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The risk of eating disorders and academic performance in adolescents: DADOS study

Riesgo de padecer trastornos de la conducta alimentaria y rendimiento académico en adolescentes: proyecto DADOS

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ABSTRACT

Introduction: eating disorders (ED) are complex multifactorial chronic diseases with adverse consequences on cognition in adolescence.

Objectives: the main aim of the present study was to analyze the association between the risk of ED and academic performance in adolescents, considering the key role of weight status.

Methods: a total of 261 adolescents (13.9 ± 0.3 years) from the DADOS *(Deporte, Adolescencia y Salud)* Study were included in the analysis. The risk of ED was assessed using the Sick Control on Fast Food (SCOFF) questionnaire. Weight status was assessed by body mass index (BMI) (kg/m^2). Academic performance was assessed through final grades and through the Spanish version of the SRA Test of Educational Ability (TEA).

Results: the risk of ED was negatively associated with academic grades, and with verbal and numeric abilities measured through TEA. Adolescents with non-eating disorder risk showed higher scores in academic grades (but not in the TEA components). Overweight and obese adolescents reported higher risk of ED.

Conclusions: the risk of ED is negatively associated with academic performance, being higher in overweight and obese adolescents. Interventional programs aimed to improve academic performance should take into account weight status and the risk of ED.

Key words: Adolescence. Health. Weight status. Educational achievement.

RESUMEN

Introducción: los trastornos de la conducta alimentaria (TCA) son alteraciones psicológicas severas con graves consecuencias sobre la función cognitiva durante la adolescencia.

Objetivos: el principal objetivo de este estudio fue analizar la asociación entre el riesgo de padecer TCA y el rendimiento académico en adolescentes, considerando el papel clave de la composición corporal.

Métodos: la muestra estuvo formada por un total de 261 adolescentes (13,9 ± 0,3 años), participantes del proyecto DADOS (Deporte, Adolescencia y Salud). La versión española del cuestionario Sick Control on Fast Food (SCOFF) se utilizó para determinar el riesgo de padecer TCA. La composición corporal se evaluó mediante el índice de masa corporal (IMC) (kg/m^2). El rendimiento académico fue evaluado mediante las notas finales y mediante la versión española del cuestionario SRA Test of Educational Ability (TEA).

Resultados: el riesgo de padecer TCA estuvo inversamente asociado con las notas y con las habilidades verbales y numéricas medidas mediante el TEA. Los adolescentes que no presentaban riesgo de padecer TCA mostraron calificaciones más altas en las notas (pero no en los componentes del cuestionario TEA). Los adolescentes con sobrepeso u obesidad reportaron un mayor riesgo de padecer TCA.

Conclusiones: el riesgo de padecer TCA está asociado de forma inversa con el rendimiento académico y es más elevado en adolescentes con sobrepeso u obesidad.

Las intervenciones cuyo objetivo sea mejorar el rendimiento académico deberían tener en cuenta la composición corporal y el riesgo de padecer TCA.

Palabras clave: Adolescencia. Salud. Composición corporal. Rendimiento escolar.

INTRODUCTION

Adolescence is a period of life characterized by important physical, behavioral and brain changes (1,2). Nutritional requirements and dietary habits are modified during this age-span, which could lead to different nutrition-related disorders with adverse consequences for overall health status (3).

Eating disorders (ED) are complex diseases characterized by disruptive eating behaviors linked to body shape dissatisfaction, disinterest in food and an intense fear of gaining weight (4). According to scientific literature, anorexia nervosa, bulimia nervosa and binge eating disorder are the most investigated severe clinically defined ED. The origin of ED is multifaceted, being involved a combination of psychological (i.e., positive self-esteem, emotional well-being), biological (i.e., sex) and social factors (i.e., family connectedness) (5). A peak of incidence in the number of ED has been reported in adolescents between 15-19 years old (6), with symptoms starting during pre-adolescence and early adolescence (7).

Since ED are associated to adverse consequences for physical health and psychosocial and cognitive functioning (5), the early detection of people at risk of developing ED is essential to prevent its progression. Evidence from previous studies in adolescents suggest that cognitive deficits pre-exist and underlie the etiology of ED (8), while high academic performance could act as a protective factor (9). However, limited and non-conclusive research has been undertaken regarding the link between the risk of developing ED and academic performance in adolescents. To this extent, Veses et al. (10) found higher risk of ED among non-overweight adolescent girls with low academic performance, and among overweight adolescent boys with low school grades in physical education (PE). Conversely, Gil et al. (11) did not find differences in academic performance between adolescents at risk and not at risk of ED.

