Hospitalaria

Original

Gender-specific influence of health behaviors on academic performance in Spanish adolescents; the AFINOS study

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Abstract

Introduction: **New paradigms based on the multifactorial etiology of chronic diseases and behavioral outcomes suggest that a combination of health behaviors may have more impact on the outcome of interest than any single factor.**

Objective: **To examine the independent and combined influence of four health behaviors on school performance in Spanish adolescents.**

Methods: **A total of 1825 Spanish adolescents reported their grades in Language and Literature (LL) and Math. Body mass index, family structure and school-related factors (attitude to school, need to repeat ≥ 1-yr and absenteeism) were self-reported. Adolescents were dichotomized as healthy or unhealthy based on meeting or not meeting lifestyle recommendations on physical activity, TV viewing, sleep and fruit intake. Each adolescent was also scored according to the number of healthy recommendations fulfilled.**

Results: **In boys, there were no associations between health behaviors and academic performance. Good academic performance in girls was associated with physical activity ($P < 0.05$) or fruit consumption ($P < 0.05$). Moreover, girls who scored 3-4 health behaviors showed higher odds of passing LL (OR = 3.18, $P < 0.001$), Math (OR = 1.75, $P = 0.028$) or LL+Math (OR = 2.32, $P = 0.001$) compared with those with 0-1 health behaviors. All the analyses were adjusted by weight status, family context and different school-related factors.**

Conclusions: **A combination of health behaviors may have a positive influence on academic performance in adolescent girls.**

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Key words: *Academic performance. Physical activity. Sedentary patterns. Sleep. Nutrition. Adolescents.*

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ROL DEL GÉNERO EN LA INFLUENCIA DE LAS CONDUCTAS SALUDABLES SOBRE EL RENDIMIENTO ACADÉMICO EN ADOLESCENTES ESPAÑOLES; EL ESTUDIO AFINOS

Resumen

Introducción: **Los nuevos paradigmas basados en la etiología multifactorial de las enfermedades crónicas y los resultados en el comportamiento sugieren que la combinación de comportamientos saludables puede tener un impacto más positivo en algún resultado de interés que cualquier otro factor aislado.**

Objetivo: **explorar la influencia independiente y combinada de cuatro comportamientos saludables sobre el rendimiento escolar de adolescentes españoles.**

Métodos: **Un total de 1.825 adolescentes españoles proporcionaron sus notas en lengua y literatura (LL) y matemáticas. El índice de masa corporal, la estructura de la familia y factores relacionados con la escuela (actitud hacia el colegio, necesidad de repetir más de un año y absentismo) fueron autoinformados. Se dividió a los adolescentes en saludables y no saludables en función de si cumplían o no unas recomendaciones de estilo de vida relativas a la práctica de actividad física, tiempo viendo la TV, sueño e ingesta de fruta. También se valoró a cada adolescente en función de número de recomendaciones saludables que cumplían.**

Resultados: **En los chicos, no hubo asociaciones entre los comportamientos saludables y el rendimiento académico. El buen rendimiento académico de las chicas se asoció con la actividad física ($P < 0,05$) y el consumo de fruta ($P < 0,05$). Además, las chicas que cumplían 3-4 recomendaciones de comportamientos saludables tuvieron una mayor probabilidad de aprobar LL (OR = 3,18, $P < 0,001$), matemáticas (OR = 1,75, $P = 0,028$) o LL+Matemáticas (OR = 2,32, $P = 0,001$) en comparación con aquellas con puntuaciones de 0-1. Se ajustaron todos los análisis por peso, contexto familiar y diferentes factores relacionados con la escuela.**

Conclusiones: **una combinación de comportamientos saludables podría tener una influencia positiva en el rendimiento académico en las chicas adolescentes.**

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Palabras clave: *Rendimiento académico. Actividad física. Patrones sedentarios. Sueño. Nutrición. Adolescentes.*

Introduction

Academic performance during secondary education is a major concern for educational and public health organizations.[1,2] Driven by the idea that access to a university education will lead to better future job opportunities, in the Spanish secondary education system, adolescents are pressured to pass examinations annually otherwise they cannot pass to the next grade and have to repeat the entire year's course. Poor academic performance during adolescence may have a negative effect on psychological well-being leading to harmful health consequences such as stress, anxiety, depression and low self-esteem.[3-5] From a public health perspective, it is essential the determinants of academic achievement are well understood so that measures can be designed to improve both intellectual and health factors.

