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Associations between parental educational/occupational levels and cognitive performance in Spanish adolescents: The AVENA study

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We examined the associations between parental educational/occupational levels and cognitive performance in Spanish adolescents. Cognitive performance was measured by a validated Scholar Aptitudes test in 2,162 participants. Parental educational and occupational levels were positively associated with all specific cognitive abilities and the overall score (p<001 to .04). The odds ratios of having a high cognitive performance (top quartile) in adolescents with high parental educational level were 1.6 to 1.7 times higher than for those with a low parental educational level. Similarly, the odds ratios were 1.9 to 2.4 times higher for adolescents with high parental occupational level. These findings suggest an association between parental educational/occupational levels and cognitive performance in Spanish adolescents and support the parents' role in the creation of a stimulating intellectual environment.

Asociaciones entre el nivel educativo/profesional de los padres y rendimiento cognitivo en adolescentes españoles: el estudio AVENA. Se examinaron las asociaciones entre el nivel educativo/profesional de los padres y el rendimiento cognitivo de adolescentes españoles. El rendimiento cognitivo se midió mediante un test validado de inteligencia en 2.162 participantes. El nivel educativo y profesional de los padres se asoció positivamente con todas las habilidades cognitivas específicas y la puntuación total (p<0,001 a 0,04). La probabilidad de que los adolescentes tuvieran un alto rendimiento cognitivo (cuartil superior) y padres con nivel educativo alto fue de 1,6 a 1,7 veces superior al de aquellos con padres de bajo nivel educativo. Del mismo modo, las probabilidades fueron de 1,9 a 2,4 veces mayor para los adolescentes con padres de nivel profesional alto. Estos resultados sugieren una asociación entre la educación/profesión de los padres y los niveles de rendimiento cognitivo en adolescentes y confirman el papel que desempeñan los padres en la creación de un entorno intelectual estimulante.

Intelligence or cognitive performance in youth seems to be an important predictor of future physical and psychological health problems (Batty & Deary, 2005; Martin, Fitzmaurice, Kindlon, & Buka, 2004). Furthermore, poor executive functioning is a strong predictor of self-reported poor quality of life in patients with mental disorder (Brissos, Dias, & Kapczinski, 2008) and it is associated with suicidal ideations among patients with depressive symptoms (Dombrovski et al., 2008).

In adolescents, academic achievement seems to be associated with positive psychological-related variables such as self-esteem and self-concept (Fati-Ashtiani, Ejei, Khodapanahi, & Tarkhorani, 2007). A poor cognitive performance during childhood is associated with later in life anxiety disorders (Batty, Mortensen, & Osler, 2005; Martin, Kubzansky, LeWinn, Lipsitt, Satz, & Buka, 2007), stress (Maldonado et al., 2008), coronary heart disease (Batty, Mortensen, Nybo, Andersen, & Osler, 2005) and even with higher morbidity and mortality (Martin & Kubzansky, 2005; Whalley & Deary, 2001). Moreover, there is evidence about how intelligence is an important predictor of future occupational level and is related to the ability of handling successfully the situations in workplace and activities of the daily life (Gottfredson, 1997; Schmidt & Hunter, 2004).

One of the most widely environmental conditions investigated related to cognitive performance, are socioeconomic factors (Sirin, 2005). These factors can be understood as social and economical advantages or disadvantages experienced by family members during the life. Previous scientific literature showed that different socioeconomic factors seem to be associated with poor physical health (Melchior, Moffitt, Milne, Poulton, & Caspi, 2007; Yarnell et al., 2005) and psychological problems such as depressive symptoms or anxiety disorders (Eaton, Muntaner, Bovasso, & Smith, 2001; Merikangas, 2005). Furthermore, it has been reported that socioeconomic factors, like parental education, father's occupation and parental income are also related to intelligence and socioeconomic success (Strenze, 2007). Others research pointed relationships between different aspects of socioeconomic status and their children's cognitive performance, such as verbal and

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numeric abilities (Noble, Farah, & Mcandliss, 2006; Sutton & Soderstrom, 1999). Recent findings with Latin-American students aged 5 to 16 years old, also indicated that school type (private vs public) seems to be related to attention and memory tasks. Those students attending to private school and with high parental educational level have a better performance in cognitive abilities (Villaseñor, Martín, Díaz, Rosselli y Ardila, 2009).

