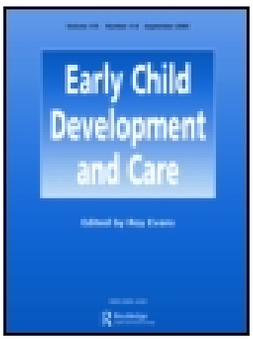

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Developmental disparities based on socioeconomic status and sex: an analysis of two large, population-based early childhood development assessments in Uruguay

Alejandro Vásquez-Echeverría[a], Clementina Tomás[a], Meliza González[a], Juan I. Rodríguez[a], Lucía Alvarez-Nuñez[a], Maite Liz[a], Mónica Pérez[a], Fanny Rudnitzky[b], Cristian Berón[b], Giorgina Gariboto[b] and Florencia Lopez Boo[c]

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ABSTRACT

Measurement of early childhood development at the population level has traditionally been neglected in Latin America. In this context, Uruguay stands out for having two population-based protocols: the Nutrition, Child Development and Health Survey (ENDIS), a home survey, and the School Readiness - Child Development Inventory (INDI). This paper aims to present both assessment experiences and analyse Uruguayan children's cognitive and socioemotional development according to sex and their families' socioeconomic status (SES). Comparisons were made between samples of children aged 1–6. Results suggest that girls generally show better development, except for internalized behaviour, but effect sizes tend to be small. In both surveys, children of high-SES show better development indicators than their low-SES counterparts, with larger effect sizes in fluid intelligence (problem-solving and mathematics). Differences between SES-quintiles consolidate after 30 months of age. Our findings contribute to the development of evidence-based public policies aimed to reduce developmental disparities.

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Early childhood; school readiness; socioeconomic status; child sex; cognitive development; socioemotional development

1. Introduction

Availability of accurate information on child development at a national level is critical for improving early childhood policies, also being a better guide for professional practice in education, health, or social development. Despite its importance, child development has not been measured regularly in population surveys in Latin America. Although some progress has been made in recent years, scholars and policymakers have not reached consensus on what should be the tools for a quality measurement of child development at a reasonable cost in large-scale surveys.

This lack of consensus can be seen in those Latin America and Caribbean (LAC) countries that have conducted surveys that include child development assessments (Interamerican Development Bank, 2019). Most surveys include up to three data collection waves and assess children up to 59 months, with some exceptions, such as Chile, Colombia, and Uruguay. Furthermore, considerable

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heterogeneity of measures of child development have been used. A full list of developmental surveys in Latin America is presented as Electronic Supplementary Material 1.

In this context, Uruguay, a small South-American country with 3,505,985 inhabitants according to 2018 estimates (INE, 2019) and ranked 55th in the Human Development Index (UNDP, 2020), stands out for the implementation of two large-scale developmental assessment protocols: (a) a nationally representative survey that assesses various aspects of child development (Nutrition, Child Development, and Health survey, ENDIS by its acronym in Spanish) and (b) a multidimensional instrument for assessing school readiness in a census-fashion, the School Readiness Child Development Inventory (*Inventario de Desarrollo Infantil*, INDI by its acronym in Spanish; Vásquez-Echeverría, 2020). The overarching objective of this paper is to introduce both developmental surveys to a broader audience.

1.1 Child development in Uruguay: nutrition, child development and health survey (ENDIS)

The ENDIS was first implemented in 2013, run by various governmental agencies' joint efforts to generate information on nutritional, developmental, and health status in early childhood. As of 2020, an inter-institutional steering committee integrated by the Ministries of Social Development, Public Health, Education and Culture, the Uruguayan Institute for Children and Adolescents, the National Institute of Statistics, and the Council for Preschool and Primary Education manages the survey.

The sustainability of this survey is strongly related to this inter-institutional chair, which seeks: (a) economic sustainability – currently, ENDIS is co-funded by different governmental funds; (b) the availability of a governmental survey to generate the information that each agency considers relevant for the implementation or monitoring of public policies; (c) that these institutions develop appropriation processes regarding the survey, which also favours collaboration between them. This model also prioritized cooperation with academia, requesting for technical support and broadening the project's horizon by addressing new dimensions of child development and public policies.

The population surveyed consists of representative samples of children from 0 to 3 years of age for the first cohort (wave 1: 2013) and from 0 to 4 years of age for the second cohort (wave 1: 2018). See Figure 1 for a description of the ENDIS cohorts, waves, and sample size.