Although ED is commonly related to normal or low body weight, obesity and ED may coexist (12). Since obesity is a weight-related disorder with a high prevalence among

adolescents, it might affect body satisfaction and perception leading to disruptive eating behaviors. Overweight and obesity have been positively associated with an increased risk of developing ED in adolescents (10,13,14). These disorders share multiple similarities and may occur simultaneously (15) or as a consequence of each other (16). In addition, recent research has also pointed out the negative association of body fatness with cognition in adolescents (17). Body image dissatisfaction, weight-related teasing, unhealthy behaviors, and health-related problems closely linked to overweight and obese adolescents have been postulated as potential mechanisms by which excess of body fat negatively influences academic outcomes and cognitive functions (17).

Given the high prevalence of obesity and the key role of body weight on the risk of developing ED and cognition in adolescents, the main aim of the present study was to analyze the association between the risk of ED and academic performance in healthy adolescents, considering the effect of weight status. We additionally examined: a) the differences in academic performance according to ED categories; and b) the risk of ED according to weight status.

METHODS

Participants

The DADOS (Deporte, Adolescencia y Salud) Study is a 3-year longitudinal research project (from 2015 to 2017) aimed to assess the influence of physical activity on health, cognition and psychological wellness through adolescence. All the participants were recruited from secondary schools and sport clubs of Castellon (Spain), and met the general DADOS inclusion criteria: born in 2001, enrolled in second grade of secondary school and free of any chronic disease. The results presented in this study belong to baseline data obtained between February and May of 2015. From the total DADOS study sample, 261 adolescents (138 boys) with valid data for at least risk of eating disorders, weight status, and academic performance were included in the analyses.

Adolescents and their parents or guardians were informed of the nature and characteristics of the study, and all provided a written informed consent. The DADOS study protocol was designed in accordance with the ethical guidelines of the

Declaration of Helsinki of 1961 (last revision of Fortaleza, Brazil, 2013) and approved by the Research Ethics Committee of the Jaume I University of Castellon.

Weight status

Briefly, body weight was measured to the nearest 0.1 kg using an electronic scale (Seca® 861, Hamburg, Germany) with the participant lightly dressed and without shoes. Height was measured to the nearest 0.1 cm using a wall-mounted stadiometer (Seca® 213, Hamburg, Germany). Measures were assessed in duplicate by trained members of the DADOS research group following standardized procedures (18) and average measures were used for data analysis. Body mass index (BMI) was calculated as weight/height square (kg/m^2).

Comentario [MPG1]: Inserto símbolo.

Comentario [MPG2]: Inserto símbolo.

The risk of eating disorders

The risk of ED was assessed using the Sick Control on Fast Food (SCOFF) questionnaire (19). The questionnaire consists of five questions regarding deliberate vomiting, loss of control over eating, weight loss, body image distortion and impact of food on life. A value of 1 is assigned to each affirmative answer, ranging the SCOFF overall score from 0 to 5. A score ≥ 2 in the SCOFF score indicates a likely case of suffering from ED. The Spanish version of the SCOFF validated for adolescents was used (20), which has shown accurate internal consistency and criteria validity for screening ED in adolescents (81.9% sensitivity and 78.7% specificity) (21).

Academic performance

Academic performance was assessed by two components:

1. The final academic grades from the 1st course of secondary school provided by each school's secretary office. The following indicators were included in the analyses: individual grades for Math, Language and Physical Education (PE) and grade point average (GPA) score. Language is the grade of Catalan, the official teaching language at school. GPA score was defined as the single average for Geography and History, Natural Science, Math, Spanish, Catalan, English and Physical Education grades. All the subjects are measured on a ten-point scale, where 1 is the worst and 10 is the best.