The present study aimed to explore the relationships of parental educational, occupational levels, as well as type of school, with cognitive performance in Spanish adolescents participating in The AVENA (Alimentación y Valoración del Estado Nutricional de los Adolescentes / Feeding and assessment of nutritional status of Spanish adolescents) study.

Method

Participants

A total of 2,162 adolescents (1,016 males and 1,146 females) with complete and valid data on cognitive performance and parental educational and occupational levels were included in the present study. Identification of pubertal development was assessed according to Tanner & Whitehouse (1976). Self-reported breast development in girls, and genital development in boys, was used for pubertal stage classification.

Instruments

Socioeconomic factors

Detailed description about the socioeconomic assessment, as well as an analysis of the representativeness of the AVENA participants concerning the study socioeconomic factors can be found elsewhere (Chillon et al., 2009).

Parental educational level

Both parents were asked to fill in a questionnaire about their educational level. Possible answers were: primary school, secondary school/technical training or university degree. The minimum education periods used for classification, which is in agreement with the Spanish education system, was 8 years for primary school, 4 years for secondary school/technical training and 3 or more years for university degree.

Parental occupational level

Both parents were asked to answer a number of questions concerning their current occupation. The questions were adapted from, and classified according to the Spanish Society of Epidemiology (Álvarez-Dardet, Alonso, Domingo, & Regidor, 1995; Berra et al., 2006). Three categories of parental occupational levels were established: managerial, skilled worker and unskilled worker/ unemployed or household. These three categories shall be referred to as high, medium and low occupational level, respectively.

Type of school

The schools were classified as public or privates. Public schools are those funded by the national government, whereas private schools are those not funded by the national government (the costs of the education are fully assumed by parents).

Cognitive performance

Cognitive performance was measured by the TEA test (Scholar Aptitudes Test) (Thurstone & Thurstone, 1998). The TEA is a Spanish version of the «SRA Test of Educational Ability» (Thurstone & Thurstone, 1958). TEA is a complete cognitive test battery that assesses intelligence by means of three basic school skills: verbal, numeric and reasoning. The TEA test battery provides three complexity levels: level 1 for children aged 8 to 12 years, level 2 for those aged 11 to 14 years and level 3 for adolescents aged 14 to 18 years. Based on the age range of our sample, we used the level 2 and 3. The psychometric properties of level 2 TEA test battery showed an internal consistency reliability of α= 0.78, for verbal component, α= 0.83 for numeric, α= 0.88 for reasoning and α= 0.92 for total score. Regarding level 3, internal consistency reliability was α= 0.74 for verbal, α= 0.87 for numeric, α= 0.77 for reasoning and α= 0.89 for total score. The TEA test battery administration is collective and requires 42 and 27 minutes for level 2 and 3, respectively.

Verbal ability assesses command of language, verbal identification, verbal reasoning, understanding of synonyms and vocabulary. Numeric ability assesses speed and precision in performing operations with numbers and quantitative concepts. Reasoning ability assesses logical ordination criteria in sets of figures, numbers and letters. Direct scores were obtained for each of these parameters and we also computed a total score variable by summing up the individual scores of the three items.

Procedure

The AVENA study is a cross-sectional study designed to assess the nutritional status in a sample of urban Spanish adolescents aged 13-18.5 years (González-Gross et al., 2003; Moreno et al., 2003). The population was selected by multiple-step, simple random sampling - first taking into account location (Granada, Madrid, Murcia, Santander and Zaragoza) and then by random assignment of the school within each city. The cities were chosen according to the population rate (>100.000 inhabitants), geographical location in the country and taking into account a main practical issue, the presence of a qualified research group in the city. Sample size was stratified by age and sex. The socio-economic variable was considered to be associated to location within the city and type of school. As the selection of schools was done by random selection proportionally to the number of schools in each city district, guaranteeing the presence of almost one school per district, the socio-economic variable was also considered to be randomly assigned. To calculate the number of adolescents to be included in the AVENA study, we selected the variable with the greatest variance for this age group from the data published in the literature at the time the study was planned; that was body mass index (Moreno, Fleta, Mur, Feja, Sarria, & Bueno, 1997).

Parents and school supervisors were informed about the nature and purpose of the study, and written consent to participate was requested. The study protocol was designed and followed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki (amended in Hong-Kong in 1989 and in Edinburgh in 2000), and was approved by the Review Committee for

Research Involving Human Subjects of the Hospital Universitario Marqués de Valdecilla (Santander, Spain).