ENDIS' different waves revealed information about the following domains: (a) child care and home organization; (b) child–parent and parental relationship; (c) sanitary situation, lactation, diet,

Figure 1. The Nutrition, Child Development and Health survey's (ENDIS') fieldwork sequence. There were three waves for the 2013 cohort, while for the 2018 cohort, there was a single wave. In 2013, child development was only assessed in Montevideo.

and nutritional status; (d) sexual and reproductive health of the main caregiver and pregnancy characteristics; (e) emotional well-being of the main caregiver; (f) psychological development of the child; (g) sociodemographic variables of the family (income, housing characteristics, formal education). For this article, we analysed data extracted from two modules: child development and sociodemographic characteristics of the family.

1.2. School readiness in Uruguay: the INDI assessment system

Children between 3 and 6 years of age experience a wide range of cognitive and socioemotional development changes. These changes occur during the transition from preschool to primary education, a period characterized by a redefinition of adults' expectations regarding children's achievements, a more structured schedule and use of classroom space, changes in the role of play, and a shift towards more explicit academic evaluation methods (Vásquez-Echeverría, 2020). As a matter of fact, such changes may lead children with reduced developmental resources, family or community support to behavioural problems and academic struggling when starting primary education (Unicef, 2012).

School readiness is the overarching construct with which scholars define this phenomenon and its long-term implications for educational achievement (Halle, Hair, Wandner, & Chien, 2012). School readiness is currently defined as a multidimensional construct, in an interplay between the child, the educational, family, and community agents to promote healthy transitions between preprimary and primary education (Carlton & Winsler, 1999; Sabol & Pianta, 2012). Healthy transitions may refer to, for example, positive academic, social and mental health outcomes during the school years (Hair, Halle, Terry-Humen, Lavelle, & Calkins, 2006; Kagan, Moore, & Bredekamp, 1995). Longitudinal studies provide evidence of short- and long-term effects of early development and school readiness on later academic achievement (e.g.: Duncan et al., 2007; Feinstein, 2003), while the school entry gap is likely to influence children's outcomes throughout subsequent school years (Duncan et al., 2007; Sabol & Pianta, 2012; Watts, Duncan, Siegler, & Davis-Kean, 2014). For instance, mathematical, linguistic, attentional, socioemotional and fine-motor skills have been reported as significant predictors of academic skills years later, with mathematical ability showing the largest effect size (Duncan et al., 2007; Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010; Romano, Babchishin, Pagani, & Kohen, 2010). Besides child individual factors, family and school environment are also considered crucial for the success of all children in their transition to primary school (Hughes, White, Foley, & Devine, 2018; Unicef, 2012).

In Uruguay, retention rate in the 1st grade is the highest across all primary grades (Ineed, 2017). Accordingly, educational policy-makers have acknowledged the need for generalized developmental, school readiness standardized assessment in recent years. INDI was created in 2015, in close collaboration with the Uruguayan Administration of Education (Vásquez-Echeverría, 2020). Continuous improvement and participation of educators were hallmarks during this process, facilitating INDÍs consolidation as a universal assessment for preschool age levels 4 and 5 in 2018, and for level age 3 in 2019. For this purpose, the following requirements were met: (a) the digital implementation of INDI for ease of access by teachers throughout the country; (b) the development of test norms based on a nationally representative sample; and (c) the creation of an automatic reports system to provide teachers an immediate interpretation of scores.

As a school readiness assessment policy of the Uruguayan education authorities, the massive implementation of INDI demands to the academic team: (a) fluent dialogue with political and educational authorities (e.g.: frequent presentation of reports); (b) interdisciplinary work with technical staff of the Unified Management of Records and Information System (GURI) – the digital platform within the educational system in which INDI is hosted – for data exchange and improvement of the automatic report system; (c) national meetings with district supervisors – senior teachers in charge of monitoring educational practices; (d) annual training meetings with educational staff (teachers and principals) at the national level; and (e) the development of digital resources (e.g. tutorials,

websites) that facilitate access to information that supports training, administration process and reports' interpretation.

1.3 This study

Previous literature analysing early child development and school readiness rarely used census or nationally representative samples to analyse sex and SES differences in developmental outcomes. Based on these variables and the availability of Uruguayan administrative data, we intend to explore the aforementioned developmental disparities. In this work, we also try to offer an overview of the developmental trajectories using different measures and informants provided by ENDIS and INDI datasets.

