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Relationship between socioeconomic factors and intelligence of preschoolers: A cohort study in the Serbian context

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Abstract

The aim of the current research is to analyse the relationship between the socioeconomic status (SES) of parents and intellectual abilities (IQ) of preschool children of Serbian territory, and in particular how SES factors relate to preschool children's IQ measured with Raven's Coloured Progressive Matrices (CPM), in the different age groups. The research included 430 parents and 430 preschool children. A confirmatory factor analysis of the SES questionnaire revealed five factors: educational and professional status of father and mother, residential and educational status of the family, sport status of parents and comfort of family housing. No gender differences in IQ levels were found in children. Multiple linear regression at four age groups showed that the educational status of the parents and residential and educational status of the family was positively correlated with the IQ at the older groups of preschool children. Two groups of children with the lowest and highest Raven's CPM scores (1st and 4th quartiles) were used in the Logistic Regression, which determined the significant predictive value of SES factor in children with low Raven's CPM scores. The results of the current research are in line with other studies on the topic, emphasizing the critical role of social environment for cognitive abilities of children.

Keywords Pre-schoolers · Intelligence · Raven's coloured progressive matrices · Socioeconomic factors · Family

Introduction

Socioeconomic status (SES) identifies an individual's position within a hierarchical social structure (Campbell et al. 2018), whose inequality is one of the major causes of differentiation among people, including children and youth, in terms of physical, socio-emotional and cognitive abilities (Chen et al. 2019; Hackman et al. 2010; Mollborn et al. 2014; Ronfani et al. 2015).

Social scientists have been researching how inequalities affect children's development and school achievement, and they have drawn on several concepts of advantage and disadvantage, among which socioeconomic resources are significantly important (Bradley and Corwyn 2002). Furthermore, the importance of SES influence on cognitive development is recently recognized by neuroscientists (Hackman et al. 2010; Jednoróg et al. 2012; Machlin et al. 2020; Ronfani et al. 2015).[1] Furthermore, Jednoróg et al. (2012) found that lower SES status was related to smaller volumes of the grey matter in several brain aries in children. Influence of SES on IQ is somehow circular, because, higher level of IQ is also related to a higher SES of an individual later in life (Strenze 2007).

In several articles, SES is operationalized as a quantification of a family income and educational and occupational level of parents (Bradley and Corwyn 2002; Hanscombe

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[1] For example, neurophysiological studies emphasized that SES influences neural development through different environmental aspects, for instance, prenatal factors, parental care and cognitive stimulations, nutrition, drug and alcohol abuse and many others.

et al. 2012; Sirin 2005; White 1982). In other words, the main function of SES is to measure the quality of child's environment (Turkheimer et al. 2003; Propper and Rigg, 2007; Coleman and Dyment, 2013). Therefore, the analysis of socioeconomic status (SES) and, more specifically, the relation between parents' SES and intellectual abilities of their children, also reveals the influence of inherited and environmental factors. In doing so, identifying the extent of the heritage and the social environment in which children live in the development of their intellectual abilities could be not easy (Turkheimer et al. 2003). The narrower and wider environment (socio-cultural context) in which the child lives and is educated can be defined by conditions in the household, kindergarten, school, formal and informal groups of children and adults, and socio-economic living conditions. The term "inherited" includes all the factors not related to a narrower or wider environment (physical, social, cultural, spiritual environment of the child), and can be understood as a compilation of inherited traits, obtained from biological parents; innate traits, created by mutations and segregations in the genetic code of the child; constitutional aspect, referred to the variability in the body's constitution, morphological structure and functioning; congenital trait, created during the development in the biological mother's uterus (Plomin and Deary 2015).[2]

According to Kline (1991), the IQ test scores in Western Europe and US Caucasians could be attributed to genetic factors of up to 65% of the population variance, and around 40% to environmental factors. Later on, other authors suggested that test scores in the intelligence field are not constant across racial or socio-economic lines (Nisbett et al. 2012). Turkheimer et al. (2003) found that in poor environmental conditions, almost 60% of IQ variability can be attributed to the shared environment, and the influence of genes is close to zero. On the other side, families with high SES conditions have shown opposite results: the study of Hanscombe et al. 2012 has shown that the effect of the shared environment on the IQ in children with different ages was greater for the children from low SES families. In fact, children from low SES families tend to read less, have fewer books, and spend more time watching television. Furthermore, their parents tend to be less responsive to children and the school activities are not in their focus. However, the above mentioned authors realised that the environmental influence declines with the age. In other words, environmental interventions are more beneficial for children in lower SES families and in early childhood. These benefits of environmental interventions have already been demonstrated in the study with adopted children (Duyme et al. 1999; Christoffersen 2012).

