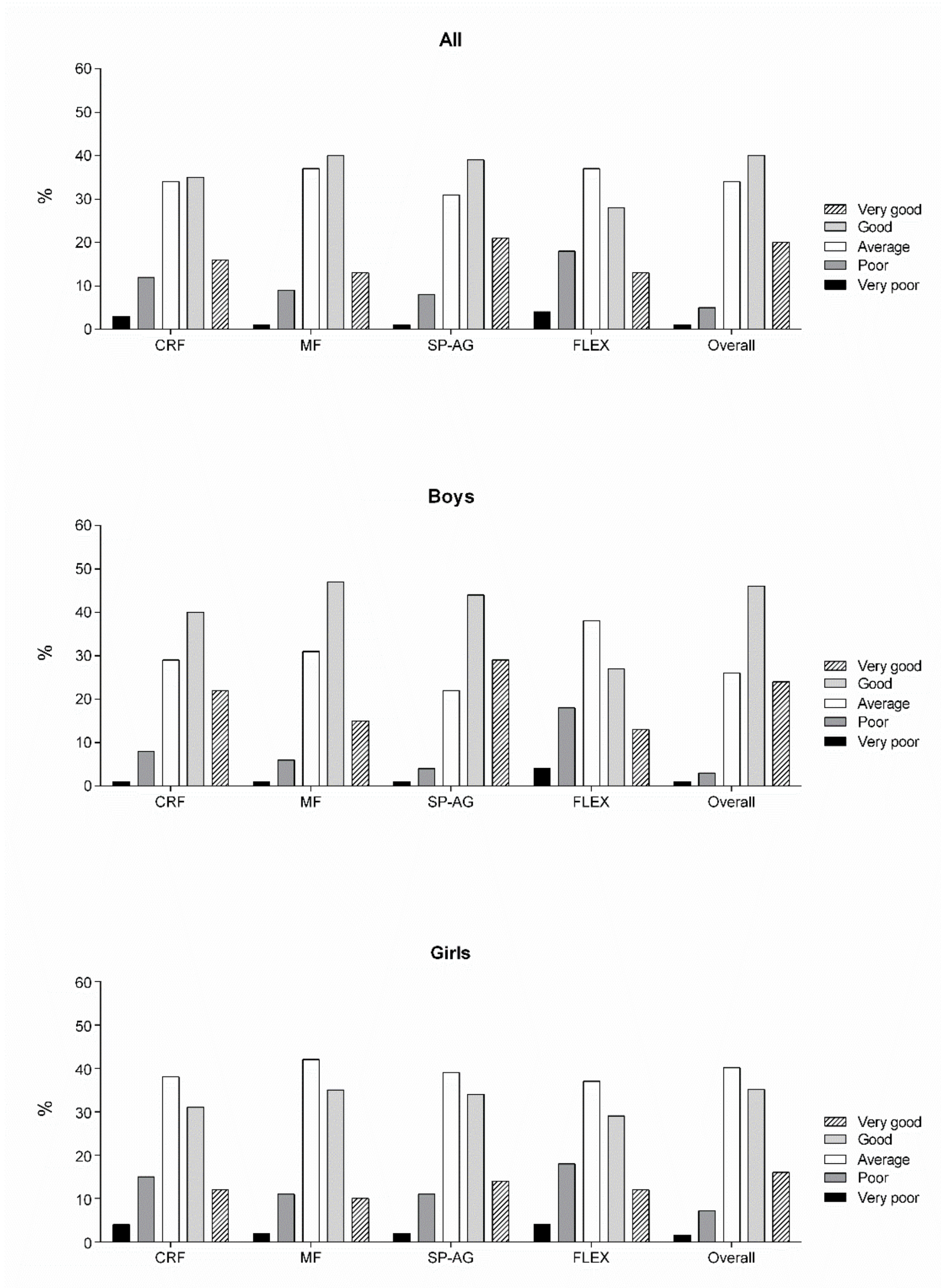
Components[a]	Very poor (1)	Poor (2)	Average (3)	Good (4)	Very good (5)	P-value	Pair-wise comparisons[c]			
							1-2	2-3	3-4	4-5
20-m shuttle run (stage)	3.0 (0.2)	2.9 (0.1)	3.3 (0.1)	3.7 (0.1)	4.2 (0.1)	<0.001	0.039	<0.001	<0.001	<0.001
Handgrip (kg)	24.1 (0.6)	25.8 (0.4)	28.3 (0.6)	30.5 (2.4)	31.8 (5.4)	<0.001	<0.001	<0.001	<0.001	<0.001
Standing-long jump (cm)	118.7 (3.1)	117.2 (1.4)	121.7 (0.6)	124.3 (0.5)	131.3 (1.5)	<0.001	0.002	<0.001	<0.001	<0.001
Shuttle run 4x10m (s)[b]	15.7 (0.5)	15.2 (0.2)	14.9 (0.1)	14.3 (0.1)	13.4 (0.1)	<0.001	0.377	0.483	<0.001	<0.001
Sit and reach (cm)	19.8 (0.9)	21.7 (0.4)	21.3 (0.2)	27.7 (0.1)	29.8 (0.2)	<0.001	0.044	<0.001	<0.001	<0.001