1. The Spanish version of the validated Science Research Associates Test of Educational Abilities (TEA) (22). This test measures three basic abilities: verbal ability (command of language), numeric ability (speed and precision in performing operations with numbers and quantitative concepts), and reasoning ability (the aptitude to find logical ordination criteria in sets of numbers, figures or letters). Scores for the three abilities were obtained by adding positive answers. Overall academic ability was calculated by adding the three abilities' scores (verbal + numeric + reasoning). This battery test provides three complexity levels based on the age range of the sample. The present work used the level 3 designed for adolescents aged 14 to 18 years (reliability: verbal $\alpha = 0.74$, numeric $\alpha = 0.87$, reasoning $\alpha = 0.77$ and overall academic ability $\alpha = 0.89$) (22).

Covariates

Pubertal stage was self-reported according to the five stages defined by Tanner and Whitehouse (23). It is based on external primary and secondary sex characteristics, which are described by the participants using standard pictures according to Tanner instructions.

The Family Affluence Scale "FAS" developed by Currie et al. (24) was used as a proxy of socioeconomic status (SES), which is based on material conditions in the family such as car ownership, bedroom occupancy, computer ownership and home internet access.

Parental educational attainment was self-reported by both parents as primary school, secondary school, bachelor studies or university degree. Study levels were dichotomized in two groups: no university degree *vs* university degree for each parent. Maximum parental educational attainment was used in the analyses.

Statistical analysis

Descriptive characteristics are presented as mean and standard deviation (SD) or percentages. Differences between sexes were examined using the t-test and Chi-square test for continuous and nominal variables, respectively. As preliminary analyses showed no significant interactions between sex and ED risk scores ($p > 0.10$), all analyses were performed with the total sample.

Partial correlation analyses controlling for sex, pubertal stage, SES and parental educational attainment were performed to examine the associations of the risk of ED with weight status and academic performance.

Linear regression analyses were performed to investigate the associations of the risk of ED (SCOFF score ranging from 0 to 5) with academic performance. We created three regression models: a) unadjusted model; b) model adjusted for sex, pubertal stage, SES and parental educational attainment; and c) model adjusted for confounders in model 2 plus BMI. Analyses of covariance (ANCOVA) were conducted to examine whether academic performance differed between eating disorders risk categories (eating disorder risk *vs* non-eating disorder risk). These analyses were adjusted for sex, pubertal stage, SES, parental educational attainment and BMI.

Finally, binary logistic regression analysis controlling for sex, pubertal stage, SES and parental educational attainment was performed to estimate the probability of the risk of eating disorders according to weight status (non-overweight *vs* overweight including obesity). All the analyses were performed using the IBM SPSS Statistics for Windows version 22.0 (Armonk, NY: IBM Corp), and the level of significance was set to $p < 0.05$.

RESULTS

Descriptive characteristics of the study sample by sex are displayed in table I. Weight status was similar for boys and girls, with a 13% of overweight or obese adolescents. The risk of developing ED was of 12%, with no differences among sexes. Girls reported higher loss of control over eating and body image distortion than boys (26.0% *vs* 13.8% and 17.9% *vs* 8.0%, respectively; all $p < 0.05$). Academic performance did not show differences among sexes except for numeric ability that was higher in boys ($p < 0.001$).

Partial correlations among all the study variables controlling for sex, pubertal stage, SES and parental educational attainment are shown in table II. The risk of ED (SCOFF score) was positively associated with weight status ($r = 0.262$, $p < 0.001$) and negatively associated with all the academic grades (r ranging from -0.261 to -0.186; all $p < 0.01$), and with verbal and numeric abilities ($r = -0.146$ and -0.125, respectively; all $p < 0.05$).

Table III presents the associations between the risk of ED and academic performance variables. In model 1 (unadjusted model), the risk of ED was negatively associated with all the academic grades (Math, Language, PE and GPA; β ranging from -0.152 to -

0.202), while no significant associations were found with academic abilities. After further controlling for sex, pubertal stage, SES and parental educational attainment (model 2; β ranging from -0.181 to -0.253), and BMI (model 3; β ranging from -0.214 to -0.141), the results for academic grades remained the same. Regarding academic abilities, the risk of ED was negatively associated with verbal and numeric abilities in model 2, and with verbal ability in model 3 (all $p < 0.05$).

Figure 1 displays the differences in academic grades between categories of risk of developing ED, adjusting for potential confounders. Non-risk of ED adolescents (SCOFF score < 2) showed higher academic grades (all $p < 0.01$) compared with those adolescents with risk of ED (SCOFF score ≥ 2). No differences were found for academic abilities between categories of ED risk (data not shown).