Considering the importance of the topic, this paper represents an empirical contribution to the issue, with a focus on preschool[3] children in Serbian society. Serbia is located in Southeast Europe, and its society has undergone intense post-socialist and post-war transformation in the last 30 years. Until 1991, Serbia was a republic of the former Federal Republic of Yugoslavia. With the outbreak of civil war on the territory of other republics (Croatia and Bosnia and Herzegovina), as well as the secession of those and other republics (Slovenia and Macedonia, and Montenegro in 2006). Serbia became a state to which 617,728 refugees have migrated from the former Yugoslav republics (UNHCR, CRRS 1996; Lukić 2016). There has been a intensive pauperization of the population due to international economic sanctions and hyperinflation. In the first decade of the twenty-first century, post-socialist transformation was still a key feature of the social relations system, which directly reflected on the everyday life of citizens (Lazić 2011). This transformation encompasses all aspects of life of social actors and is conditioned by the general impoverishment of the population, which is visible in all areas of social life (Milošević et al. 2016). As this transition has its repercussion on the SES of the society, exploring the relationship between the SES of the family and the development of the children should be in the research scope since the quality of this development influences the quality of adulthood and therefore the whole society. By focusing the research on the relation between SES and the intellectual abilities of preschool children, the authors of this research made an additional effort to explore which aspects of the parents' SES affect the intellectual abilities of preschool children in Serbia, as a socio-cultural context.

The main goal of this research is to explore the relationship between pre-school children's cognitive ability and SES of their family. To fulfil this goal, at first we wanted to explore the factor structure of the SES questionnaire in order to determine which component of the SES of the family has the strongest relation with the children's IQ. Additionally, we wanted to explore the relation of SES with different age categories, since it was found that the correlation of SES with IQ varies with age (Hanscombe et al. 2012; Piccolo et al. 2016; Von Stumm and Plomin 2015). Finally, we want to evaluate the difference between low-IQ and high-IQ children in terms of influence by SES factors.

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[2] There could be an interaction between the factors of the child's environment and genetic inheritance from their parents that is most commonly represented as linear, although researchers are aware of potential existence of nonlinear effects, moderator effect and the effects of SES that are not straightforward as it was previously thought.

[3] In accordance with the legislation of the Republic of Serbia, preschool age is 3 to 7 years of age and is usually divided into younger children from 3 to 4 years, middle aged from 4 to 5 years and older from 5 to 6 until the child has left school. In this paper, the expression "preschool age" refers to the children of the oldest preschool population: children from 5 to 7 years old.

Methods

Sample

The sample was made up of 860 participants, including 430 parents and 430 children (235 boys, 195 girls) from 5 to 7 years old (6.1 ± .5 decimal years). All children had been attending kindergarten within preschool institutions in four cities of autonomous provinces of Vojvodina. Having in mind that all children were attending a state-run kindergarten in a society that has been undergoing a process of post-socialist transformation until recently, it should be emphasized that the socio-economic situation of their families is similar to some extent. Parents voluntarily agreed to participate in the study and gave their consent for the participation of their children.

Measures

Measurement and data collection procedures were organized and implemented in collaboration with pre-schools and educators of children covered by the survey. In all preschools, the conditions for the implementation of data collection were the same.

Socioeconomic Status of Parents In order to define the socio-economic status of parents, the SSMAXIP questionnaire was administered (Hošek 2004). The questionnaire is generally made up of 24 questions. In this study, two indicators have been deleted from data processing due to their low communalities. The reduced questionnaire contained 22 indicators: 1) education of the father, 2) education of the mother, 3) father's knowledge of foreign languages, 4) mother's knowledge of foreign languages, 5) type of father's secondary school, 6) type of mother's secondary school, 7) qualifications of the father, 8) qualifications of the mother, 9) education of paternal grandfather, 10) education of maternal grandfather, 11) type of place where the father spent his childhood, 12) type of place where the mother spent her childhood, 13) type of present place of family, 14) number of children in family, 15) position of the father in his work organization, 16) position of the mother in her work organization, 17) size of the apartment (house), 18) monthly household income, 19) father's involvement in sports organizations, 20) mother's involvement in sports organizations, 21) father's sports results, and 22) mother's sports results. All indicators contained a scale of 5–7 categories of assessment of the corresponding characteristics.

