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Comunicaciones breves

Socioeconomic status influences physical fitness in European adolescents independently of body fat and physical activity: the HELENA Study

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Abstract

Introduction: **The influence of socioeconomic status on health-related fitness is not clear.**

Aim: **To examine the influence of socioeconomic status on health-related fitness in adolescents.**

Methods: **A total of 3,259 adolescents (15.0 ± 1.3 y) from the Healthy Lifestyle in Europe by Nutrition in Adolescence Cross-Sectional Study (HELENA-CSS) participated in the study. Socioeconomic status was assessed by the family affluence scale (FAS). Speed-agility, muscular strength and cardiorespiratory fitness were assessed. Covariates included total body fat, physical activity and pubertal status.**

Results: **Adolescents with high FAS had significantly higher fitness levels than their peers of lower FAS categories except for speed-agility and handgrip in boys. Overall, the associations observed presented a medium to large effect size.**

Conclusion: **These results suggest that socioeconomic status is positively associated with physical fitness in European adolescents independently of total body fat and habitual physical activity.**

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Key words: *Socioeconomic status. Physical fitness. Physical activity. Total body fat.*

EL ESTATUS SOCIOECONÓMICO INFLUENCIA LA CONDICIÓN FÍSICA EN ADOLESCENTES EUROPEOS. EL ESTUDIO HELENA

Resumen

Introducción: **La influencia del estatus socioeconómico sobre la condición física en relación con la salud no está clara.**

Objetivo: **Examinar la influencia del estatus socioeconómico sobre la condición física en relación con la salud en adolescentes.**

Metodología: **Un total de 3259 adolescentes (15,0 ± 1,3 años) del "Healthy Lifestyle in Europe by Nutrition in Adolescence Cross-Sectional Study" (HELENA-CSS) participaron en el estudio. El estatus socioeconómico fue medido con una escala de riqueza familiar "family affluence scale (FAS)". Se midieron velocidad-agilidad, fuerza muscular y capacidad aeróbica. Las covariables incluidas fueron grasa corporal total, actividad física y estadio madurativo.**

Resultados: **Los adolescentes con alto FAS tuvieron significativamente mayores niveles de condición física que aquellos con bajo FAS exceptuando los tests de velocidad-agilidad y fuerza de prensión manual en chicos. En general, las asociaciones observadas presentaron un efecto del tamaño de la muestra (effect size) entre medio y largo.**

Conclusión: **Estos resultados sugieren que el estatus socioeconómico esta positivamente asociado con la condición física en adolescentes Europeos independientemente de la grasa corporal total y el nivel de actividad física.**

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Palabras clave: *Estatus socioeconómico. Condición física. Actividad física y grasa corporal total.*

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Introduction

Speed-agility, muscular fitness, and cardiorespiratory fitness (CRF) are considered important health-related markers already in youth.[1,2] Genetics greatly determines physical fitness[3], but there is little doubt that environmental factors also play an important role. Socioeconomic status is associated with several health outcomes (e.g., birth weight, obesity, diet, etc.)[4,5] and with mortality.[6] To better understand the specific role of different indicators of socioeconomic status on health-related fitness markers will enable a more efficient physical fitness promotion. In this regard, the association between socioeconomic status and fitness was investigated in Portuguese[7] and Irish[8] youth with contradictory results. In Portuguese adolescents, the socioeconomic status was inversely associated with fitness in boys but positively in girls.[7] However, in Irish youth there was a positive association of socioeconomic status with fitness.[8] These previous findings highlight that both social and cultural contexts are often country-specific, so studies from a widespread vision and including populations from different countries are required to facilitate a better understanding.

The Healthy Lifestyle in Europe by Nutrition in Adolescence Cross-Sectional Study (HELENA-CSS) used harmonised and well standardised methods of measurement in nine European countries and previous workshops were organised in order to guarantee this process. Therefore the HELENA-CSS provides a good opportunity to explore the relationship between socioeconomic status and physical fitness in European adolescents (see annex 2). The aim of this study was to examine the influence of socioeconomic status on health-related physical fitness (speed-agility, muscular fitness, and CRF) in urban European adolescents.