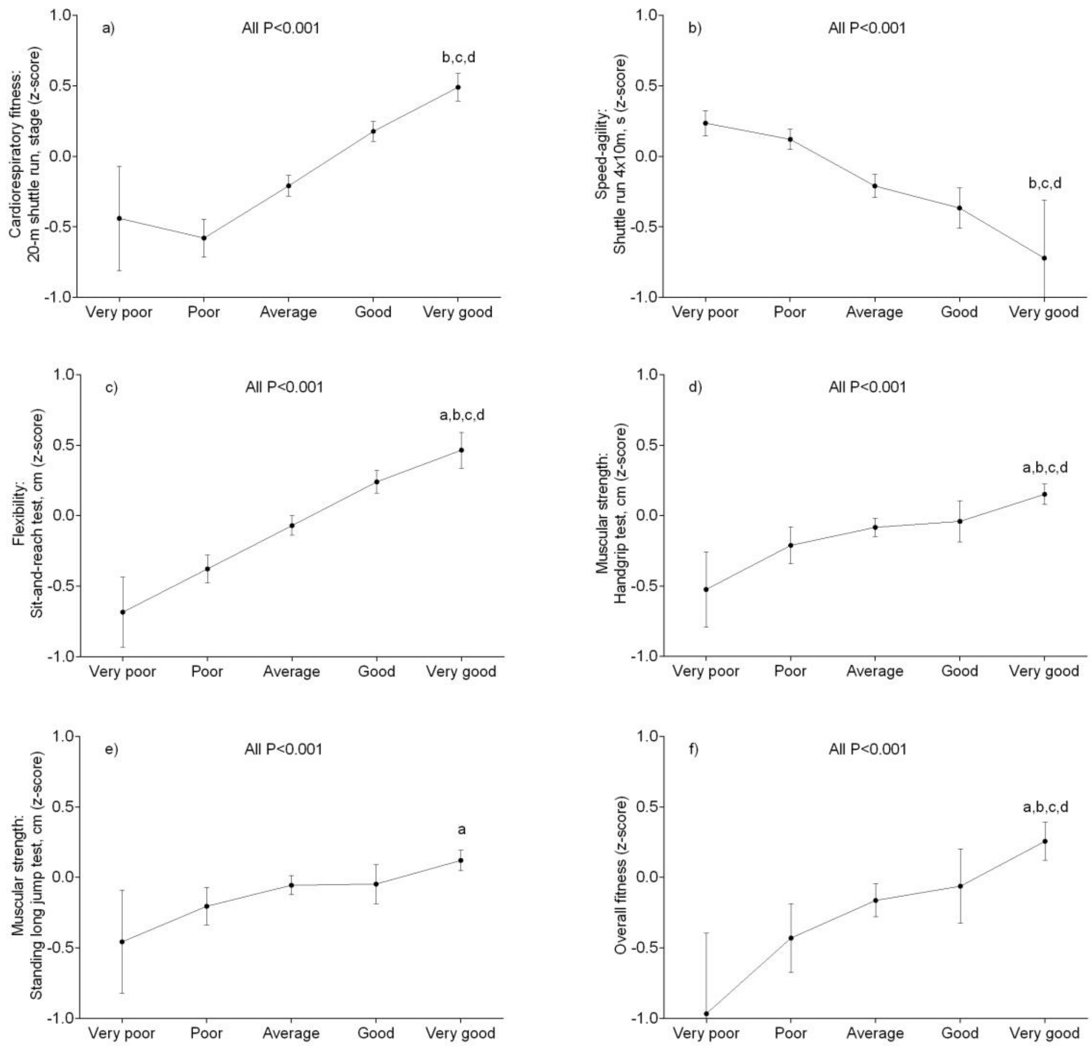
[a] Analysis of covariance adjusted for sex, age and sexual maturation status.
[b] Higher scores indicating higher levels of speed-agility.
[c] Bonferroni-adjusted pairwise comparisons.