Within the cognitive domain, some studies report gender-based differences in executive function (Berlin & Bohlin, 2002; Carlson & Moses, 2001) and communication skills (Toivainen, Papageorgiou, Tosto, & Kovas, 2017), favouring girls. Based on a representative sample from children from Netherlands and Germany, Buczyłowska, Ronniger, Melzer, and Petermann (2019) found small significant differences favouring girls in fluid and visuospatial abilities until age four. Furthermore, some evidence suggests girls outperform boys in gross motor domains (Barnett et al., 2016; Thomas & French, 1985), even though other studies found differences in fine but not gross motor skills during the preschool years (Peyre et al., 2019). Regarding the socioemotional domain, Chaplin and Aldao's (2013) meta-analytic review focused on gender-based differences in emotion expression from infancy to adolescence, finding small gender differences in positive and internalizing emotions (higher in girls) and externalizing emotions (higher in boys, in particular during preschool years and middle childhood), a pattern also found in Berlin and Bohlin (2002), Chen (2010) and Frigerio et al. (2004). Some literature suggests these differences may be transferred into educational achievement years later (Buchmann, DiPrete, & McDaniel, 2008), being the case that in Uruguay, more females than males complete secondary education (INEEd, 2017).

Concerning SES-differences, larger effects sizes are found when comparing high-SES children with their underprivileged counterparts (Bradley & Corwyn, 2002; Duncan, Magnuson, & Votruba-Drzal, 2017; Fletcher & Wolfe, 2016). There are consistent correlates between SES and brain structure and functions (Pavlakis, Noble, Pavlakis, Ali, & Frank, 2015), and these patterns are stronger between disadvantaged children (Noble et al., 2015). Some studies suggest SES effects may be more pronounced in cognitive and linguistic domains (Richards, Bacon-Shone, & Rao, 2018; Rubio-Codina, Attanasio, Meghir, Varela, & Grantham-McGregor, 2015). In Uruguay, higher SES adolescents have a five times higher probability of completing secondary education than their lower-income counterparts (INEEd, 2017).

Hence, the specific objectives of this work – in addition to introducing both Uruguayan large-scale early childhood developmental assessment experiences- are: (a) to describe the state of child development and its disparities in Uruguay, focusing on differences based on sex and socioeconomic level of the families and (b) to offer some explanation on these differences with which children start primary education.

2. Method

2.1. ENDIS' study

2.1.1. Sample and procedure

We intend to provide an overview of early child development in Uruguay using ENDIS data, specifically analysing children's developmental status and differences based on sex and parents' socioeconomic status. Technical data about survey procedures to determine the nationally representativeness of the sample can be found at ine.gub.uy/endis.

For the CBCL 1½–5, we merged ENDIS data collected in the second wave of the first cohort (2015) with the first wave of the second cohort (2018) to reach a better age-in-month distribution. 4210

primary caregivers' answers (95.3% mothers, 3.1% fathers, 2.6% others) for their children's behavioural problems were analysed (2571 correspond to wave 2 of the first cohort and 1639 to the second cohort). We selected children aged 18–71 months ($M = 46.0$; $SD = 12.9$; 51.7% boys) given the age range recommended by the test authors.

For the ASQ-3 data, we merged data from surveys of 2013 ($n = 804$), 2015 ($n = 1639$) and 2018 ($n = 1573$) to reach a bigger sample size for each age version of the questionnaire. Nonetheless, questionnaires from 2 to 16 months were excluded because the sample size was too small to enable robust statistical inferences. In total, we counted 4.016 main caregiver responses (95.9% mothers, 2.7% fathers, 1.4% others) to the ASQ-3 questionnaires from the 18 months to the 54 months versions (n per versions were as follows: 18 months: 155, 20 months: 156, 22 months: 145, 24 months: 196, 27 months: 245, 30 months: 257, 36 months: 435, 42 months: 681, 48 months: 730, 54 months: 706). Collapsing all versions, the mean age in months was 38.42 ($SD = 11.18$) and 49.9% of the sample were boys.

Families were interviewed at their home by trained university students and both ASQ-3 and CBCL items were administered orally.

