ORIGINAL ARTICLES

Cycling to School and Body Composition, Physical Fitness, and Metabolic Syndrome in Children and Adolescents

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Objective To evaluate the association between cycling to/from school and body composition, physical fitness, and metabolic syndrome among a sample of Colombian children and adolescents.

Study design During the 2014-2015 school year, we examined a cross-sectional component of the Association for muscular strength with early manifestation of cardiovascular disease risk factors among Colombian children and adolescents (FUPRECOL) study. Participants included 2877 youths (54.5% girls) from Bogota, Colombia. A self-reported questionnaire was used to measure the frequency and mode of commuting to school. Four components of physical fitness were measured: (1) anthropometric (height, weight, body mass index, and waist circumference); (2) musculoskeletal (handgrip and standing long jump test); (3) motor (speed-agility test; 4 × 10-meter shuttle run); and (4) cardiorespiratory (20-m shuttle run test [20mSRT]). The prevalence of metabolic syndrome was determined by the definitions provided by the International Diabetes Federation.

Results Twenty-three percent of the sample reported commuting by cycle. Active commuting boys had a likelihood of having an unhealthy 4 × 10 m value (OR, 0.72; 95% CI, 0.53-0.98; $P = .038$) compared with the reference group (passive commuters). Active commuting girls showed a lower likelihood of having unhealthy a 20mSRT value (OR, 0.81; 95% CI, 0.56-0.99; $P = .047$) and metabolic syndrome (OR, 0.61; 95% CI, 0.35-0.99; $P = .048$) compared with passive commuters.

Conclusion Regular cycling to school may to be associated with better physical fitness and a lower incidence of metabolic syndrome than passive transport, especially in girls. *(J Pediatr 2017;188:57-63).*

Active school transport (AST), including walking, cycling, and even public transportation, is one component of an active lifestyle.[1] There is emerging and consistent evidence indicating that AST increases physical activity levels in children and adolescents.[2,3]

Physical activity has many benefits for young people; however, the evidence linking AST directly to health outcomes has not been examined in detail and remains unclear. The vast majority of studies have shown a positive relationship between AST and physical activity levels.[4] In addition, there is a consistent evidence that cycling to and from school is associated with greater cardiorespiratory fitness; however, the association between AST and indicators of body composition, as well as other physical fitness components, remains equivocal.[4]

In youths, several factors have been described as more or less influential determinants regarding the decision to commute actively, including socioeconomic status, characteristics of the natural environment, parental educational level, social support for active commuting, distance between school and home, and the perceptions of parents and children regarding neighborhood characteristics.[5,6]

Despite the importance of AST as a strategy to promote physical activity in achieving the international physical activity guidelines of the World Health Organisation and the high rates of physical inactivity (≈70%) and sedentary lifestyles among students in Bogotá,[7,8] to date few studies have analyzed correlates and health-related associations in this population.[6,9] Thus, the aim of the present study was

20mSRT	20-m shuttle run test
AST	Active school transport
BMI	Body mass index
FUPRECOL	Association for muscular strength with early manifestation of cardiovascular disease risk factors among Colombian children and adolescents
ICC	Intraclass correlation coefficient
SLJ	Standing long jump
VO_2	Oxygen consumption
WC	Waist circumference

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Supported by Instituto Colombiano para el Desarrollo de la Ciencia y la Tecnología "Francisco José de Caldas" COLCIENCIAS (671-2014 Code 122265743978). The authors declare no conflicts of interest.

http://dx.doi.org10.1016/j.jpeds.2017.05.065

to analyze the association between cycling to and from school and adiposity, physical fitness, and cardiometabolic risk factors in a sample of Colombian children and adolescents.

Methods

We performed cross-sectional analyses of baseline data from participants of the Association for muscular strength with early manifestation of cardiovascular disease risk factors among Colombian children and adolescents (FUPRECOL) study, which focused on the associations among fitness, health, and noncommunicable diseases. The FUPRECOL study design, methods, and primary outcomes for our present cohort have been described previously.[10] In this study, we included a subsample (n = 2877) of 9- to 17.9-year-old healthy Colombian children and adolescents. Data were collected between 2013 and 2016.[11] Individuals with psychiatric disorders, pregnancy, cardiovascular disease, systemic infections, asthma, or other physical impairments that made them unable to participate in this study, as well as individuals using any prescribed drugs or actively using illegal or illicit drugs, were excluded from the investigation.