There is certain evidence to suggest that lifestyles may be key determinants of academic achievement in children and adolescents.[6-9] For example, healthy dietary patterns and an active lifestyle might play an important role in academic performance.[6,7] Although backed by more limited evidence, sleep duration and sedentary behavior should also be taken into consideration.[8,9] Nutrition, physical activity, sleep and sedentarism patterns should therefore be among the targets of efforts made to improve academic performance. As far as we know, no study has attempted to assess the independent influence of these four areas of behavior on academic performance in adolescents. Further, new paradigms based on the multifactorial etiology of chronic diseases and behavioral outcomes suggest a combination of health behaviors may have more impact on the outcome of interest than any single factor.[10]

Several investigations have confirmed previous findings regarding the influence of obesity, family context and certain school-related factors on the academic performance of Spanish adolescents.[11,12] Although certain relationships with school achievement such as skipping breakfast have been identified,[12,13] no such study has examined possible associations between other lifestyles and the academic performance of Spanish adolescents. From an educational and public health perspective, the aim of this study was to examine both the independent and combined influence of physical activity, sedentary behavior, sleep and nutrition patterns on the academic performance of Spanish adolescents.

Methods

Participants

Participants for the current study were those enrolled in the AFINOS (La Actividad Física como Agente Preventivo del Desarrollo de Sobrepeso, Obesidad, Alergias, Infecciones y Factores de Riesgo Cardiovascular en Adolescentes: Physical Activity as a Preventive Measure Against Overweight, Obesity, Infections, Allergies and Cardiovascular Disease Risk Factors in Adolescents) study between 2007 and 2008. The AFINOS study rationale and protocols have been described in detail elsewhere.[14] Briefly, the AFINOS study is a cross-sectional survey designed to assess health status and lifestyle indicators through a questionnaire completed by a representative sample of adolescents, aged 13 to 17 years, from the Madrid region. Secondary schools were randomly selected according to the geographic distributions of adolescents in the region. The sample size was calculated taking 0.05 as the maximum permissible error (reliability of 95%) and based on an estimated prevalence of overweight adolescents of 20%. The final sample size calculated at 1998 individuals was increased by 20% to compensate from possible dropouts or data losses to give a final sample size of 2,400 adolescents of both genders. Of these individuals, 1,825 (860 boys and 965 girls) providing valid data on their physical characteristics, academic performance and lifestyle factors, were included in the present study. All volunteers and their parents/guardians gave their written informed consent for participation. The AFINOS study protocol has been approved by the Ethics Committee of the Puerta de Hierro Hospital (Madrid, Spain) and the Bioethics Committee of the Spanish National Research Council.

Lifestyle factors

Physical activity was assessed using the PACE+ (Physician-based Assessment and Counseling for Exercise) questionnaire for adolescents.[15] This questionnaire uses 2 questions to assess physical activity: P1: "Over the past 7-d, on how many days were you physically active for a total of at least 60 min per day? P2: Over a typical or usual week, on how many days are you physically active for a total of at least 60 min per day? Both questions have a scale of 0 to 7 days. The results of this questionnaire correlated moderately ($r = 0.40$) against an accelerometer in the original validity study on an adolescent sample.[15] The Spanish version of the questionnaire has provided similar results for assessing physical activity in Spanish adolescents.[16] Since TV viewing is often used as a broader marker of sedentary behavior, adolescents were asked to self-report how much time they usually spent watching TV both on a usual weekday and on a weekend day without including other sedentary activities (e.g. computer use, surfing the Internet, so on). Similarly, sleep duration during a weekday and a weekend day was also reported. Adolescents filled out a food frequency questionnaire to identify their intake of several food items using an ordinal scale of 1 (never) to 7 (everyday, at least twice) to assess their dietary patterns.