2.1.2 Instruments

ENDIS' child development module is composed of three instruments: Child Behavior Checklist (CBCL 1 ½–5); Ages and Stages Questionnaire 3rd edition (ASQ-3); and Ages and Stages Questionnaire-Socioemotional (ASQ-SE). We analysed the performance of Uruguayan children according to the risk criteria suggested by the original authors. We excluded the ASQ-SE data for the analyses since results resemble those of the CBCL, and both instruments present overlapping content. For more information of the ASQ-SE results using ENDIS data please refer to Alvarez-Nuñez, González, Rudnitzky, and Vásquez-Echeverría (2020).

The CBCL 1 ½–5 (Achenbach & Rescorla, 2000) is composed of seven syndromes' subscales: (I) emotionally reactive; (II) anxious/depressed; (III) somatic complaints, (IV) withdrawn; (V) sleep problems; (VI) attention problems; and (VII) aggressive behaviour, each obtained by adding the corresponding items. Moreover, two second-order factors may be computed: internalizing behaviour (summing up emotionally reactive, anxious/depressed, somatic complaints and withdrawn) and externalizing behaviour (summing up attention problems and aggressive behaviour). Likewise, the total problems score may also be computed.

ASQ-3 assesses the risk of developmental delay in children between 1 and 66 months of age (Squires, Bricker, & Twombly, 2009). It consists of 21 parent-reported questionnaires corresponding to different age intervals. In this study, we used versions of 18, 20, 22, 24, 27, 30, 36, 42, 48, 54 and 60 months. Each questionnaire consists of 30 items organized into five dimensions: (I) communication; (II) fine motor skills; (III) gross motor skills; (IV) problem solving and; (V) social-individual skills. The score for each dimension is obtained by adding its six items. Each item has a three-value response scale (No = 0, Not yet = 5, Yes = 10). Higher scores on the ASQ-3 indicate higher development levels and, therefore, less likelihood of delay in the skill assessed.

ENDIŚ sociodemographic variables. Child's sex, household income, and mother education (in years) variables were self-reported and collected during home interview. Socioeconomic quintiles were estimated based on per-capita household income.

Psychometric Properties of CBCL and ASQ-3 in this sample

CBCL's psychometric properties using ENDIS samples are very good to excellent. For the scores used in this study, reliability levels were excellent for broadband scales ($\Omega = .94$ and .91 for internalizing and externalizing respectively) and for total problems ($\Omega = .97$). The original factor solution showed very good fit and measurement invariance by age and sex (Vásquez-Echeverría, Alvarez-Nuñez, González, & Rudnitzky, 2020).

The ASQ-3 scores showed a tendency to ceiling effects, i.e. a high percentage of children reaching the highest scores, especially in the gross motor and communication scales. Fit indices for the confirmatory factor analyses were adequate-to-good across versions, except for 22 months (Alvarez-Nuñez, González, Rudnitzky, & Vásquez-Echeverría, 2021). Concerning reliability, coefficients were acceptable-to-good ($\Omega > .70$) for communication, gross motor (except for the 30-month version), fine motor and problem-solving (except for 20-, 24- and 27-month versions). For personal social subscale, most age-versions had suboptimal reliabilities (only 18-, 32- 42- versions had $\Omega > .70$). Therefore, researchers should be cautious when interpreting results of this subscale (Alvarez-Nuñez et al., 2021).

2.2. INDI's study

2.2.1 Sample and procedure

Informants were children's teachers, who evaluated students through INDI within a 3–4 week period, in the school context. Administrative data gathered with INDI involves six data collection points, from 2017 to 2019, two for each year, separated by a 6-month interval. The 2017 data come from a nationally representative sample. This sample was drawn from a two-step stratified cluster selection by school *socioeconomic status* (SES) and region. More populated schools had more probabilities of being selected. A total of 90 of the 92 initially selected schools agreed to participate in INDI's standardization, and the remaining two were replaced according to stratification criteria. The final sample consisted of 9423 children (4725 from preschool level age 4 and 4698 from age 5). In 2018 and 2019, INDI was administered in public preschools as part of a school readiness assessment policy of the National Administration of Education of Uruguay reaching more than 90% of coverage of Uruguayan preschoolers attending public education. Descriptive statistics for SES and sex distribution for the six samples are shown in Table 1. No significant bias in dropout between the first and second annual assessment could be observed in terms of child age or SES. For 2017, 54.9% of children were assessed both at T1 and T2. For 2018 and 2019, there were 93.6% and 96.6%, respectively.