Binary logistic regression analysis (Table IV) showed that the risk of ED was three times higher in overweight or obese adolescents than in non-overweight participants (OR = 3.016; 95% CI = [1.212; 7.504]; p = 0.018).

DISCUSSION

The main finding of our study suggests an inverse association between the risk of ED and academic performance in adolescents. Adolescents without risk of ED had higher scores in all the academic grades. Moreover, overweight or obese adolescents showed higher risk of ED. These findings extend the existing scientific knowledge by highlighting the impact of ED on academic performance in adolescents and the importance of considering weight status.

The estimated prevalence of the risk of developing ED in our sample (12.3%) did not show differences between sexes, concurring with Veses et al. (13). However, previous studies have reported higher prevalence rates of the risk of ED in Spanish (i.e., 17% or 21%) (10,25) and German (22%) (26) adolescents showing differences between boys and girls.

The present study reveals an inverse association between the risk of ED and academic grades, verbal ability and numeric ability in adolescents. Additional analyses according ED categories showed higher scores in all the academic grades (Math, Language, PE and GPA) among those adolescents without risk of ED. Our results concur with Veses et al. (10), who analyzed a sample of 1,877 Spanish adolescents showing an inverse

association between the risk of ED and academic grades. However, Gil García et al. (11) did not find differences in academic performance between Spanish adolescents with different levels of risk of developing ED (at risk *vs* not at risk). Such inconsistent findings may be due to methodological aspects, such as the different tools used to assess academic performance and ED or the multifactorial character of academic performance.

Previous studies in patients with ED have shown poor academic and cognitive performance (27). For instance, Yanover et al. (28) analyzed a sample of 1,584 college students concluding that eating disturbance may have a negative impact on academic outcomes. In 2011, Sarrar et al. (29) analyzed a sample of 30 patients with anorexia nervosa showing deficits in cognitive flexibility. More recently, Weider et al. (30) found that patients with anorexia nervosa showed lower performance when compared with the control group, on eight out of 13 cognitive measurements. A possible explanation might be that increased levels of metabolic factors (i.e., cortisol serum) in patients with ED alter synaptic function and brain areas closely linked to learning and memory (31), which may impair cognitive functioning (32). In addition, psychological aspects related to ED could affect attitude, interest, motivation and other behaviors linked to academic success which may impair academic performance in adolescents (33,34).

Our analyses indicate that overweight and obese adolescents might present higher risk of ED than non-overweight and obese adolescents in accordance with prior research (13,35,36). This finding highlights the importance of dealing with obesity and ED jointly (12) and could be explained by different mechanisms. Body dissatisfaction and weight-related teasing in overweight and obese adolescents may encourage behaviors associated with weight control, increasing the risk of ED (37,38). In addition, the lack of self-esteem derived from body image dislike might have relevance for the development of ED in overweight and obese adolescents (39).

Strengths and limitations

These results should be interpreted cautiously because of some limitations. First, the cross-sectional design of our study does not allow to infer a causal relationship. A second significant limitation of this research is the small sample size. Despite these limitations, the main strengths of our study comprise the inclusion of potential

confounders closely related with weight status and academic performance (10,40). Another strength was the use of the SCOFF questionnaire as an effective screening instrument (before its clinical manifestation) with excellent psychometric properties for the early detection of the risk of ED in Spanish adolescents (20,21). In addition, the SCOFF questionnaire has been validated in different languages making possible to establish comparisons between our data and other studies.

CONCLUSIONS

In conclusion, the results of this study suggest a negative association between the risk of ED and academic performance in adolescents, revealing higher risk of ED in overweight and obese adolescents. Early detection of youth at risk of developing ED is highly necessary not only to avoid academic failure, but also to limit its progression, since adolescents showing problematic eating behaviors are predisposed to ED later in life. Therefore, families, educators and policy makers should consider weight and the risk of ED assessments when designing programs aimed to improve academic outcomes.

REFERENCES

1. Giedd JN, Denker AH. The adolescent brain: insights from neuroimaging. In: Brain crosstalk in puberty and adolescence. Research and perspectives in endocrine interactions; vol. 13. Switzerland: Springer International Publishing; 2015. pp. 85-96.