This set of indicators should cover five out of six socioeconomic factors defined by Hošek-Momirović and Bala (2007), namely vocational-educational status of the father, vocational-educational status of the mother, residential status of the family, cultural level of the family, sports involvement of parents and comfort of the family.

Intellectual Ability of Children Raven's Colour Progressive Matrices (further referred to as Raven's CPM; Raven 1998) were employed to evaluate the children's intelligence (Raven 1956). Raven's CPM is suitable both for individual and group use, primarily for children ages from 5 to 11 years. It represents a nonverbal test of intellectual ability and discursive thought, made up of a perceptive, figurative material organized in several series in which the tasks vary in order of severity, from simple to complex. The test was administered face-to-face. Although there are other, more recent tests in use, Raven's CPM was employed due to the fact that it provides valid data for the sample tested. The coverage of children was large for a relatively short time (Fajgelj et al. 2010).

The version of Raven's CPM is a simplified form of the test with 36 tasks divided into three series, each one made up of 12 tasks. Within Raven's CPM, the A set is based on completing continuous structures and is associated with visual-perceptual abilities; the B set requires the disclosure of analogies between elements, and the AB set evaluates the ability to identify symmetries.

In the current study, data for Raven's CPM were collected using small groups of children (from 10 to 20). All tests were carried out by 10 master's students of Psychology, who were previously trained for administering Raven's CPM, through instructions and materials adapted for the Serbian language.

Data Analysis

First of all, the ordinal variables obtained from the questionnaire were standardized according to Blom's method (Solomon and Sawilowsky 2009). Therefore, for testing the hypothetical model of six socioeconomic factors, a Pearson correlation matrix of socioeconomic status variables was first calculated, then a Confirmatory Factor Analysis was performed.

The number of significant factors was determined by applicationthe Kaiser-Guttmann criteria, Cattell's scree plot, and Parallel Analysis criteria (Watkins 2000). Isolated initial factors were transformed into the Varimax orthogonal position in order to obtain independent factors of the socioeconomic status of parents, that were further used in the regression analysis.

The relationship between SES factors and intellectual abilities of four defined groups of children, created according to their age in a step of 0.5 decimal years, were analysed using multiple linear regression (Cohen, 1988).

Table 1 Mean (M) and standard deviation (SD) for Raven's CPM scores depending on the sex and age of the children

Age categories (decimal years)	Male		Female		Total	
	N	M ± SD	N	M ± SD	N	M ± SD
5.0–5.5	47	19.91 ± 4.8	25	19.52 ± 4.3	72	19.78 ± 4.6
6.01–6.5	68	20.01 ± 5.1	42	20.55 ± 5.7	110	20.22 ± 5.6
5.51–6.0	60	20.43 ± 5.1	74	22.24 ± 5.7	134	21.53 ± 5.5
6.51–7.0	60	23.68 ± 6.0	54	23.54 ± 5.4	114	23.61 ± 5.7
Total	235	21.04 ± 5.7	195	21.89 ± 5.6	430	21.42 ± 5.6

To create the two contrary group of respondents (low score vs high score in Raven CPM), the 1st and 4th quartiles of Raven's CPM score of respondents were considered. To determine the predictive value of socioeconomic factors in four age groups, we used Binomial Logistic Regression. In this analysis, the dependent binary variable is coded with 0 for the group with a higher average Raven CPM score and with 1 for group with a lower average Raven CMP score.

Data analyses were conducted using the IBM SPS 20.0 statistical software. The level of statistical significance was set at $p ≤ 0.05$.

Results

Characteristics of Raven's CPM Scores of Children

Mean values of Raven's CPM scores in boys and girls were fairly uniform within the same age categories, while the overall scores for both sexes increased with age (Table 1). Levene test for equality of variances did not show statistical variations in boys and girls in any age categories. No significant differences were found between boys and girls in Raven CPM scores, nor in total ($t_{428} = -1.56$; $p = .12$), nor in individual age categories. Taking into account these results in the