Table I
Descriptive characteristics of the Spanish adolescent sample examined

	All	*Boys*	*Girls*	*P*
n	1,825	860	965	
Physical characteristics				
Age, yr	14.9 (1.3)	14.8 (1.3)	14.9 (1.3)	0.132
Weight, kg	58.6 (11.1)	63.1 (12.1)	54.5 (8.3)	**<0.001**
Height, cm	166.7 (9.1)	170.8 (9.6)	163.0 (6.7)	**<0.001**
Body mass index, kg/m^2	21.1 (3.7)	21.7 (4.6)	20.5 (2.6)	**<0.001**
Overweight + obesity, %	18	26	11	**<0.001**
Family structure				
Both parents living at home, %	79	81	77	**<0.001**
Academic performance				
Passing Language & Literature, %	81	77	83	**0.001**
Passing Math, %	77	79	75	0.059
Passing both subjects, %	69	68	69	0.581
School-related factors				
Poor school attitude, %	40	46	37	**0.001**
Repeating ≥1 yr, %	31	34	29	**0.040**
Absenteeism, %	18	18	18	0.698
Health behaviors				
Physical activity ≥5 d/week, %	22	29	16	**<0.001**
TV viewing <2 hr/d, %	75	76	74	0.184
Sleep duration ≥ 8hr/d, %	66	68	65	0.130
Fruit consumption ≥2 servings/d, %	22	20	24	**0.039**
4/3/2/1/0 health behaviors, %	3/20/43/29/5	4/22/42/27/5	2/17/44/30/7	**0.004**

Health behaviors in the current sample were defined as follows: 1) ≥ 5 d/week of physical activity according to the PACE + criterion;[15] 2) < 2 h/d watching TV according to the American Academy of Pediatrics;[17] 3) ≥ 8 h/d sleeping according to the National Sleep Foundation recommendation for adolescents (www.sleepfoundation.org); 4) ≥ 2 servings of fruit/d according to the AESAN (Spanish Agency for Food Security and Nutrition) for these ages (www.naos.aesan.msps.es). A pragmatic cluster of health behaviors was calculated by adding the number of recommendations fulfilled by each adolescent. This variable graded as 0 to 4 therefore indicated a combination of physical activity, TV viewing, sleep and dietary patterns such that a higher score was taken to indicate a healthier lifestyle.

Academic performance

Adolescents were asked to self-report their last semester grades in two subjects: Language and Literature (LL) and Mathematics. Adolescents reported their grades in these subjects on a 5-point ordinal scale (A, B, C, D, E). The minimum requirement for a "pass" in any subject is grade D, applicable to all secondary schools according to the Spanish Educational System (www.educacion.es). Passing both the subjects LL and Math was also taken to indicate good academic achievement.

Confounders

Several variables associated with both lifestyle factors or academic performances were taken into account.[18,19] Adolescents were asked to self-report their body weight and height. Body mass index (BMI) was calculated as: weight/height^2 (kg/m^2). Overweight and obesity prevalence was calculated using the BMI age- and gender-specific cut offs proposed by Cole et al.[20] Family structure was determined by asking adolescents if their mothers and fathers lived with them at home. The final variable was recorded as the 2 categories: 0 = both parents at home, 1 = mother or father or neither at home. Three school factors that could be related to academic performance were also obtained by questionnaire. First, adolescents rated their school attitude (poor/good). Secondly, adolescents who had had to repeat at least one grade during secondary school were identified by a dichotomized (yes/no) question. Finally, skipping classes recorded, as habitual school absenteeism (yes/no), was also self-reported.