2.2.2 Instrument

INDI is a multidimensional teacher-reported school readiness measure composed of four dimensions. Language, logic-mathematical skills, self-projection and executive function subscales are part of the Cognitive development dimension. Prosocial, externalizing and internalizing behaviour subscales are part of the Socioemotional development dimension. Motor development and Attitudes towards learning are the remaining two dimensions. Some of the main contents include, for Language: receptive, productive and articulatory skills as well as phonological awareness. Contents of the Logic-mathematical subscale include numeracy, relation and operation skills. Self-projection subscale comprises theory of mind, episodic memory and temporal cognition. Executive functions include self-regulation, inhibitory control, and cognitive flexibility. Motor development includes gross and fine motor skills. Socioemotional development considers cooperation and

Table 1. Descriptive statistics for the first (T1) and second (T2) INDI annual assessment by grade, sex distribution and socioeconomic status.

		Level Age 4				Level Age 5			
				SES				SES	
		N	Mean age (SD)	Q1	Q5	*N*	Mean age (SD)	Q1	Q5
T1	2017	4725 (50% F)	55.2 (3.4)	22.3%	31.5%	4698 (49% F)	67.0 (3.4)	23.2%	28.2%
	2018	35786 (49% F)	53.6 (3.5)	17.1%	22.5%	37138 (49% F)	65.6 (4.2)	17.8%	23.8%
	2019	37091 (49% F)	53.9 (6.5)	17.4%	22.9%	38312 (49% F)	65.8 (3.5)	17.6%	23.3%
T2	2017	4237 (50% F)	60.9 (3.5)	25.3%	33.4%	4214 (49% F)	72.9 (3.6)	23.4%	31.0%
	2018	35493 (49% F)	60.2 (3.5)	17.5%	22.5%	36731 (49% F)	72.2 (4.3)	18.2%	23.7%
	2019	36702 (49% F)	59.8 (6.5)	17.4%	22.9%	37956 (49% F)	71.6 (3.5)	17.8%	23.1%

Note. *Q* = quintile. *F* = female. Age is in months.

empathic behaviour, anxious-withdrawn, and aggressive-defiant indicators. Finally, Attitudes towards learning evaluates school adaptation, persistence, creativity, and motivation. INDI administration requires a two-hour training session, and individual assessment is conducted by observing child behaviour in different class situations. Detailed information about the INDI may be accessed at indi.psico.edu.uy/en.

INDÍs sociodemographic variables. The child's sex and socioeconomic information were collected from administrative records. In particular, socioeconomic level refers to the socioeconomic quintile classification of school centres made by the National administration of education based on data of the families of attending children.

Psychometric properties of INDI scores

Different studies have explored the reliability and validity of the INDI scores over the years. It was initially submitted to expert judgement including child development researchers, preschool teachers and educational authorities. Concurrent validity studies (see Vásquez-Echeverría, 2020) showed significant correlations between Cognitive development scores and Bracken school readiness assessment ($r = 0.49$, $p < .05$), language subscale, PPVT-III and K-BIT vocabulary subtest (range $r = 0.43$–0.55, $p < .05$), logic-mathematical subscale, TEMA-3 and WPPSÍs arithmetic subscale (range $r = 0.59$–0.67, $p < .05$), self-projection subscale and traditional theory of mind tasks such as false belief understanding ($r > 0.28$, $p < .05$), executive function subscale and different executive function experimental tasks such as Balance Beam, Pencil Tap and Snack Delay ($r = 0.44$, 0.38 and 0.49 respectively, all $p < .05$); motor development dimension and Battellés motor development subtest (range $r = 0.35$–0.67, $p < .05$), and socioemotional subscales and ASEBA's Direct Observation Form (range $r = 0.32$–0.49, $p < .05$). Results also showed satisfactory internal consistency values for scores. Using data from the 2019 sample, Cronbach's alpha values were .96 for Cognitive, .92 for language and logic-mathematical; .90 for self-projection; .86 for executive-functioning; .83 for Motor; .85 for prosocial skills; .73 for internalizing, .87 for externalizing; and .86 for attitudes towards learning. Test–retest and inter-rater reliabilities were also estimated, ranging from good-to-excellent. Multilevel confirmatory factor analyses showed good fit both at the inter- and intra-group levels. Items were calibrated through item response theory (IRT) graded-response model.