Table 2 Structure and reliability of parent's socioeconomic factors

Variables	F1	F2	F3	F4	F5
Education of the father	**.83**	.32	.11	.08	−.05
Qualifications of the father	**.82**	.33	.10	.04	−.01
Position of the father in work organization	**.81**	.22	.03	.07	−.05
Type of the father's secondary school	**.66**	.18	.14	−.03	.10
Father's knowledge of foreign languages	**.54**	.01	.34	.09	.23
Qualifications of the mother	.22	**.84**	.09	.10	−.07
Position of the mother in work organization	.15	**.83**	.08	.10	−.10
Education of the mother	.31	**.80**	.13	−.02	.08
Type of the mother's secondary school	.17	**.50**	.12	−.09	.18
The mother's knowledge of foreign languages	.13	**.44**	.37	.11	.37
Type of place where the father spent his childhood	.04	−.02	**.75**	.22	.27
Type of place where the mother spent her childhood	−.01	.11	**.69**	.09	−.06
Type of present place of family	.19	.10	**.67**	.00	.16
Education of maternal grandfather	.34	.09	**.49**	.03	−.15
Education of paternal grandfather	.15	.39	**.48**	−.04	−.03
Father's sports results	.16	−.01	.05	**.69**	−.15
Father's involvement in sports organizations	.15	−.11	−.05	**.68**	.10
Mother's sports results	−.07	.13	.21	**.52**	−.07
Mother's involvement in sports organizations	−.09	.11	.08	**.46**	.14
Number of children in family	.25	.00	.13	.15	**.67**
Size of apartment	.25	.11	−.20	.15	**.64**
Monthly household income	.22	.27	−.14	.27	**.41**
% of variance	15.1	14.5	11.1	7.4	6.1
Cronbach's Alpha	.85	.82	.70	.45	.36

Table 3 Results of linear regression analyses of Raven's CPM variable

Variables in model	Group (decimal years)			
	5–5.5 $N = 72$	5.51–6 $N = 110$	6.01–6.5 $N = 134$	6.51–7 $N = 114$
Educational and professional status of father	.13	.09	.20*	.24**
Educational and professional status of mother	.10	.13	.08	.14
Residential and educational status of family	−.01	.07	.23**	.14
Sport status of parents	−.11	.13	−.04	.18*
Comfort of family housing	−.08	−.04	.07	.09
Adjusted R Square	.02	.01	.05*	.10**

Partial regression coefficients and statistical signification (** $p <= .01$; * $p <= .05$)

following analyses, we treated the sample as gender independent. However, girls had a slightly higher overall average of Raven's CPM scores than boys. Statistically significant differences were found in the Raven's CPM scores between age categories ($F_{3,468} = 10.05$; $p = .001$). Such a finding supported the justification for analyzing the relationships between socioeconomic factors and Raven's CPM score by separate age categories.

Structure of Socioeconomic Variables

The matrix of the correlation of parents' socioeconomic variables revealed mostly positive, low and medium-high coefficients. Over 60% of correlations had a statistically significant level. The level of the KMO indicator of sample variables adequacy (.80) and Bartlett's sphericity test ($p = .001$), supported the validity of the application of Factor analysis on the set of socioeconomic variables. By applying the target hypothetical model, five initial factors were isolated in accordance with the applicable criteria, which included 54.7% of the common variance of the socioeconomic variables.

The structure of isolated factors after the Varimax orthogonal rotation (Table 2) showed a logical grouping of variables that quite clearly and distinctively defined the five hypothetical factors. The first isolated factor was defined by five variables for assessing the *educational and professional status of the father*, namely Education of the father, Qualifications of the father, Position of the father in work organization, Type of father's secondary school and Father's knowledge of foreign languages. The second isolated factor was determined by five variables assessing the *educational and professional status of the mother*, which were Qualification of the mother, Position of the mother in the work organization, Education of the mother, Type of the mother's secondary school, and the Mother's knowledge of foreign languages. The third factor, which was determined by a high projection of variables that assessed the origins of the families, and the educational profile of the primary parent's family, was defined as the *residential and educational status of the family* and was made up of Type of place where the father spent his childhood, Type of place where the mother spent her childhood, Type of present place of family, Education of maternal grandfather, Education of paternal

Table 4 Results of Logistic regression analysis of SEM factors in prediction of belonging to groups of children with low and high IQ score