Data analysis

All variables are provided as means (SD) and percentages. Differences between genders were examined by one-way analysis of variance (ANOVA) and the Chi-squared test was used for continuous and categorical variables, respectively. Since associations with academic performance were significantly affected by interactions between gender and the main variables, all analyses were performed separately for boys and girls. Binary logistic regression was performed to analyze the influence of weight status, family structure and academic characteristics (school attitude, repeating ≥ 1 yr, absenteeism) on the academic performance indicators (that is, passing or not

Table II

Independent influence of weight status, family context and school-related factors on academic performance in adolescents (n = 1825)

		n	*Language & Literature Odds ratio (95% CI)*	*P*	*Math Odds ratio (95% CI)*	*P*	*Combined Odds ratio (95% CI)*	*P*
Boys								
Weight status	Overweight†	221	Reference		Reference		Reference	
	Non-overweight	639	0.96 (0.66-1.39)	0.819	1.21 (0.82-1.82)	0.337	1.02 (0.72-1.43)	0.929
Family structure	0-1 parents	166	Reference		Reference		Reference	
	2 parents	694	1.23 (0.83-1.83)	0.215	1.51 (1.01-2.24)	**0.043**	1.41 (0.99-2.02)	0.060
School attitude	Poor	389	Reference		Reference		Reference	
	Good	471	2.02 (1.44-2.82)	**<0.001**	1.51 (1.08-2.11)	**0.017**	1.89 (1.40-2.55)	**<0.001**
Repeating ≥1 yr	Yes	292	Reference		Reference		Reference	
	No	568	7.69 (5.18-11.40)	**<0.001**	4.93 (3.36-7.23)	**<0.001**	6.56 (4.63-9.30)	**<0.001**
Absenteeism	Yes	157	Reference		Reference		Reference	
	No	703	1.63 (1.10-2.41)	**0.015**	1.79 (1.20-2.66)	**0.004**	1.76 (1.21-2.54)	**0.003**
Girls								
Weight status	Overweight†	99	Reference		Reference		Reference	
	Non-overweight	866	1.88 (0.95-3.72)	0.070	0.99 (0.60-1.65)	0.984	1.07 (0.66-1.71)	0.787
Family structure	0-1 parents*	227	Reference		Reference		Reference	
	2 parents	738	1.43 (0.98-2.10)	0.062	2.05 (1.48-2.85)	**<0.001**	1.84 (1.34-2.51)	**<0.001**
School attitude	Poor	357	Reference		Reference		Reference	
	Good	608	2.04 (1.44-2.89)	**<0.001**	1.61 (1.19-2.19)	**0.002**	1.69 (1.27-2.25)	**<0.001**
Repeating ≥1 yr	Yes	285	Reference		Reference		Reference	
	No	680	13.26 (8.59-20.47)	**<0.001**	6.27 (4.46-8.82)	**<0.001**	8.13 (5.81-11.40)	**<0.001**
Absenteeism	Yes	178	Reference		Reference		Reference	
	No	787	2.59 (1.74-3.86)	**<0.001**	2.12 (1.49-3.04)	**<0.001**	2.31 (1.64-3.25)	**<0.001**

Data were adjusted for age. † Including obesity. * Parents living at home.

passing LL or Math or both subjects) controlling for age. The independent (physical activity, TV viewing, sleep duration and diet) and combined (cluster of healthy habits) influence of health behaviors on academic achievement was also analyzed by binary logistic regression (pass/not pass) for each gender controlling for physical characteristics (age, weight status), family structure and school-related characteristics. All statistical analyses were performed using SPSS v.15.0. The level of significance was set at 5% for all tests.

Results

The descriptive characteristics of the adolescent population included in this study are provided in table I. On average, more boys than girls were in the overweight + obesity range ($P < 0.001$). When we examined family structure in this Spanish population, fewer girls than boys had both parents living at home ($P < 0.001$). Significant gender differences were only detected for LL such that a higher percentage of girls passed this subject than boys ($P = 0.001$). No gender effects were observed on passing Math ($P = 0.059$) or passing both subjects ($P = 0.581$). However, girls showed a better school attitude ($P = 0.001$) and had to repeat fewer times during secondary school ($P = 0.04$) than boys. The prevalence of absenteeism was 18% for both genders. Gender differences were nevertheless detected for levels of physical activity ($P < 0.001$) and fruit consumption ($P = 0.039$), but not time spent watching TV ($P = 0.184$) or sleep duration ($P = 0.13$).