2. Patton GC, Viner R. Pubertal transitions in health. Lancet 2007;369:1130-9.

3. Moreno LA, Gottrand F, Huybrechts I, Ruiz JR, González-Gross M, DeHenauw S. Nutrition and lifestyle in European adolescents: the HELENA (HealthyLiftestyle in Europe by Nutrition in Adolescence) study. Adv Nutr 2014;5(Part 2):615A-23AS.

4. Mairs R, Nicholls D. Assessment and treatment of eating disorders in children and adolescents. Arch Dis Child 2016;101(12):1168-75.

5. Herpertz-Dahlmann B. Adolescent eating disorders. Child Adolesc Psychiatr Clin N Am 2015;24(1):177-96.

6. Favaro A, Caregaro L, Tenconi E, Bosello R, Santonastaso P. Time trends in age at onset of anorexia nervosa and bulimia nervosa. J Clin Psychiatry 2009;70(12):1715-21.

7. Field AE, Javaras KM, Aneja P, Kitos N, Camargo CA, Taylor CB, et al. Family, peer, and media predictors of becoming eating disordered. Arch Pediatr Adolesc Med 2008;162(6):574-9.

8. Lena SM, Fiocco AJ, Leyenaar J. The role of cognitive deficits in the development of eating disorders. Neuropsychol Rev 2004;14(2):99-113.

9. Croll J, Neumark-Sztainer D, Story M, Ireland M. Prevalence and risk and protective factors related to disordered eating behaviors among adolescents: Relationship to gender and ethnicity. J Adolesc Heal 2002;31(2):166-75.

10. Veses AM, Gómez-Martínez S, Pérez de Heredia F, Esteban-Cornejo I, Castillo R, Estecha S, et al. Cognition and the risk of eating disorders in Spanish adolescents : the AVENA and AFINOS studies. Eur J Pediatr 2015;174:229-36.

11. Gil García E, Ortiz Gómez T, Fernández Soto ML. Social profiles, diet, and prediction of eating disorders in urban Andalusian adolescents. Aten Primaria 2007;39(1):7-11.

12. Haines J, Neumark-Sztainer D. Prevention of obesity and eating disorders: a consideration of shared risk factors. Health Educ Res 2006;21(6):770-82.

13. Veses AM, Martínez-Gómez D, Gómez-Martínez S, Zapatera B, Veiga ÓL, Marcos A. Association between excessive body fat and eating-disorder risk in adolescents: the AFINOS Study. Med Clin 2011;136(14):620-2.

14. Babio N, Canals J, Pietrobelli A, Pérez S, Arija V, Arija V. A two-phase population study: relationships between overweight, body composition and risk of eating disorders. Nutr Hosp 2009;24(4):485-91.

15. Neumark-Sztainer D. Obesity and eating disorder prevention: an integrated approach? Adolesc Med 2003;14(1):159-73.

16. Reed ZE, Micali N, Bulik CM, Davey Smith G, Wade KH. Assessing the causal role of adiposity on disordered eating in childhood, adolescence, and adulthood: a Mendelian randomization analysis. Am J Clin Nutr 2017;106(3):764-72.

17. Martin A, Booth JN, McGeown S, Niven A, Sproule J, Saunders DH, et al. Longitudinal associations between childhood obesity and academic achievement: Systematic review with focus group data. Curr Obes Rep 2017;6(3):297-313.

18. Beltran-Valls MR, García Artero E, Capdevila-Seder A, Legaz-Arrese A, Adelantado-Renau M, Moliner-Urdiales D. Regular practice of competitive sports does

not impair sleep in adolescents: DADOS study. Pediatr Exerc Sci 2017;17:1-8.

19. Morgan JF, Reid F, Lacey JH. The SCOFF questionnaire: assessment of a new screening tool for eating disorders. BMJ 1999;319:1467-8.

20. García-Campayo J, Sanz-Carrillo C, Ibáñez JA, Lou S, Solano V, Alda M. Validation of the Spanish version of the SCOFF questionnaire for the screening of eating disorders in primary care. J Psychosom Res 2005;59(2):51-5.

21. Rueda Jaimes GE, Díaz Martínez LA, Ortiz Barajas DP, Pinzón Plata C, Rodríguez Martínez J, Cadena Afanador LP. Validation of the SCOFF questionnaire for screening the eating behaviour disorders of adolescents in school. Aten Primaria 2005;35(2):89-94.