INDI assessment results are available for teachers, principals, and supervisors through an automatic reports system. It provides immediate feedback on developmental strengths and weaknesses at individual, group, school, and regional levels based on the nationally representative sample norms. The different types of automatic reports include the analysis of cross-sectional and intraindividual variability (trajectory) information of the children (see Figure 2). Reports offer information regarding each developmental area (cognitive, motor, socioemotional and attitudes towards learning).

2.3. Data analysis

First, we explored gender and socioeconomic differences in early development by comparing the frequencies of risk categories suggested by the authors of both the CBCL and ASQ-3. In the CBCL, internalizing, externalizing, and total behaviour problems can be categorized in borderline and clinical risk levels when scores correspond to the 83rd and 90th percentiles of the normative sample T-score distribution. Following Achenbach and Rescorla (2010) criteria, we used the norms for Group 2 societies. The ASQ-3 identifies three risk levels calculated by standardizing each child's scores with the US norms. Children who score below two standard deviations are classified within the *Risk* category, and those who score between −2 and −1 standard deviation are classified within the *Monitoring Zone* (Squires et al., 2009).

For further measurement of the extent of the developmental disparities, we calculated the effect sizes of the differences in ENDIS scores according to sex and extreme household income quintiles (1 and 5), following Cohen's (1988) recommendations (Cohen's *d*). We used income quintiles to allow

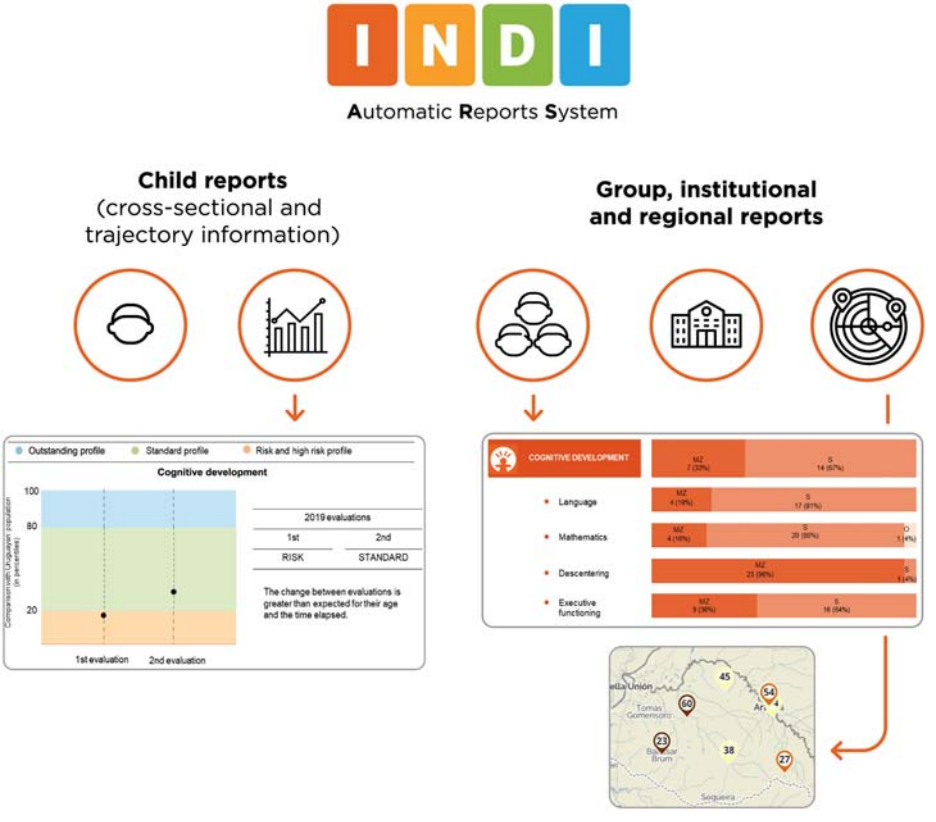


Figure 2. The School Readiness – Child Development Inventory's (INDI's) Automatic Report System. This system provides child development profiles through individual and trajectory reports, group, centre, and jurisdiction reports, including all developmental areas. The figure depicts report extracts from simulated cases: (a) trajectory information based on norm-referenced intraindividual change within 6 months; (b) graph view specifying the group's developmental profile per area and (c) a jurisdiction heat map regarding risk profiles at a regional level.