The effects of confounder variables (that is, weight status, family context and school-related factors) on academic performance are shown in table II. Overall, a good school attitude, not having to repeat a year and no absenteeism were correlated with good achievement in boys and girls (all $P < 0.05$). The item "both parents at home" was positively correlated with passing Math both in boys (odds ratio 1.51, $P = 0.043$) and girls (odds ratio 2.05, $P < 0.001$), and with passing both subjects in girls (odds ratio 1.84, $P < 0.001$). In contrast, weight status failed to affect the academic performance of boys or girls (all $P > 0.05$).

Table III shows the independent influence of health behaviors on academic performance. In boys, physical activity, TV viewing, sleep duration and fruit consumption habits considered healthy did not affect academic performance independently of weight status, family structure and school-related factors. However, adequate fruit consumption in girls was linked to good academic achievement (odds ratios of 3.10, 1.70, 1.96 for passing LL, Math or both subjects, respectively, all $P < 0.05$). Similarly, a good level of physical activity in girls was also correlated with doing well in Math (odds ratio 1.69, $P = 0.036$) and passing both subjects (odds ratio 1.72, $P = 0.021$) independently of possible confounding factors.

Figure 1 illustrates the combined influence of health behaviors on academic performance. Given the low number of adolescents scoring 0 or 4 for the cluster of healthy behaviors established, we stratified the adolescents into three groups according to the number of healthy recommendations fulfilled (0-1, 2 or 3-4). In

Table III
Independent influence of health behaviors on the academic performance of adolescents (n = 1825)

		n	Language & Literature Odds ratio (95% CI)	P	Math Odds ratio (95% CI)	P	Combined Odds ratio (95% CI)	P
Boys								
Physical activity	<5 d/week	608	Reference		Reference		Reference	
	≥5 d/week	252	1.01 (0.66-1.54)	0.961	0.98 (0.66-1.45)	0.902	1.28 (0.87-1.87)	0.206
TV viewing	≥2 hr/d	204	Reference		Reference		Reference	
	<2 hr/d	656	1.26 (0.82-1.95)	0.294	0.92 (0.60-1.40)	0.691	1.06 (0.72-1.56)	0.784
Sleep duration	<8 hr/d	275	Reference		Reference		Reference	
	≥8 hr/d	585	1.05 (0.69-1.58)	0.824	1.29 (0.88-1.89)	0.200	1.27 (0.88-1.82)	0.202
Fruit consumption	<2 servings/d	687	Reference		Reference		Reference	
	≥2 servings/d	173	0.87 (0.53-1.43)	0.568	1.32 (0.80-2.18)	0.275	1.27 (0.82-1.98)	0.289
Girls								
Physical activity	<5 d/week	811	Reference		Reference		Reference	
	≥5 d/week	154	1.59 (0.88-2.85)	0.121	1.69 (1.03-2.75)	**0.036**	1.72 (1.09-2.73)	**0.021**
TV viewing	≥2 hr/d	255	Reference		Reference		Reference	
	<2 hr/d	710	1.40 (0.93-2.10)	0.105	0.90 (0.62-1.29)	0.556	1.07 (0.76-1.52)	0.692
Sleep duration	<8 hr/d	341	Reference		Reference		Reference	
	≥8 hr/d	624	0.95 (0.64-1.40)	0.780	1.17 (0.84-1.64)	0.355	1.16 (0.83-1.59)	0.395
Fruit consumption	<2 servings/d	233	Reference		Reference		Reference	
	≥2 servings/d	732	3.10 (1.63-5.89)	**0.001**	1.70 (1.10-2.64)	**0.017**	1.96 (1.30-2.97)	**0.001**

Data were adjusted for age, weight status, family structure, school attitude, repeating ≥1 yr, and absenteeism.

terms of odds ratios, boys scoring 2 or 3-4 health behaviors were not more likely to pass LL, Math or both, independently of potential confounding factors. In contrast, girls showing 3-4 health behaviors were more likely to pass LL (odds ratio 3.18, P < 0.001), Math (Odds ratio: 1.75, P = 0.028) or both subjects (odds ratio 2.32, P = 0.001), independently of potential confounders. Moreover, adolescent girls with 2 health behaviors were also independently associated with higher odds of passing LL (odds ratio 2.25, P = 0.025) and both subjects (odds ratio 1.70, P = 0.03). All statistical tests were repeated adjusting for secondary school as a confounding factor and results were unchanged (data not shown).