Variables in model	Group (decimal years)			
	5–5.5 $N = 39$	5.51–6 $N = 61$	6.01–6.5 $N = 73$	6.51–7 $N = 66$
Educational and professional status of father	1.39	1.37	1.53	2.15*
Educational and professional status of mother	1.46	1.21	1.08	1.57
Residential and educational status of family	1.18	1.18	1.67*	2.43*
Sport status of parents	.67	1.37	1.05	1.98
Comfort of family housing	.71	.84	1.14	1.28
Nagelkerke R Square	.10	.10	.14	.32
Model fit (χ^2)	2.98	4.89	8.12	17.71**

Odds ratios and statistical signification of Wald χ^2 (** $p <= .01$; * $p <= .05$)

Fig. 1 Age related success in classification children to low and high IQ groups
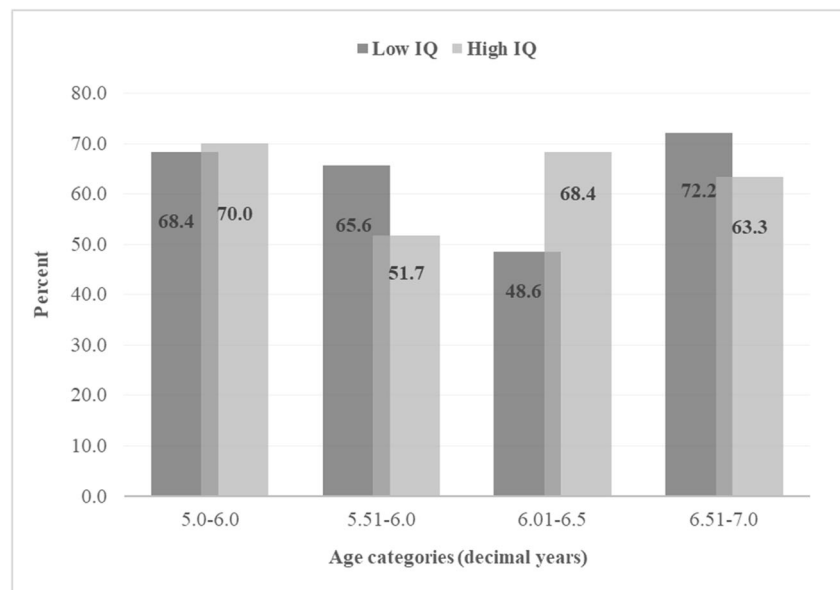
grandfather. The fourth factor, defined as the *sport status of parents,* was determined by a projection of the following variables: Father's involvement in sports organizations, Mother's involvement in sports organizations, Father's sports results and Mother's sports results. The fifth factor, the comfort of housing, was determined by a projection of variables: Size of the apartment, Number of children in the family and Monthly household income. Three of the five socioeconomic factors have satisfactory reliability.

Relations of Socioeconomic Factors and Raven's CPM According to Age of the Children

Concerning the relationship between socioeconomic status and Raven's CPM, for children of 5.0–5.5 age category, the regression model was not significantly different from zero ($F_{5,66} = .71$; $p = .62$), as well as the regression model for the age category 5.6–6.0 ($F_{5,104} = .90$; $p = .48$). In both cases, the model explained only 2% of the variability.

For what concerns the age group 6.01–6.5, the Educational and professional status of the father and Residential and educational status of family significantly influenced children's score on Raven's CPM, explaining the 5% of variance ($F_{5,127} = 2.38$, $p = .04$). Relating to the age group 6.51–7, the educational and professional status of father and the sport status of the parents significantly predicted children's score on Raven's CPM, explaining the 10% of variance ($F_{5,108} = 3.58$, $p = .005$) (see Table 3).

Predictive Value of the SES Factor Related to the IQ Score of Children

A Logistic regression was performed to ascertain the effects of the socioeconomic factors on the age related sample of

children with the lowest and highest Raven's CPM scores (Table 4). The whole model was statistically significant only for the last age group (6.5–7 decimal years) and fits well into the dependent variable ($X^2 = 17.72$; $p = .003$), suggesting that the model differentiates children with low and high Raven's CPM scores. The model for the higher age group explained 31.5% of the variance in Raven's CPM scores (Nagelkerke R^2) and correctly classified 72.2% low and 63.3% high Raven's CPM scores (Fig. 1). Increasing age was associated with an increasing trend of explained percent of the variance in Raven's CPM scores. Positive odds ratios greater that 1 at almost all SES factors, indicate best prediction for children in low CPM scores at defined age groups.