Data analysis

The association between parental educational level and occupation level was assessed by chi-squared analysis and the associations between parental educational and occupational levels and cognitive performance were assessed by one-way analysis of covariance (ANCOVA). Parental education/ occupation and type of school were fixed factors (exposures), and verbal, numeric, and reasoning ability as well as total score, were dependent variables (outcomes). For those cases where significant associations were found, we estimated the effect size of the differences between the upper and the lower categories for the different socioeconomic factors. Effect size statistics is a measure of the magnitude of effect and in this study it was assessed using Cohen's *d* (standardized mean difference) (Nakagawa & Cuthill, 2007). 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 used binary logistic regression models to determine the odds of having a high (top sex- and age-specific quartile) total score, according to parental educational/ occupational levels and type of school. We set low education, low occupation and public school as reference groups, and sex and age were entered as covariates.

We merged maternal and paternal educational level into a single variable, in order to study the combined effect of having both mother and father with a high/low educational level. This new variable had 4 possible categories: 0= both primary, 1= at least one secondary, 2= only one university, 3= both university; category 0 was set as reference group. The same categorization was used for occupational level.

Results

Table 1 shows the descriptive characteristics of the study sample. Maternal and paternal educational levels were classed as university in 46% and 51% of the study sample (respectively). Maternal occupational level was «low» in 53% of the participants, while paternal occupational level was «low» only in 4% of the sample.

Table 1
Descriptive characteristics of the study sample

	All	Males	Females
Pubertal status (I/II/III/IV/V)[a]	0/3/12/44/41	0/4/14/38/44	0/1/10/50/39
Maternal educational level (P/S/U)[a]	36/18/46	35/19/46	37/18/45
Paternal educational level (P/S/U)[a]	31/18/51	30/19/51	31/18/51
Maternal occupational level (L/M/H)[a]	53/31/17	51/31/19	54/31/15
Paternal occupational level (L/M/H)[a]	4/63/33	5/62/33	4/64/32
Verbal ability	20.9 (6.4)	21.4 (6.6)	20.4 (6.2)
Numeric ability	14.0 (5.1)	15.2 (5.3)	13.0 (4.8)
Reasoning ability	18.1 (5.7)	17.4 (5.9)	18.7 (5.4)
Total score	52.9 (14.2)	53.9 (15.0)	52.1 (13.6)

All values are means (standard deviation) or percentages [a]. P, Primary; S, Secondary; U, University; L, Low; M, Medium; H, High

Chi-square analysis revealed that there is a significant relationship between maternal educational level and occupational level in males (χ^2= 146.36; p<0.001) and in females (χ^2= 193.19; p<0.001). Likewise, there was a significant relationship between paternal educational level and occupational level in males (χ^2= 147.11; p<0.001) and in females (χ^2= 164.55; p<0.001).

Associations of parental educational, occupational levels and type of school with cognitive performance are displayed in tables 2, 3 and 4, respectively. Significant and positive associations were found between parental educational or occupational level and total score in males and females (p values ranging from <0.001 to 0.017). Parental educational and occupational levels were positively associated with verbal and reasoning ability in males and females (p for values ranging from <0.001 to 0.02). Parental educational and occupational levels were positively associated with numeric ability in females (p values ranging from 0.003 to 0.044), whereas in males, paternal educational level (p= 0.005) was associated with numeric ability. These results remained similar, when all the analyses were repeated controlling type of school.

Additional analysis (exposure: educational level) further controlling for maternal occupational level attenuated the associations and only verbal ability remained significant in males (p= 0.018), whereas in females, both reasoning ability and total score remained significant (p= 0.002 and 0.015, respectively). The associations between parental occupational levels and cognitive performance remained similar after further adjusting for educational level (data not shown).

Attendance to private school was positively associated with total score and verbal ability in males and females (p values ranging from <0.001 to 0.015), with reasoning ability only in males (p<0.001) and with numeric ability only in females (p= 0.033). When the analyses were repeated controlling for parental educational or occupational levels, results remain similar.

The effect size (Cohen's *d*) for the significant differences between the upper and lower categories of the socioeconomic factors studied ranged from 0.2 to 0.5, indicating small to medium effects.