Discussion

The main findings of our study suggest that a combination of health behaviors (daily physical activity, appropriate TV viewing time, sufficient sleep and adequate daily fruit intake) is related to good academic performance in Spanish secondary school girls independently of weight status, family structure and school-related factors such as skipping classes, repeating a course or a poor attitude to school. In boys, school achievement seems to be more influenced by school-related factors.

Lifestyle indicators including physical activity, sedentary patterns, sleep and fruit consumption have shown some evidence of a beneficial impact on academic performance in children and adolescents.[6-9] In the Spanish educational system, the subjects LL and Math are considered the main indicators of academic achievement in secondary school. We therefore examined the relationship between a series of lifestyle factors and these two subjects in Spanish adolescents. When the independent influence of each factor was examined, significant relations with academic performance were detected in girls but not boys. Thus, girls showing healthier physical activity or fruit consumption habits showed increased odds of passing these academic subjects independently of potential confounders, whereas TV viewing and sleep failed to affect school performance. Some studies have also identified a gender-related association between lifestyle indicators and academic achievement.[21,22] However, most studies report mixed results for boys and girls hindering comparisons. Our results highlight the need to consider gender differences when searching for relationships between lifestyle habits and academic performance.

Physical activity has known beneficial impacts on cognitive function, concentration, memory and classroom attention in children and adolescents.[7,23] Similarly, nutrition quality and dietary patterns seem to play a key role in academic achievement throughout adolescence.[6] Recently, a quasi-experimental crossover-controlled pilot program called 'EatFit' based on 9 lessons of nutrition and physical activity education, reported acceptable results in terms of higher grades obtained in Math and English in 11-14 year-olds, though no differences were detected between genders.[24] Unfortunately, several confounding factors included in our study have not been taken into account in previous studies making comparisons difficult. Although the available evidence is still scarce, it seems that TV viewing and insufficient sleep are inversely associated with academic achievement in children and adolescents.[8,9] The present findings revealed an independent influence only of physical activity and fruit consumption.

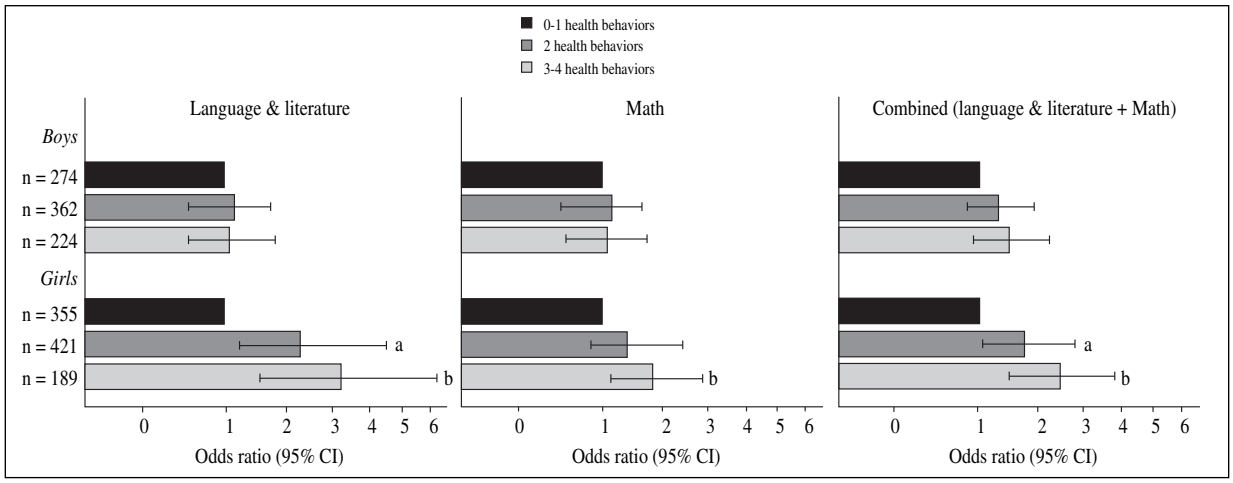

Fig. 1.—Combined influence of health behaviors on the academic performance of adolescents (n = 1825).*

The odds ratios provided are log-transformed. Black bars represent the reference group. Data were adjusted for age, weight status, family structure, school attitude, repeating ≥1 yr, and absenteeism. * Computed as physical activity, television viewing, sleep duration and fruit consumption. [a] $P<.05$. [b] $P\leq.001$.