Methods

The HELENA-CSS study is a multi-centre study aiming to obtain reliable data from European adolescents aged 12.5 to 17.5 years about nutritional habits and patterns, body composition and levels of physical activity and fitness (see annex 2). The total sample of the HELENA-CSS was 3,528 adolescents and the present work comprised 3,259 (1,558 boys and 1,701 girls) adolescents with valid data on socioeconomic status and at least one physical fitness test. More details about the sampling procedures, preparation of the field teams, pilot study and reliability of the data can be found elsewhere (see annex 2).

Ten cities in nine different European countries were chosen due to an existing network of research groups and a rough geographical balance across Europe; Stockholm (Sweden), Athens (Greece), Heraklion (Greece), Rome (Italy), Zaragoza (Spain), Pecs (Hungary), Ghent (Belgium) Lille (France), Dortmund (Germany) and Vienna (Austria). Signed informed consent was obtained from all participants and their parents, and the protocol was approved by the Human Research Review Committees of the involved centres (see annex 2).

Socioeconomic status

The Family Affluence Scale (FAS) is based on the concept of material conditions in the family to base the selection of items. Currie et al.[9] chose a set of items which reflected family expenditure and consumption that were relevant to family circumstances. Possessing these items was considered to reflect affluence and their lack, on the other hand, material deprivation. FAS was used in the present study as an index of socioeconomic status,[10] which includes 4 questions answered by the adolescent: Do you have your own bedroom?; How many cars are there in your family?; How many PCs are there in your home?; Do you have internet access at home? We defined low, medium and high socioeconomic status based on the final score obtained from the four questions. That is, we give a numerical value to each possible answer in the four questions. Then we summed the final score from all the questions being ranged from 0 to 8. Finally, we grouped these scores in three levels: low (from 0 to 2), medium (from 3 to 5) and high (from 6 to 8).

Physical fitness

Speed-agility was assessed with the 4 x 10 m shuttle run test. Upper-body muscular strength was assessed with the handgrip strength and the bent arm hang tests. Lower-body muscular strength was assessed with the standing long jump, the squat jump, the counter movement jump and the Abalakov jump tests. The Infrared Platform ERGO JUMP Plus-BOSCO SYSTEM (Byomedic, S.C.P., Barcelona, Spain) was used for the jump assessment. CRF was assessed by the 20 m shuttle run test. More detailed information about the fitness testing protocol has been published elsewhere (see annex 2).

Covariates

Following standard procedures (see annex 2), weight was measured in underwear and without shoes with an electronic scale (Type SECA 861) to the nearest 0.05 kg, and height was measured barefoot in the Frankfort plane with a telescopic height measuring instrument (Type SECA 225) to the nearest 0.1 cm. Skinfold thickness was measured to the nearest 0.2 mm in triplicate in the left side at biceps, triceps, subscapular, suprailiac, thigh, and medial calf with a Holtain Caliper (Crymmych, UK).[11] The Actigraph accelerometer (Actigraph MTI, model GT1M, Manufacturing

Technology Inc., Fort Walton Beach, FL, USA) was used to assess physical activity and expressed as counts/min.[12] Adolescents were asked to wear the accelerometer during the daytime for 7 consecutive days, except during water based activities. The criterion for inclusion was to record at least 8 h per day, for at least 3 days.[13] A total of 2,208 (68% of the total) adolescents (1,192 girls) reported valid data of accelerometry. Pubertal status was assessed by a medical doctor according to Tanner stages.[14]

Statistical analysis

The data are presented as means (standard deviation). To achieve normality in the residuals, handgrip, bent arm hang, squat jump, counter movement jump, Abalakov jump, and sum of skinfold thickness were transformed to the natural logarithm. The associations between FAS and physical fitness were assessed by one-way analysis of covariance with FAS entered as fixed factor and the fitness tests as dependent variables. Age, height, total body fat and physical activity were entered as covariates. Effect size statistics is a measure of the magnitude of effect and in this study was assessed using Cohen's *d* (standardized mean difference) and 95% confidence interval.[15] Taking into account the cut-off established by Cohen, the effect size (Cohen'd) can be small (~0.2), medium (~0.5) or large (~0.8). We analysed possible differences in age, weight, height and BMI (variables available for the whole study sample) between adolescents with complete valid data (1,411) and missing data. No differences were observed in the variables studied. The analyses were performed using the Statistical Package for Social Science (SPSS, v. 15.0 for Windows; SPSS Inc., Chicago, IL) and the level of significance was set at 0.05.