The odds of having a high (top sex- and age-specific quartile) cognitive performance in adolescents with high parental educational or occupational level were 1.6 to 2.4 times higher than for those with a low parental educational or occupational level (table 5). In relation to school type, the odds of having a high cognitive performance was 1.5 times higher in adolescents attending private schools than those attending public schools (table 5). When the analyses were repeated using the top tertile or quintile to define high cognitive performance, instead of the top quartile, the results persisted (data not shown). Also, when all the analyses were adjusted for sexual maturation (Tanner) instead of age, the results did not change (data not shown).

Figure 1 shows that the odds of having high cognitive performance in those adolescents whose both parents had university educational level, was 1.8 times higher than those whose both parents had primary educational level. The odds of having high (top sex- and age-specific quartile) cognitive performance in adolescents whose both parents had a high occupational level was 2.7 higher than those whose parents had non-qualified occupations. To have one or both parents with high educational level did not substantially affect the odds for high cognitive performance in their offspring. The same pattern was observed for occupational level.

Table 2
Associations of maternal and paternal educational level with cognitive performance, after adjusting for age

		Parental educational level														
		Maternal								Paternal						
			Primary		Secondary		University		P		Primary		Secondary		University		P
Males		*n*								*n*							
	Total score	780	52.9	(0.9)	54.7	(1.2)	56.8††	(0.7)	**0.003**	764	50.8	(0.9)	54.7	(1.2)	57.9†††	(0.7)	**<0.001**
	Verbal ability	780	20.6	(0.4)	22.1	(0.5)	22.5††	(0.3)	**0.001**	764	19.9	(0.4)	21.5§	(0.5)	23.1†††	(0.3)	**<0.001**
	Numeric ability	780	15.4	(0.3)	15.3	(0.4)	15.8	(0.3)	0.467	764	14.7	(0.3)	15.4	(0.4)	16.1††	(0.3)	**0.005**
	Reasoning ability	780	17.0	(0.4)	17.3	(0.5)	18.5††	(0.3)	**0.003**	764	16.1	(0.4)	17.8*	(0.5)	18.7†††	(0.3)	**<0.001**
Females																	
	Total score	979	50.3	(0.7)	54.3**	(1.0)	53.6††	(0.6)	**<0.001**	949	49.6	(0.8)	53.4*	(1.0)	54.1†††	(0.6)	**<0.001**
	Verbal ability	979	19.8	(0.3)	20.8	(0.4)	21.1†	(0.3)	**0.012**	949	19.8	(0.4)	20.5	(0.5)	21.1†	(0.3)	**0.015**
	Numeric ability	979	12.6	(0.3)	13.5	(0.3)	13.3	(0.2)	**0.043**	949	12.3	(0.3)	13.4	(0.4)	13.5††	(0.2)	**0.003**
	Reasoning ability	979	18.0	(0.3)	20.0***	(0.4)	19.2††	(0.2)	**<0.001**	949	17.5	(0.3)	19.5***	(0.4)	19.5†††	(0.2)	**<0.001**

Values are mean (standard error of the mean). * Differences Secondary vs Primary. § Differences University vs Secondary. † Differences University vs Primary
One symbol indicates P<0.05, two symbols indicates P<0.01 and three symbols indicates P<0.001

Table 3
Associations of maternal and paternal occupational level with cognitive performance, after adjusting for age

		Parental occupational level														
		Maternal								Paternal						
		N	Low		Medium		High		P	N	Low		Medium		High		P
Males																	
	Total score	732	53.4	(0.7)	56.5*	(1.0)	58.2††	(1.2)	**0.001**	665	55.1	(2.6)	54.2§	(0.7)	57.9	(0.8)	**0.011**
	Verbal ability	732	20.9	(0.3)	22.6*	(0.4)	23.3††	(0.6)	**<0.001**	665	19.9	(1.2)	21.5§§	(0.3)	23.2†	(0.4)	**0.001**
	Numeric ability	732	15.4	(0.3)	15.7	(0.4)	16.1	(0.4)	0.460	665	16.2	(0.9)	15.5	(0.3)	15.9	(0.3)	0.503
	Reasoning ability	732	17.0	(0.3)	18.2	(0.4)	18.8††	(0.4)	**0.003**	665	19.0	(1.0)	17.3§§	(0.3)	18.7	(0.4)	**0.006**
Females																	
	Total score	923	51.1	(0.6)	54.0**	(0.8)	56.2†††	(1.1)	**<0.001**	801	46.8	(2.3)	52.6*	(0.6)	54.2††	(0.8)	**0.006**
	Verbal ability	923	20.0	(0.3)	21.2*	(0.4)	22.1††	(0.5)	**<0.001**	801	19.4	(1.0)	20.3§	(0.3)	21.5	(0.4)	**0.020**
	Numeric ability	923	12.7	(0.2)	13.4	(0.3)	14.2††	(0.4)	**0.003**	801	11.3	(0.8)	13.2	(0.2)	13.5†	(0.3)	**0.044**
	Reasoning ability	923	18.4	(0.2)	19.5*	(0.3)	19.9††	(0.4)	**0.001**	801	16.1	(0.9)	19.1	(0.2)	19.3††	(0.3)	**0.004**

