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Professional paper

ADIPOSITY, PHYSICAL ACTIVITY AND PHYSICAL FITNESS AMONG ADOLESCENTS FROM TIRANA

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Abstract

Objective: The main purpose of this study was to determine the relationship between physical activity (PA) levels and adiposity. The secondary purpose was to assess the effect of physical fitness and living area on adiposity.
Research Methods and Procedures: A cross-sectional study was carried out in a regional representative sample of 250 adolescents from 13 to 17 years of age, in 2019. Anthropometric and physical fitness values (including BMI, aerobic capacity, strength levels, velocity assessment, and flexibility) were measured in all adolescents.
Results: Similar overweight prevalence was founded in boys (40%) and girls (45%) whereas significant differences were found in the corresponding obesity rates (15% vs. 12%, $p < 0.05$, boys and girls, respectively). 127 boys and girls were considered the physically active group, while the other 123 were considered non-physically active. When active and sedentary adolescents were compared, physically active boys showed a trend toward a slightly higher overweight and obesity prevalence than the non-physically active boys (35% vs. 29% and 9% vs. 4%, both p 3 0.09 to 0.10). Conversely, physically active girls had lower obesity rates than nonphysically active girls (8% vs. 11%, $p < 0.05$). Adolescents from the rural area showed similar overweight (34% vs. 28% and 36% vs. 32%, boys and girls, respectively) and obesity rates (6% vs. 8% and 10% vs. 9%, boys and girls, respectively) compared with their urban counterparts.
Discussion: Regular participation in at least 2 hours per week of sports activities on top of the compulsory education program is associated with better physical fitness and lower whole-body adiposity. In the adolescents included in our study, among all physical fitness variables, VO2max showed the strongest relationship with BMI and fat mass assessed by means of skinfold measurements.

Keywords: body composition, childhood obesity, exercise, health education.

1. Introduction

Data from the latest epidemiological studies showed a significant and striking increase in the mean BMI values and in the prevalence of being overweight and/or obese among adolescents from 13 to 17 years old (4). Our study was developed in 2019 and data included in the present investigation are an update of the available figures and will serve to verify the current tendencies in this population. Moreover, new, and interesting information regarding physical activity (PA)1 levels and physical fitness is incorporated, including aerobic capacity, strength levels, velocity, and flexibility assessments in all of the investigated adolescents.
Another important issue is whether physical fitness and/or physical activity level are determining factors for the BMI and adiposity in boys and girls.
Therefore, the main purpose of this study was to determine the relationship between PA levels and adiposity. The secondary purpose was to assess the effect of physical fitness and living area on adiposity.

2. Research Methods and Procedures

2.1. Subjects: A random sample of 250 healthy adolescents (13 to 17 years of age) was selected using a multistage, proportional-cluster sampling from a total 4 high schools in the city of Tirana, Albania. A

proportionate cluster with schools at the primary sampling cluster was used. The different strata were selected according to the structure of the local school system, the geographic distribution and by gender. Participation rate was higher than 90%.

2.2. Experimental Design: Each adolescent underwent a one-day testing session. During this session, anthropometric assessments, and physical fitness tests (in the same order as suggested for the one-day protocol published elsewhere (7,8) were carried out. In addition, all adolescents answered a questionnaire providing information about personal data, sports participation (including the number of training hours per week and the kind of sport), and medical history (including the past injuries and medication). Both parents and adolescents were informed about the aims and procedures of the study, as well as the possible risks and benefits. Adolescents gave their verbal consent and written informed consent was obtained from their parents. None of the subjects was on medication at the time of the study.

2.3. Anthropometry and definition of overweight and obese: Anthropometric measurements were obtained on each subject. Height was measured in the upright position to the nearest millimeter (Kawe, Asperg, Germany). Body mass was determined using a balance with a 100 g imprecision (Seca, Hamburg, Germany). Adolescents were considered as overweight or obese based on BMI age-specific, when their BMI was more than or equal to the international cut off point corresponding to the centile curve that passes through either the BMI curve of 25 or 30 kg/m2 respectively (9).
All anthropometric measurements were performed by two experienced physicians according to the well standardized procedures of the International Society for the Advancement in Kinanthropometry. Skinfold thickness was measured in triplicate at biceps, triceps, subscapular, su-prailiac, abdominal, and medium calf sites with a Holtain skinfold caliper (Holtain Ltd, Crosswell, United Kingdom), as previously described (10). The median value of the three measurements was taken as final value. The sum of the 6 skinfolds thickness (SSF) measurements from the whole body and those from the trunk region (subscapular, suprailiac, abdominal) were also calculated.