comparisons between ENDIS and INDI data. CBCL data (2013 cohort: wave 2; 2018 cohort: wave 1), and the ASQ-3 data (2013 cohort: waves 1 and 2; 2018 cohort: wave 1) were analysed to meet a larger sample size across questionnaires and more balanced coverage of different child ages (in months). According to Ferguson's (2019) guidelines, all effect sizes were interpreted as follows: values of $d = 0.41$ should be considered as a threshold, representing the minimum effect size of practical significance for social sciences data.

Considering there are six INDI data collection points, a meta-analytic approach was used with the intention of summarizing the effects of SES and sex differences. Cohen's *d* were calculated for each of the six assessments by age level (4 and 5 years), sex and SES (Quintile 1 and Quintile 5 schools). Afterwards, each sample's effect size was pooled to obtain a summarized effect size following the guidelines of Neyeloff, Fuchs, and Moreira (2012). *Q* statistic evaluates if effect sizes are homogeneous. Thus associated small *p* values will reject the null hypothesis. I^2 will be interpreted as 25%, 50% and 75%, indicating low, medium and high levels of heterogeneity across effects (Higgins, Thompson, Deeks, & Altman, 2003). As very large sample sizes may imply significant *Q* and I^2 values when there is small heterogeneity, we will consider also the confidence interval of the overall meta-analytic mean to draw conclusions, i.e. a very narrow confidence interval will be interpreted as indicating homogeneity.

3. Results

3.1. Socioeconomic status and sex differences based on ENDIS' scores

The percentage of clinical and borderline total problems assessed through CBCL was similar for boys and girls (see Figure 3). However, sex-related differences were observed when discriminating between internalizing and externalizing behaviour. Internalizing behaviour problems were more frequent in girls while externalizing behaviour was more frequent in boys.

Figure 4 shows the frequency of risk in behavioural problems, either measured through mother's education (in years) or the household's income quintile. Part A of Figure 4 shows the percentage of children in the clinical and borderline risk groups with behavioural or emotional problems according to the mother's educational level. In total problems clinical risk, the difference between children with mothers that had more than 12 years of education and children with mothers that only completed primary education or less, was 11.3%. According to mother's educational level, differences were more pronounced for internalizing problems, with 15.3 percentage points difference between the extreme groups. When including the borderline category, the difference between groups with higher: lower education was 23 percentage points for internalizing behaviour and 11.1 points for externalizing behaviour.

Part B of Figure 4 presents the percentage of children at clinical risk in CBCL according to socioeconomic level, estimated through the household income quintile. The percentage of children with emotional and behavioural problems increased in lower quintiles. Clinical risk in externalizing behaviour was more clear-cut comparing extreme income quintiles (quintiles 1 and 5; 8.1 percentage points difference), while internalizing behaviour presented an exact hierarchical order in the five income quintiles.

Regarding ASQ-3, boys presented slightly more at-risk percentages than girls in all domains, except gross motor, in which no differences were identified (8.5% risk for both sexes). Boys presented a higher percentage of risk in the fine motor domain (10.3%), while girls presented a higher risk in gross motor skills, followed by fine motor skills (7.6%). The domain with the lowest percentage of risk for both sexes was Communication (5.4% for boys versus 3.5% for girls). Problem-solving (8% for boys, 6.8% for girls) and social-individual skills (8.1% for boys, 6.2% for girls) stood in the intermediate range in terms of risk level for both sexes.

Figure 5 shows the percentage of risk in ASQ-3 according to the number of years of maternal education. Children with mothers who received up to 6 years of schooling presented a higher risk in all domains assessed with the ASQ-3 (except fine motor). On the other hand, children whose mothers reported 12 or more years of education presented a lower risk percentage. This

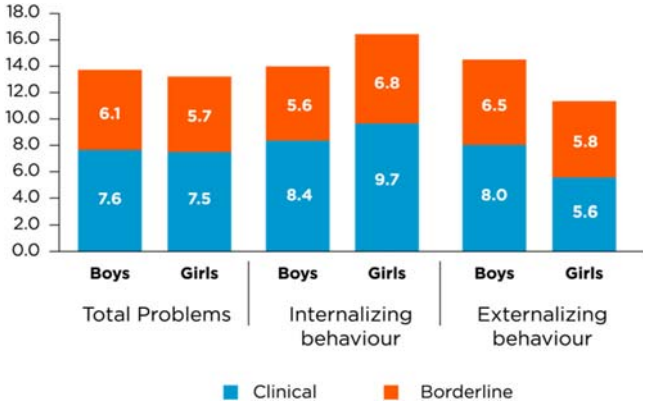


Figure 3. Percentage of children categorized in Child Behavior Checklist (CBCL's) Clinical and Borderline risk groups according to child's sex.