Values are mean (standard error of the mean). * Differences Medium vs Low. § Differences High vs Medium. † Differences High vs Low
One symbol indicates P<0.05, two symbols indicates P<0.01 and three symbols indicates P<0.001

Discussion

We examined the association between socioeconomic status and cognitive performance in Spanish adolescents. The results suggest a rather consistent positive association between parental educational/ occupational levels and cognitive performance. Overall, our findings indicated that male and female adolescents with parents highly educated and/or having high occupational level had better results on verbal, numeric, reasoning abilities and total score, compared to their peers whose parents had a lower educational or occupational level. Our results also suggest that parental educational level, especially paternal educational level, when adjusted by their occupational level, is still related to a better cognitive performance in nearly all the study cognitive performance variables. Moreover, attending to a private school was associated with a better cognitive performance compared to adolescents attending to public schools, yet but given the important differences between the samples these results should be taken with caution. The small/medium effect size observed for the associations of parental educational and occupational levels with cognitive performance, indicates the multifactorial determinants of adolescent cognition.

Table 4
Associations between type of school and cognitive performance, after adjusting for age

		Type of school						
		N	Public		N	Private		P
Males								
	Total score	909	53.3	(0.5)	106	59.9	(1.5)	**<0.001**
	Verbal ability	909	21.0	(0.2)	106	24.4	(0.6)	**<0.001**
	Numeric ability	909	15.1	(0.2)	106	15.8	(0.5)	0.236
	Reasoning ability	909	17.1	(0.2)	106	19.8	(0.6)	**<0.001**
Females								
	Total score	1076	51.8	(0.4)	70	56.1	(1.6)	**0.013**
	Verbal ability	1076	20.3	(0.2)	70	22.2	(0.7)	**0.015**
	Numeric ability	1076	12.9	(0.1)	70	14.2	(0.6)	**0.033**
	Reasoning ability	1076	18.6	(0.2)	70	19.7	(0.7)	0.112

Values are mean (standard error of the mean)

Table 5
Odds ratios of having a high (top sex- and age-specific quartile) cognitive performance according to socioeconomic factors (parental educational, occupational levels and school type), after adjusting for sex and age

		N	OR	95% CI	P
Parental educational level					
	Primary		1	Reference	
Maternal	Secondary	1655	1.44	1.06-1.96	**0.02**
	University		1.60	1.25-2.04	**<0.001**
	Primary		1	Reference	
Paternal	Secondary	1655	1.36	0.97-1.89	0.06
	University		1.73	1.34-2.24	**<0.001**
Parental occupational level					
	Low		1	Reference	
Maternal	Medium	1466	1.35	1.06-1.73	**0.02**
	High		1.86	1.40-2.48	**<0.001**
	Low		1	Reference	
Paternal	Medium	1466	1.76	0.91-3.43	0.09
	High		2.36	1.21-4.65	**0.01**
Type of school					
	Public		1	Reference	
	Private	2161	1.52	1.08-2.12	**0.01**