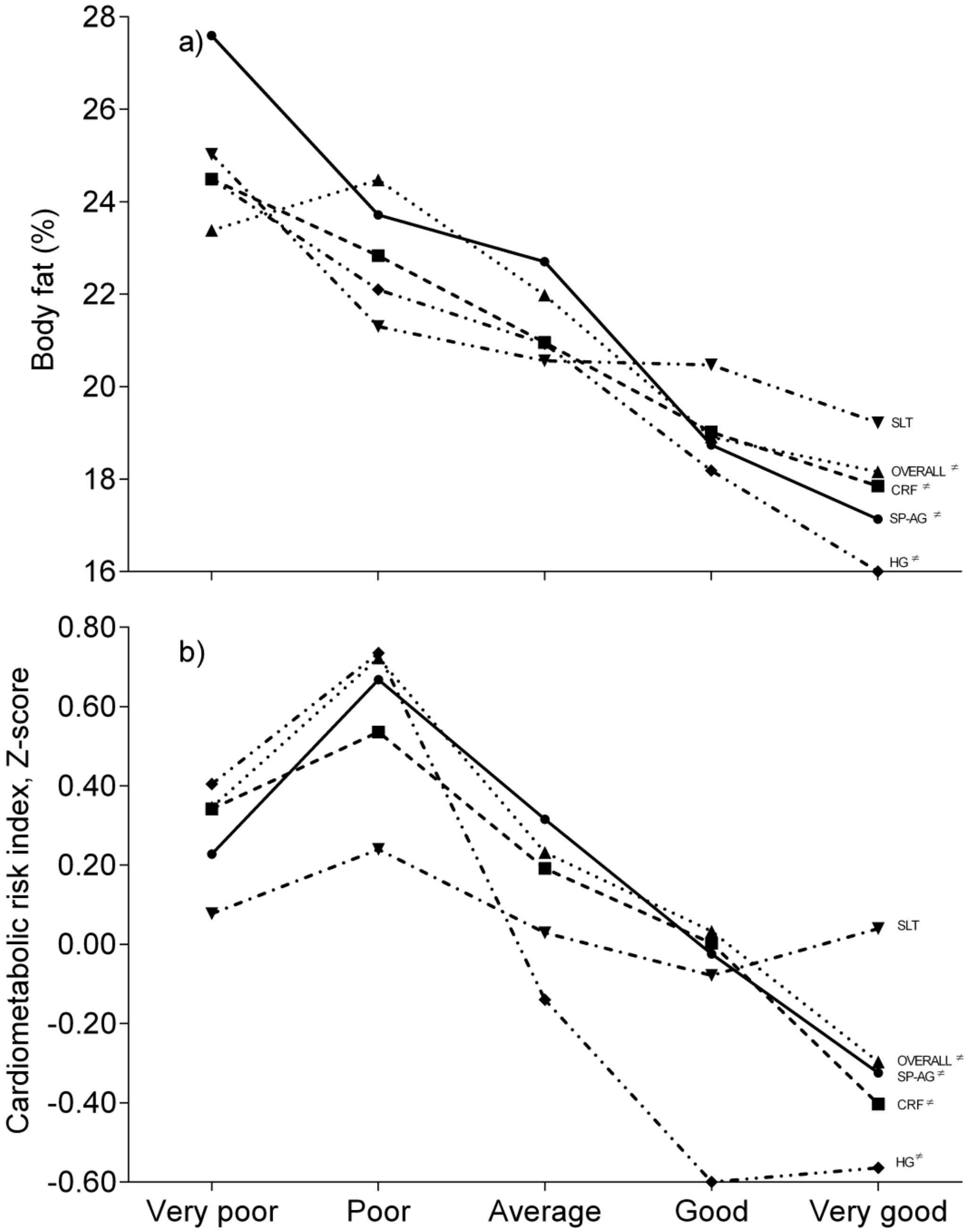
Table 2. Test–retest (1 week apart) reliability of self-reported fitness in schoolchildren from Bogota, Colombia (n = 229)

IFIS Components	Test Mean (SD)	Re-test Mean (SD)	Kappa	95%CI	α
20-m shuttle run (stage)	3.74 (0.81)	3.75 (0.84)	0.834	0.786 – 0.871	0.733
Handgrip (kg)	3.41 (0.97)	3.51 (0.96)	0.775	0.710 – 0.825	0.743
Standing-long jump (cm)	3.54 (0.88)	3.54 (0.86)	0.847	0.803 – 0.881	0.763
Shuttle run 4x10m (s)	3.77 (0.94)	3.66 (0.94)	0.797	0.739 – 0.842	0.726
Sit and reach (cm)	3.24 (1.00)	3.33 (1.01)	0.802	0.745 – 0.846	0.789

IFIS: International Fitness Scale; SD: standard deviation, SP-AG, speed-agility; α = Cronbach's alpha


All
Boys
Girls
%
60
50
40
30
20
10
0
CRF
MF
SP-AG
FLEX
Overall
Very good
Good
Average
Poor
Very poor


a)
All P<0.001
Cardiorespiratory fitness:
20-m shuttle run, stage (z-score)
b,c,d
b)
All P<0.001
Speed-agility:
Shuttle run 4x10m, s (z-score)
b,c,d
c)
All P<0.001
Flexibility:
Sit-and-reach test, cm (z-score)
a,b,c,d
d)
All P<0.001
Muscular strength:
Handgrip test, cm (z-score)
a,b,c,d
e)
All P<0.001
Muscular strength:
Standing long jump test, cm (z-score)
a
f)
All P<0.001
Overall fitness (z-score)
a,b,c,d
1.0
0.5
0.0
-0.5
-1.0
Very poor
Poor
Average
Good
Very good


28
26
24
22
20
18
16
a)
Body fat (%)
SLT
OVERALL ≠
CRF ≠
SP-AG ≠
HG ≠
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
b)
Cardiometabolic risk index, Z-score
SLT
OVERALL ≠
SP-AG ≠
CRF ≠
HG ≠
Very poor
Poor
Average
Good
Very good

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