Results

Table I shows the associations between FAS and physical fitness by sex. In boys, those with high FAS performed better in bent arm hang, standing long jump, squat jump, counter movement jump, Abalakov jump or 20 m shuttle run test (all $P \leq 0.05$). FAS was not associated with the 4 x 10 m shuttle run test or handgrip strength. Small effect sizes were observed for the standing long jump test in boys with high FAS compared to those with low FAS, whereas medium to large effect sizes were observed for the bent arm hang, squat jump, Abalakov jump, counter movement jump and 20m shuttle run tests.

Table I
Association between family affluence scale and physical fitness, after adjusting for age, height, skinfold thickness and physical activity

		Family afluence scale				*Effect size*		
Fitness Tests	*n*	*Low (L)*	*Medium (M)*	*High (H)*	*P*	*L-M*	*M-H*	*L-H*
Boys								
4 x 10 m shuttle run test (s)	921	11.6 (0.9)	11.4 (0.9)	11.4 (0.9)	0.207	0.2 (0.04; 0.45)	0.0 (-0.14; 0.14)	0.2 (0.01; 0.39)
Handgrip (kg)[a]	942	69.6 (12.0)	70.8 (12.0)	70.7 (12.0)	0.352	0.1 (-0.05; 0.26)	0.1 (-0.04; 0.23)	0.0 (-0.18; 0.21)
Bent arm hang (s)[a]	902	18.4 (16.0)	21.9 (15.9)	24.8[†§] (16.0)	< 0.001	0.4 (0.23; 0.55)	0.1 (-0.02; 0.25)	0.5 (0.31; 0.71)
Standing long jump (cm)	933	179.1 (26.2)	185.1 (26.1)	186.5[†] (26.2)	0.05	0.2 (0.02; 0.38)	0.1(-0.08; 0.19)	0.3 (0.09; 0.48)
Squat Jump (cm)[a]	868	22.5 (7.0)	24.9* (7.0)	26.9[†§] (7.0)	< 0.001	0.3 (0.19; 0.51)	0.3 (0.13; 0.41)	0.6 (0.41; 0.83)
Counter Movement Jump (cm)[a]	868	24.5 (6.7)	28.0* (6.7)	29.8[†§] (6.7)	< 0.001	0.5 (0.35; 0.68)	0.3 (0.13; 0.41)	0.8 (0.56; 0.99)
Abalakov Jump (cm)[a]	867	30.6 (7.1)	34.2* (7.0)	35.0[†§] (7.0)	< 0.001	0.4 (0.21; 0.54)	0.3 (0.12; 0.40)	0.6 (0.43; 0.85)
20m shuttle run (stage)	820	5.8 (2.6)	6.8* (2.6)	7.2[†§] (2.6)	< 0.001	0.4 (0.24; 0.48)	0.2 (0.01; 0.30)	0.6 (0.35; 0.78)
Girls								
4 x 10 m shuttle run test (s)	1060	13.4 (1.2)	12.8* (1.2)	12.8[†§] (1.2)	< 0.001	0.5 (0.33; 0.62)	0.3 (-0.13; 0.39)	0.7 (0.55; 0.92)
Handgrip (kg)[a]	1093	51.3 (8.5)	50.8 (8.4)	52.3[§] (8.5)	< 0.05	0.1 (-0.08; 0.20)	0.2 (-0.05; 0.31)	0.1 (-0.06; 0.30)
Bent arm hang (s)[a]	1048	7.3 (14.5)	8.5 (14.4)	9.8 (14.5)	< 0.001	0.3 (0.16; 0.46)	0.3 (0.16; 0.43)	0.6 (0.42; 0.79)
Standing long jump (cm)	1085	139.1 (25.0)	144.4 (24.8)	153.1[†§] (25.1)	< 0.001	0.2 (0.07; 0.36)	0.3(-0.23; 0.48)	0.6 (0.38; 0.74)
Squat Jump (cm)[a]	974	16.0 (5.6)	18.8* (5.5)	21.2[†§] (5.6)	< 0.001	0.5 (0.35; 0.65)	0.4 (0.29; 0.57)	0.9 (0.73; 1.12)
Counter Movement Jump (cm)[a]	971	19.3 (6.1)	21.1* (6.0)	23.7[†§] (6.1)	< 0.001	0.3 (0.15; 0.45)	0.4 (0.28; 0.56)	0.7 (0.52; 0.91)
Abalakov Jump (cm)[a]	967	23.2 (5.6)	24.9* (5.5)	27.2[†§] (5.6)	< 0.001	0.3 (0.17; 0.47)	0.4 (0.28; 0.55)	0.7 (0.53; 0.92)
20 m shuttle run (stage)	942	3.1 (1.9)	3.8* (1.9)	4.6[†§] (1.9)	< 0.001	0.4 (0.22; 0.53)	0.4 (0.29; 0.57)	0.8 (0.61; 1.00)