2.4. Statistical Analysis: Descriptive statistics were run on all variables. Group differences in body composition and fitness test variables were assessed using unpaired Student's t test that was applied to assess differences in the prevalence of over-weight and obesity between groups. Pearson correlation analysis was applied to identify the relationship between physical fitness and body composition variables. Stepwise multiple regression was used to determine the best predictor of the BMI and the SFF among all physical fitness tests. Additionally, multiple general linear models with successive BMI and SSF as dependent variables were used to evaluate the independent effects of age, PA levels, living area, and cardiorespiratory fitness. SPSS package (SPSS, Inc., Chicago, IL) software was used for the statistical analysis. The significance level was set at $p \leq 0.05$, and data are represented as means ± standard deviation unless otherwise stated.

3. Results

3.1. Prevalence of overweight and obesity: Similar overweight prevalence was founded in boys (40%) and girls (45%) whereas significant differences were found in the corresponding obesity rates (15% vs. 12%, $p < 0.05$, boys and girls, respectively). 127 boys and girls were considered the physically active group, while the other 123 were considered non-physically active. When active and sedentary adolescents were compared, physically active boys showed a trend toward a slightly higher overweight and obesity prevalence than the

non-physically active boys (35% vs. 29% and 9% vs. 4%, both p ³ 0.09 to 0.10). Conversely, physically active girls had lower obesity rates than nonphysically active girls (8% vs. 11%, $p < 0.05$). Adolescents from the rural area showed similar overweight (34% vs. 28% and 36% vs. 32%, boys and girls, respectively) and obesity rates (6% vs. 8% and 10% vs. 9%, boys and girls, respectively) compared with their urban counterparts.

3.2. Anthropometry: Table 1 summarizes anthropometric data for all adolescents of the study. Girls had comparable age, body mass, height, and BMI values between physically active and nonphysically active groups. Physically active boys showed significantly higher values in body mass, height, and BMI (all $p \leq 0.05$). Calculated sum of the SSF showed a trend to lower values in the active group compared with the sedentary group ($p = 0.07$). Active girls had significantly lower subcutaneous fat masses than their sedentary counterparts in the whole body ($p < 0.05$) and at the trunk sites ($p = 0.07$).

Table 1. PA Levels vs. Physical Fitness as Determining Factors for the BMI, SSF, and Truncal Subcutaneous Fat (SFT) Values

	Physically active group		**Non-physically active group**		**Significance (p)**
Boys					
Age (yrs)	10.3	é 0.1	9.8	é 0.1	0.06
Height (cm)	139.1	é 0.6	138.2	é 0.9	<0.05
Body mass (kg)	37.1	é 0.6	36.5	é 0.7	<0.05
BMI	19.2	é 0.2	18.7	é 0.2	0.05
Sum 6 skinfolds (mm)	63.4	é 1.5	62.8	é 2.3	NS
Sum trunk skinfolds (mm)	27.2	é 0.9	26.8	é 1.3	NS
Girls					
Age (years)	9.5	é 0.1	9.4	é 0.1	NS
Height (cm)	138.1	é 0.7	137.0	é 0.8	NS
Body mass (kg)	35.3	é 0.6	35.2	é 0.7	NS
BMI	18.7	é 0.2	18.6	é 0.2	NS
Sum 6 skinfolds (mm)	73.1	é 1.4	76.6	é 1.9	<0.05
Sum trunk skinfolds (mm)	31.2	é 0.8	31.7	é 1.1	0.07

NS, not significant. Unpaired t test, mean é standard error.

Apart from the plate tapping, the flexibility, and the bent arm hang tests, active boys attained better results in all physical fitness test than their sedentary counterparts ($p < 0.05$). Active girls achieved better performance in every one of the physical tests except for the handgrip and the plate tapping tests, which were similar in both groups.

The effect of interaction term gender by PA on BMI and adiposity was tested, and there was no significant effect ($p = 0.115$). Correlations between physical fitness variables and subcutaneous fat mass (truncal and whole body) were low (r §0.32) except for the VO2max (r between 0.48 and 0.51, $p < 0.01$) and the bent arm hang test (r between 0.36 and 0.40, $p < 0.01$). The handgrip test showed the strongest correlation with the BMI values ($r = 0.48$, $p < 0.01$). Multiple regression analysis showed that, compared with the physical activity levels and the living area, cardiorespiratory fitness had the strongest relationship to the BMI, SSF, and SFT values. No significant effect of the living area on adiposity and/or BMI was detected among the studied children.

4. Discussion

4.1. Influence of the residence area on the adiposity in adolescents: Data related to socio-demographic determinants on the trends of overweight and obesity prevalence in adolescents is limited (14,15). Whether children live in an urban or rural environment could also affect the subsequent obesity status because of several factors that influence the total energy expenditure of the adolescents (i.e., distance to school, proportion of physical activity facilities in the area, differences in parental habits, social inequalities, and others).
Regular participation in at least 2 hours per week of sports activities on top of the compulsory education program is associated with better physical fitness and lower whole-body adiposity. In the adolescents included in our study, among all physical fitness variables, VO2max showed the strongest relationship with BMI and fat mass assessed by means of skinfold measurements.

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