We also examined the combined influence these four potentially achievable health behaviors on academic performance. Interestingly, despite significant associations only observed in girls, our findings revealed that girls who scored 3-4 health behaviors were more likely to pass LL, Math or both subjects and those who scored 2 health behaviors also showed increased odds of passing LL or both subjects but not Math. It should be noted, that only fruit consumption was independently associated with passing LL but our combined analysis revealed that girls who reported 2, 3 or 4 healthy habits showed increased odds of passing this subject.

No studies have analyzed the combined influence of these four health behaviors on academic performance in secondary school, but several studies focused on two such lifestyles at most. For example, Kristjánsson et al.[18] used a structural equation model to examine the influence of physical activity and TV viewing on the academic performance of 14 and 15-year old Icelandic adolescents. In another study conducted in this population,[19] the combined effects of physical activity and dietary quality patterns on the grades obtained in four subjects were determined (Icelandic, Mathematics, English and Danish). The two studies yielded mixed results.

The implications of our findings are that they could support new concepts of research into health behaviors in preventive medicine and public health.[10] These concepts promote multiple factor intervention rather than interventions targeting a single factor (i.e. physical activity) to obtain greater impacts on health. In line with these new paradigms, our results suggest that a healthy lifestyle may have a beneficial impact on academic performance via three possible mechanisms. Thus, health behaviors could improve intellectual performance [6-9] or have a positive effect on psychological well-being by offsetting the stress, anxiety, or depression induced by the intellectual demands and pressures of secondary school.[3-5] A third possible mechanism is that health behaviors have a key impact on other health indicators related to poor school achievement such as obesity, hypertension and fitness.[25-27] Since the cross-sectional design of our study precludes the identification of causal relationships between variables, further longitudinal and experimental studies are needed to better understand how combinations of lifestyle factors may influence academic performance in adolescents.

In our study, other possible factors that could modify the relationship between lifestyles and academic performance (that is, confounders) were also examined.[18,19] For example, we detected no influence of BMI on the school performance of boys or girls, an observation made by some authors yet disputed by others.[25] Family context, measured as family structure, and the school-related factors attitude to school, need to repeat ≥ 1 year and skipping school showed an influence on academic performance in both genders. These results concur with in a large body of evidence obtained in adolescents from different countries.[11,18,21,28,29]

The strengths of our study include the use for the first time of four well-considered health behaviors, a multiple combined effects analysis controlling for different covariates, and a relatively large sample of Spanish adolescents. Its limitations are that, for example, BMI was only self-reported and is usually considered valuable if it is the only source of data or if it is not included as the outcome variable.[30] Also, we only included one dietary habit in this study to avoid imbalance with the other lifestyle indicators. Skipping breakfast and daily meal patterns have also been correlated with academic performance.[6,22] However, we selected fruit consumption based on the potential to provide health in humans.[31] Unfortunately, habitual measures of socioeconomic status such as parental education or income[32] were not available in the AFINOS study. Finally, although more accurate assessments of lifestyle factors (e.g. objectively measured

physical activity) could be used,[33] overall they have limitations for large-scale research. Therefore, since our lifestyle variables were obtained by self-report, the present findings must be interpreted with caution.

In conclusion, the results of this study suggest that four health behaviors combined (physical activity, TV viewing, sleep and fruit consumption) had a positive influence on academic performance in Spanish adolescent girls, whereas boys were more influenced by school-related factors such as their attitude to school. Studies addressing multiple lifestyle factors are needed to better understand the relationships between lifestyle and academic performance and identify differences between genders.

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