22. Thurstone LL, Thurstone TG. TEA Test de Aptitudes Escolares (Scholar Aptitudes Test). 11th ed. Vol. 77. Madrid: TEA Ediciones S.A.; 2004.

23. Tanner JM, Whitehouse RH. Clinical longitudinal standards for height, weight, height velocity, weight velocity, and stages of puberty. Arch Dis Child 1976;51(3):170-9.

24. Currie C, Molcho M, Boyce W, Holstein B, Torsheim T, Richter M. Researching health inequalities in adolescents: the development of the Health Behaviour in School-Aged Children (HBSC) Family Affluence Scale. Soc Sci Med 2008;66:1429-36.

25. Jáuregui Lobera I, Romero Candau J, Bolaños Ríos P, Montes Berriatúa C, Díaz Jaramillo R, Montaña González MT, et al. Conducta alimentaria e imagen corporal en una muestra de adolescentes de Sevilla. Nutr Hosp 2009;24(5):568-73.

26. Hölling H, Schlack R. Eating disorders in children and adolescents. First results of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS). Bundesgesundheitsblatt Gesundheitsforsch Gesundheitsschutz 2007;50(5-6):794-9.

27. Lang K, López C, Stahl D, Tchanturia K, Treasure J. Central coherence in eating disorders: an updated systematic review and meta-analysis. World J Biol Psychiatry 2014;15(8):586-98.

28. Yanover T, Thompson JK. Eating problems, body image disturbances, and academic achievement: preliminary evaluation of the eating and body image disturbances academic interference scale. Int J Eat Disord 2008;41(2):184-7.

29. Sarrar L, Ehrlich S, Merle JV, Pfeiffer E, Lehmkuhl U, Schneider N. Cognitive

flexibility and agouti-related protein in adolescent patients with anorexia nervosa. Psychoneuroendocrinology 2011;36(9):1396-406.

30. Weider S, Indredavik MS, Lydersen S, Hestad K. Intellectual function in patients with anorexia nervosa and bulimia nervosa. Eur Eat Disord Rev 2014;22(1):15-24.

31. Moult PR, Harvey J. Hormonal regulation of hippocampal dendritic morphology and synaptic plasticity. Cell Adh Migr 2008;2(4):269-75.

32. Blakemore S-J, Choudhury S. Development of the adolescent brain: implications for executive function and social cognition. J Child Psychol Psychiatry 2006;47(3-4):296-312.

33. Petrides KV, Chamorro-Premuzic T, Frederickson N, Furnham A. Explaining individual differences in scholastic behaviour and achievement. Br J Educ Psychol 2005;75(2):239-55.

34. Steinmayr R, Spinath B. The importance of motivation as a predictor of school achievement. Learn Individ Differ 2009;19(1):80-90.

35. Urrila AS, Artiges E, Massicotte J, Miranda R, Vulser H, Bézivin-Frere P, et al. Sleep habits, academic performance, and the adolescent brain structure. Sci Rep 2017;7:41678.

36. Veses AM, Martínez-Gómez D, Gómez-Martínez S, Vicente G, Castillo R, Ortega F, et al. Physical fitness, overweight and the risk of eating disorders in adolescents. The AVENA and AFINOS studies. Pediatr Obes 2014;9(1):1-9.

37. Sepulveda AR, Carrobles JA, Gandarillas AM. Gender, school and academic year differences among Spanish university students at high-risk for developing an eating disorder: an epidemiologic study. BMC Public Health 2008;8(1):102.

38. Neumark-Sztainer D, Falkner N, Story M, Perry C, Hannan PJ, Mulert S. Weight-teasing among adolescents: correlations with weight status and disordered eating behaviors. Int J Obes 2002;26(1):123-31.

39. Haines J, Kleinman KP, Rifas-Shiman SL, Field AE, Bryn Austin S. Examination of shared risk and protective factors for overweight and disordered eating among adolescents. Arch Pediatr Adolesc Med 2010;164(4):336-43.

40. Jiménez Pavón D, Ortega FP, Ruiz JR, España Romero V, García Artero E, Moliner Urdiales D, et al. Socioeconomic status influences physical fitness in European adolescents independently of body fat and physical activity: the HELENA study. Nutr

Hosp 2010;25(2):311-6.