OR odds ratio, CI confidence interval

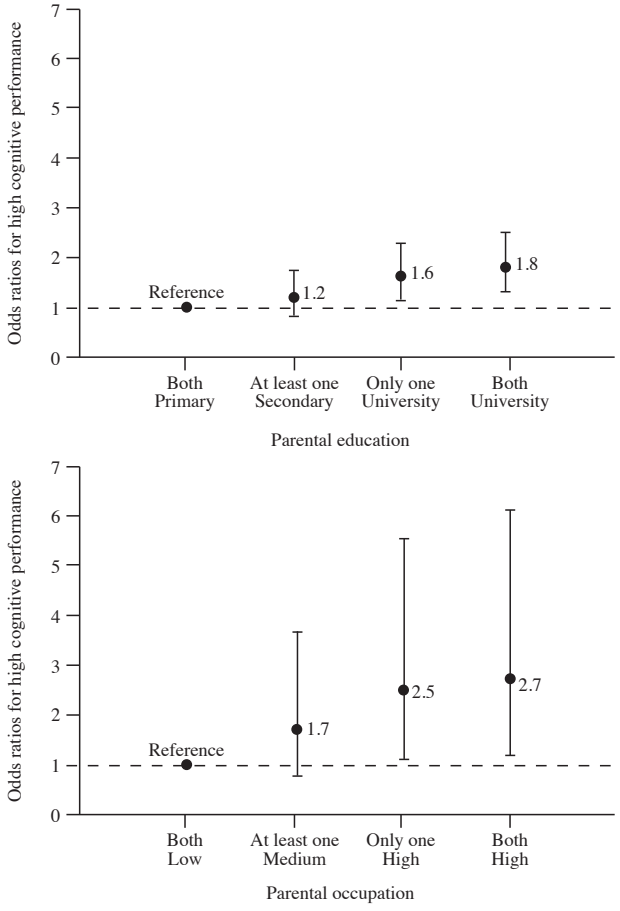

Figure 1. *Odds ratios of having a high (top sex- and age-specific quartile) cognitive performance according to parental education and occupation (combined effect). * Adjusted for sex and age*

Our results concur with previous literature in relation to several socioeconomic factors and cognitive achievement (Sirin, 2005). Indeed, the Sirin's review (2005) concluded that academic performance is widely influenced by stundent's family socioeconomic characteristics. In fact, the currently available research indicates that some socioeconomic factors are important predictors of cognitive ability in childhood, affecting the development of these abilities from infancy through adulthood (Bradley & Corwyn, 2002), a prospective cohort study conducted in a sample of children aged 2 to 13 years reported that father's occupation was related to childhood cognitive development

(Tong, Baghurst, Vimpani, & McMichael, 2007). Furthermore, it has been previously reported how variables related to schools characteristics, like teacher salary and pupil- teacher ratio, were the best predictors of student's reading and mathematics scores (Sutton & Soderstrom, 1999).

Overall, socioeconomic factors seems to have an influence on brain development, a recent study showed the effects in language and working memory (Hackman & Farah, 2009). Another finding in this area suggest an influence of parent's educational level and type of school in participant's executive function (5 to 14 years old), particularly, this association was seen in verbal test scores (Ardila, Rosselli, Matute, & Guajardo, 2005). Similar results have been shown in a recent study where school type and parental educational level seems to be related to attention and memory abilities and how this fact can be related to a better development of verbal abilities and vocabulary acquisition (Villaseñor, Martín, Díaz, Rosselli y Ardila, 2009). Noble et al., showed a similar association of socioeconomic factors with neurocognitive function, particularly in language abilities (Noble, McCandliss, & Farah, 2007) as well as reading skills (Noble, Farah, & McCandliss, 2006). All these findings concur with our work, which all the studied socioeconomic factors were associated with a better cognitive performance, especially, those related to verbal ability.

Cross-sectional designs do not allow stating the direction of the associations. However, the results from this study can be interpreted as the influence of parental educational and occupational levels on cognitive performance, rather than the other way around.

Some limitations of the current study must be acknowledged. It is well accepted that parental educational and occupational levels are good indicators of socioeconomic status, however, others socioeconomic indexes should be taken into account such as family income or affluence (Bradley & Corwyn, 2002; Sirin, 2005). As another limitation, our data are based on cross sectional design, so we couldn't be able to prove if the effect of parental educational or occupational levels on adolescents' cognitive performance remains stable throughout cognitive development.

In conclusion, the results suggest that a high parental educational and occupational level and also the type of school (private vs. public), was positively associated with better cognitive performance in a sample of Spanish adolescents. These findings support the role that parents have in the creation of a stimulating intellectual environment for their children in order to reduce possible socioeconomic inequalities, ensure optimal and equal development, social support and opportunities to succeed related to cognitive performance in their offspring.

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