Discussion

The current paper focused on the relation between the SES and intellectual abilities of preschool children. Broadly speaking, the study confirmed the existence of a relationship between the SES of parents and the intellectual abilities of preschool children. As shown by the analyses, the educational and professional status of parents and grandparents, as well as the residential area, have a clear influence upon the intellectual abilities of children. These results are in line with other studies conducted on a sample of school-age children. Parental educational and professional extracurricular activities of children, which has an influence on child development, grows in parallel with the educational level and financial status of the parents (Azad et al. 2014; Yamamoto 2015).

However, differently from similar studies showing that low parental income is associated with lower scores of children's cognitive ability (Rosen et al. 2019; Mayer 2002), the present research did not confirm importance of material status of the

family. This result could be attributed to the fact that children from the sample attended state-owned kindergarten facilities, which are subjected to general conditions for enrolling children. These enrolling conditions are rather uniform, which in turn may cause a compatible socioeconomic composition of children's families. On the other hand, it could be assumed that being in a high-income or low-income condition for a long period could have a long-term effect on children's outcomes compared to being for short period in high or low income condition. In this way, the association between the SES and children's cognitive outcomes would be significantly higher at school age (Rosen et al. 2019; Von Stumm and Plomin 2015).

Presented results revealed a positive relationship of the socioeconomic characteristics of parents and the intellectual abilities of their children. We found that the environment where the parents lived and in which they were educated is significantly related with the intellectual potential of their children. Moreover, we recorded a significant impact of SES factors on the low IQ levels of preschool children, whereas age was sufficient predictor of high ability children. This pattern of results can indicate that high IQ levels could be observed as a protective factor or factor of resilience (Vanderbilt-Adriance and Shaw 2008). As previous studies showed, IQ levels in children from low SES families are under greater influence of the environment (Turkheimer et al. 2003), and this is why it is important to make supportive conditions for children who come from low SES families, through, for example, the empowerment of socialization agents (Petrill et al. 2004).

Some limitations of the study should be noted: Raven's matrix is a good measure for children's non-verbal IQ, but other measures of intelligence might be more sensitive to socioeconomic status, as cognitive functions (Piccolo et al. 2016; Sarsour et al. 2011). Moreover, the study did not consider the influence of moderators and mediators, that return a complete landscape of the phenomenon. Family cohesion, perceived social support, children's self-esteem or self-efficacy, could have a role in their cognitive development (Bradley and Corwyn 2002). Finally, it would be necessary to perform longitudinal study on samples of school-age children as well, in order to have a better understanding on the relation between the SES and intellectual abilities of preschool children and to determine the further actual relation between the SES of parents and cognitive development, especially the intelligence of their children.

The current study showed that the relationship between the SES of the family and children's development, in general, should be observed in an inter-disciplinary way, which would clarify how the socio-economic status of parents affects the child's development in general, from the first days of life, through the pre-school period and later phases of formal education. Additionally, it would be helpful to adapt and implement the recommendations of academic researches to a concrete social and political context, not only for researchers, but also policy makers in societies at different stages of social, economic, and political development.

Conclusion

Socioeconomic status seems to be a reliable predictor for children's intellectual abilities. Some studies indicate that environmental context is very important and influential during early childhood (Bradley and Corwyn 2002; Mollborn et al. 2014; Milošević et al. 2016), which would mean that the educational experience of children is directly linked to the social class their families belong to (Azad et al. 2014; Yamamoto 2015; Braswell, 2017). Other contributions have shown that the accumulation of smaller impacts of parental income can be a major factor in a child's wellbeing (Mayer 2002; Campbell et al. 2018). This latter finding is compatible with results that showed that children with lower SES do not develop to realize their full genetic potential (Nisbett et al. 2012). Moreover, parent's educational status, as well as occupational level of parents (Makharia et al. 2016; Piccolo et al. 2016; Rowe et al. 1999) should be considered.

Children coming from low socio-economic status may also display difficulties during the school age. Identifying from the beginning which characteristics may promote their intellectual abilities could help the enhancement of their personal characteristics, as resilience (Vanderbilt-Adriance and Shaw 2008) and self-esteem (Pullmann and Allik 2008). Moreover, socialization agents, as the kindergarten environment and the quality of the relationship with peers, may attenuate the impairment associated to belong to low SES later in life (Shah et al. 2012). Finally, the identification of children's problematic consequences of low SES may stimulate practical intervention at policy level (Hackman et al. 2010; Ronfani et al. 2015).

Compliance with ethical standards

Conflict of Interest The Authors declared no conflict of interest.

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