Table I. Characteristics of the study sample for the overall sample and by sex

	All	*Boys*	*Girls*	*p*
	(n = 261)	(n = 138)	(n = 123)	
Age (y)	13.9 ± 0.3	13.9 ± 0.3	13.9 ± 0.3	0.976
Pubertal stage (I-V) (%)	0/8/34/48/10	0/10/33/43/14	0/6/36/53/5	-
Socioeconomic status (0-8)	4.2 ± 1.4	4.0 ± 1.3	4.4 ± 1.4	*0.025*
Parental university degree attainment (%)	48.3	43.5	53.7	0.100
Anthropometry				
Height (cm)	163.1 ± 7.9	164.6 ± 8.6	161.4 ± 6.8	*< 0.001*
Weight (kg)	54.2 ± 9.3	54.4 ± 9.6	53.9 ± 8.9	0.630
BMI (kg/m^2)	20.3 ± 2.7	20.0 ± 2.6	20.7 ± 2.9	0.052
Overweight* (%)	13.0	11.6	14.6	0.466
SCOFF affirmative answers (%)				
Q1: Deliberate vomiting	7.3	6.5	8.1	0.618
Q2: Loss of control over eating	19.5	13.8	26.0	*0.013*
Q3: Weight loss	9.2	11.6	6.5	0.155
Q4: Body image distortion	12.6	8.0	17.9	*0.016*
Q5: Impact of food on life	8.4	8.0	8.9	0.778
SCOFF score (0-5)	0.6 ± 0.9	0.5 ± 0.8	0.7 ± 1.0	0.079
Eating disorder risk (%)	12.3	10.1	14.6	0.270
Academic grades (0-10)				
Math	6.9 ± 1.6	7.0 ± 1.6	6.8 ± 1.6	0.277
Language	6.8 ± 1.5	6.7 ± 1.5	6.9 ± 1.6	0.173
PE	8.1 ± 1.1	8.0 ± 1.1	8.1 ± 1.1	0.468
GPA	7.1 ± 1.3	7.1 ± 1.3	7.2 ± 1.3	0.394
Academic abilities				
Verbal (0-50)	18.7 ± 5.4	19.2 ± 5.9	18.2 ± 4.7	0.132
Numeric (0-30)	13.5 ± 4.8	14.8 ± 4.6	11.9 ± 4.6	*< 0.001*
Reasoning (0-30)	16.5 ± 5.8	16.1 ± 5.7	17.0 ± 6.0	0.198

Overall (0-110)	48.7 ± 12.7	50.1 ± 12.9	47.1 ± 12.3	0.060

Data are presented as mean ± SD or percentages. Differences between sexes were examined by t-test or Chi-square test. Statistically significant values are in bold. *Includes overweight + obese participants. BMI: body mass index; SCOFF: Sick Control on Fast Food; PE: Physical Education; GPA: grade point average. A score ≥ 2 in the SCOFF questionnaire indicates risk of eating disorders. Overall indicates the sum of the three abilities scores.

Table II. Partial correlations between the risk of ED and the study variables controlling for sex, pubertal stage, socioeconomic status, and parental educational attainment (n = 261)

	Weight status	*Academic grades*				*Academic abilities*			
	BMI	Math	Language	PE	GPA	Verbal	Numeric	Reasoning	Overall
SCOFF score	0.262‡	-0.186†	-0.211‡	-0.211‡	-0.261‡	-0.146*	-0.125*	0.019	-0.098

BMI: body mass index; SCOFF: Sick Control on Fast Food; PE: Physical Education; GPA: grade point average. Overall indicates the sum of the three abilities scores. p-value = and *$p < 0.05$, †$p < 0.01$, ‡$p \leq 0.001$.