Values are mean (standard deviation). Effects size statistics are expressed as *Cohen's d* (95% Confidence interval).
*P < 0.01 for differences in Medium vs Low. [§]P<0.01 for differences in High vs Medium. [†]P < 0.01 for differences in High *vs* Low. [a]Non-transformed data are presented in the table, but analyses were performed on log-transformed data.

Girls with high FAS performed significantly better in all fitness tests (all $P < 0.05$) compared to their peers of lower FAS level. Medium effect sizes were found for the bent arm hang, 4 x 10 m shuttle run test, standing long jump, counter movement jump and Abalakov jump in girls with high FAS compared to those with low FAS. We observed large effect sizes for the squat jump and 20m shuttle run tests. Additional adjustments for pubertal status instead of age did not modify the results (data not shown). The result did not change when body mass index or waist circumference was used instead of skinfold thickness. Likewise, the results remained the same when parental educational level was used instead of FAS (data not shown).

Discussion

The results from the present study suggest that there is a strong positive association between socioeconomic status and physical fitness in European adolescents independently of total body fat and objectively assessed physical activity. Overall, the associations observed presented a medium to large effect size. These findings could be interpreted as an overall influence of socioeconomic status on the physical fitness performance. A higher socioeconomic status could allow the adolescents to have more facilities to practice exercise in terms of sport equipments acquisition, extracurricular sport sessions as well as a major awareness of their parents regarding the importance of having a healthy fitness.

These findings do not concur with a previous study[7] in which negative associations were observed between socioeconomic status and CRF (12 min walk-run) and muscular strength (standing long jump and bent arm hang) in boys.[7] Moreover, Freitas et al. reported a positive association between socioeconomic status and speed-agility performance (5 x 10 m shuttle run test). They also reported a higher upper-body muscular strength (handgrip) in those boys with medium socioeconomic status compared to those with lower socioeconomic status.[7] In contrast, our findings showed positive associations between socioeconomic status and CRF (20 m shuttle run test), lower-body muscular strength (standing long jump, squat jump, counter movement jump, Abalakov jump) and one upper-body muscular strength test (bent arm hang), while no associations for speed-agility (4 x 10 m shuttle run test) and other upper-body muscular strength (handgrip) were found. In girls, Freitas et al. found positive associations between socioeconomic status and lower-body muscular strength and speed-agility performance, but no association for CRF and upper-body muscular strength,[7] which partially concur with our results. However, we also found positive associations for CRF and upper-body muscular strength. Our data also concur with the results observed by Mutunga et al.[8] They reported higher CRF (20 m shuttle run test) in boys and girls with higher socioeconomic status compared to those with lower socioeconomic status.[8] Discrepancies among studies could be due to the specific social and cultural contexts of each country, together with the different methodologies used to assess socioeconomic status and physical fitness.

The direction of the associations cannot be established from cross-sectional designs. However, in the current study, it is not likely that adolescent physical fitness level determines the affluence of their families. The relatively large sample of adolescents studied from nine European countries (ten cities) provides a good overview of the relationships between socioeconomic status and physical fitness in European adolescent population.

In conclusion, these results suggest that high socioeconomic status, as assessed by family affluence, positively influences physical fitness in urban European adolescents independently of total body fat and habitual physical activity.

Annex

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Annex 2: Methodological references of HELENA-CSS in relation with this paper

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