Self-perceived commuting to school as well as the cutoff point were assessed following the methodology of the Health Behaviour in School-Aged Children questionnaire.[12] The method of commuting to school was elicited by asking the question "have you used a bicycle to get to school and get back home?" Youths were asked to quantify their commuting to school during the previous week, recording the data from Monday to Friday. For the analyses, cycling was dichotomized to "yes" (individual had reported cycling 3 or more days per week) or "no" (individual had reported cycling fewer than 3 days per week).

All data were collected at the same time in the morning, between 7:00 a.m. and 10:00 a.m. Body weight and height were measured following standard procedures using an electronic scale (model BC544; Tamita, Tokyo, Japan) and a mechanical stadiometer platform (model 274; Seca, Hamburg, Germany), respectively. Participants were weighed with bare feet or with light socks and wearing only lightweight clothing (e.g., shorts and t-shirt). Body mass index (BMI) was calculated as body weight in kilograms divided by the square of height in meters, and was classified as underweight, normal weight, overweight, or obese using the International Obesity Task Force criteria.[13] Waist circumference (WC) was measured at the midpoint between the last rib and the iliac crest using a tape measure (model 8004-MA; Ohaus, Parsippany, New Jersey). Test-retest reliability was body weight (intraclass correlation coefficient [ICC], 0.983), height (ICC, 0.973), BMI (ICC, 0.897), and WC (ICC, 0.967). To classify WC, we used criterion-referenced health-related cutpoints derived from de Ferranti et al[14] because of their large sample size, age-specificity, and relatively generalizable ethnicity.

We used standing long jump (SLJ) and isometric handgrip dynamometry as indicators of lower-body and upper-body muscular fitness, respectively.[15,16] To assess lower-body muscular fitness, subjects were instructed to jump as far as possible using a 2-footed take-off and landing technique. They were encouraged to flex and then extend their knees, ankles, and hips, and to swing their arms to maximize performance. SLJ performance was calculated as the distance between the toes at take-off to the heels at the landing point. The best scores from 2 correctly performed jumps were used. Handgrip strength was assessed as an indicator of upper-body muscular fitness using an adjustable analog handgrip dynamometer (T-18 TKK SMEDLY III; Takei Scientific Instruments, Niigata, Japan). Students watched a brief demonstration of the technique and were given verbal instructions on how to perform the test. The dynamometer was adjusted according to the child's hand size in accordance with predetermined protocols. SLJ and handgrip measurements in a subsample of 229 patients, similar in demographic data and biological characteristics to the whole sample, were recorded to ensure reproducibility on the day of the study. The reproducibility of our data were $R = 98\%$ for SLJ and $R = 96\%$ for the handgrip test.

The speed-agility test (assessing speed of movement, agility, and coordination) was performed using 2 parallel lines drawn on the floor 10 m apart. The participant was instructed to run as fast as possible from the starting line to the other line and then return to the starting line, crossing each line with both feet every time. This test was performed twice, covering a distance of 40 m (4×10 m). Each time that the participant crossed any of the lines, he or she was instructed to pick up (the first time) or exchange (second and third times) a sponge that had been placed behind the lines. The stopwatch was stopped when the participant 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, 4 cones, a stopwatch, and 3 sponges were used to perform the test.

Flexibility was assessed as hamstring and lumbar extensibility, measured using the 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. 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. We used the 20th percentile as a threshold for unhealthy speed-agility and flexibility, as reported in school children and adolescents from Europe[17] and Spain,[18] respectively. The reproducibility of our data were $R = 98\%$ for the speed-agility test and $R = 96\%$ for the flexibility test.

Cardiorespiratory fitness was assessed with the 20-meter shuttle run test (20mSRT).[19] This test requires participants to run back and forth between 2 lines set 20 meters apart. Running speed started at 8.5 km/hour and was increased by 0.5 km/hour each minute, reaching 18.0 km/hour per minute. Each level was announced on a tape player. The participant was instructed to keep up with the pace until exhaustion set in. The test was finished when the participant failed to reach the end lines concurrent with the audio signals on 2 consecutive occasions, or when the participant stopped because of fatigue. The participant received verbal encouragement from the investigators to achieve maximum performance to keep running as long as possible. The number of shuttles performed by each