Table III. Associations of risk of ED with academic performance in adolescents (n = 261)

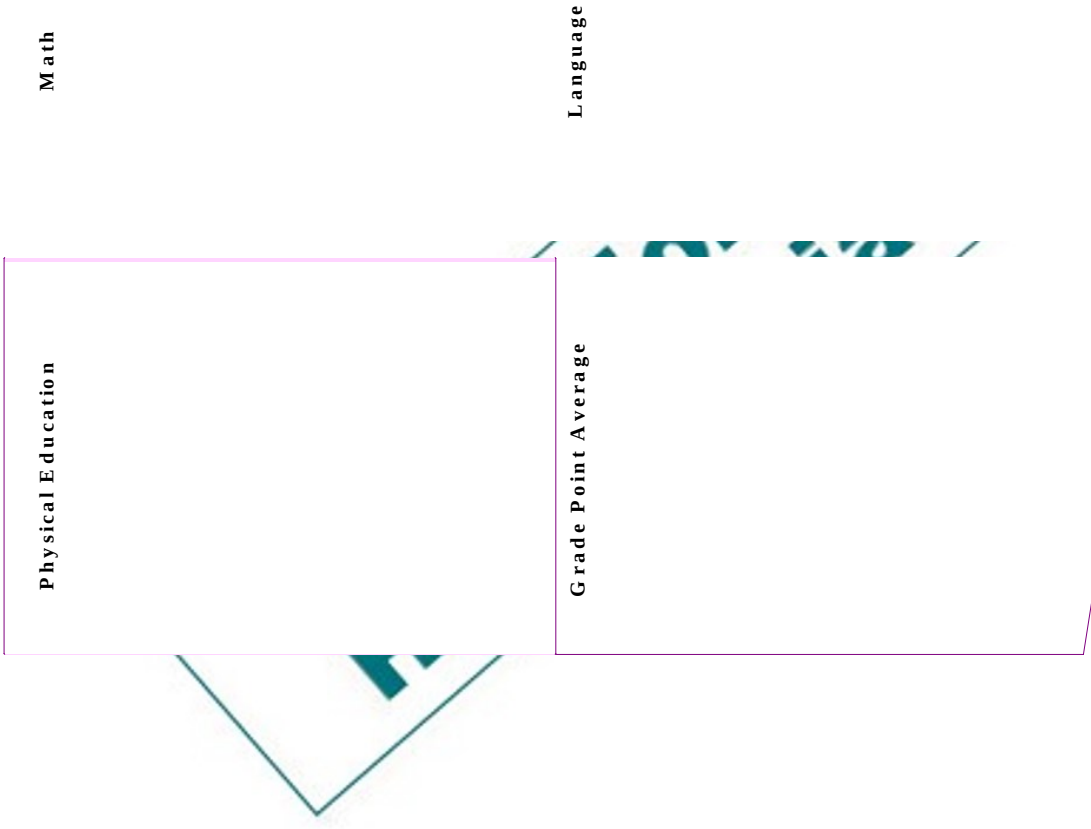
	Model 1		*Model 2*		*Model 3*	
	β	p	β	p	β	p
Academic grades						
Math	-0.152	*0.014*	-0.181	*0.003*	-0.141	*0.022*
Language	-0.159	*0.010*	-0.207	*< 0.001*	-0.163	*0.009*
PE	-0.181	*0.003*	-0.213	*< 0.001*	-0.205	*0.002*
GPA	-0.202	*0.001*	-0.253	*< 0.001*	-0.214	*< 0.001*
Academic abilities						
Verbal ability	-0.113	0.067	-0.146	*0.019*	-0.134	*0.038*
Numeric ability	-0.110	0.076	-0.118	*0.046*	-0.091	0.137
Reasoning ability	0.043	0.491	0.020	0.757	0.052	0.425
Overall	-0.070	0.262	-0.097	0.119	-0.067	0.298

PE: Physical Education; GPA: grade point average; β: standardized coefficient. Model 1: unadjusted. Model 2: adjusted for sex, pubertal stage, socioeconomic status and parental educational attainment. Model 3: adjusted for model 2 + body mass index. Overall indicates the sum of the three abilities scores. Statistically significant values are highlighted in italics.

Table IV. Risk of ED according to weight status, adjusting for sex, pubertal stage, socioeconomic status and parental educational attainment

	OR	95% CI	p
Non-overweight	1	Ref.	0.018
Overweight or obesity	3.016	1.212; 7.504	

OR: odds ratio; CI: confidence interval.



Comentario [MPG3]: - Poner “p” en minúscula y “Grade **p**oint **a**verage” (solo mayúscula inicial).

Fig. 1. ANCOVA analyses showing differences in academic grades between the categories of the risk of ED in adolescents. Estimated mean (dots) and SD represent values after adjustment for sex, pubertal stage, SES, parental educational attainment and BMI.