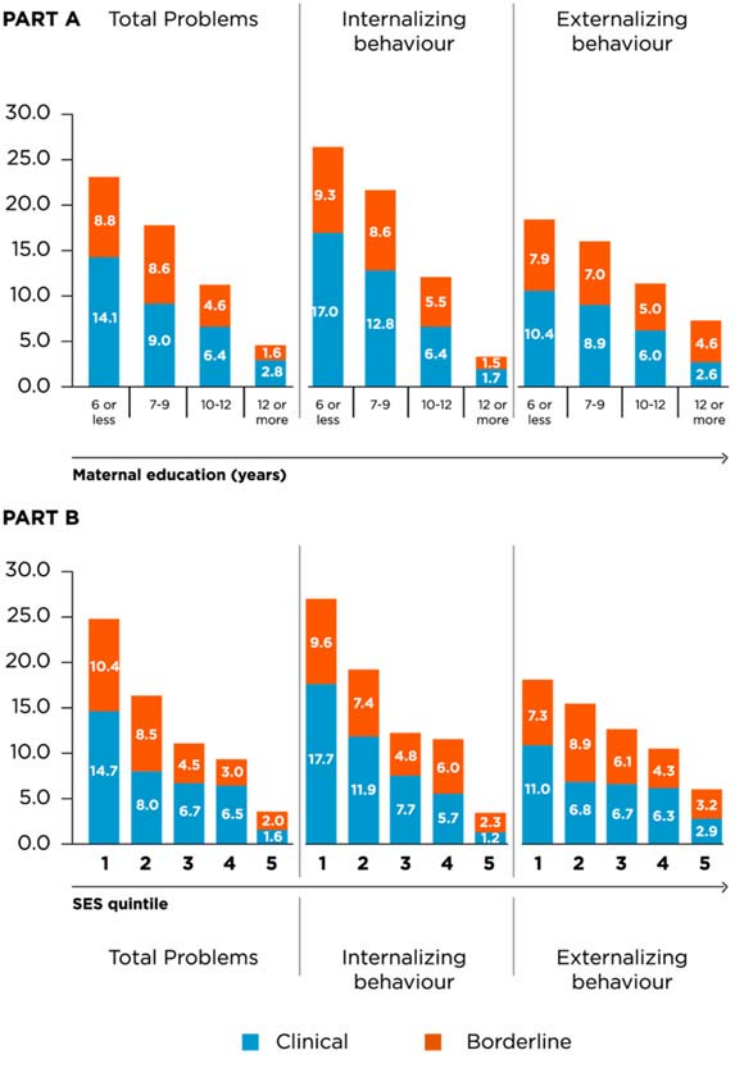


Figure 4. (A) Percentage of children categorized in CBCL's clinical and borderline risk groups, according to maternal educational level in years of education. (B) Percentage of children classified in CBCL's clinical and borderline group, according to household income quintile.

trend is more pronounced in problem-solving. Frequencies of risk in ASQ-3 by SES household income quintile show a similar pattern. Problem-solving consistently shows more differences between quintiles across all age-versions, followed by fine motor. This general pattern is also seen for the other subscales, though more clearly in the versions for older children (see Supplementary Material 2, Table S2.A).

We found no effect sizes of practical significance by sex in CBCL Total problems. In comparison, there were larger differences in externalized and internalized behaviour. Regarding the comparisons between extreme quintiles, we found effects of practical significance in all three age ranges, with a slight increase in the difference in externalized problems for older children (see Table 2). Descriptive statistics and t-tests for CBCL by SES and sex are presented in Supplementary Material 2 (Tables S2.B).

We also analysed differences by sex and SES in ASQ-3 scores. Since ASQ-3 offers multiple questionnaires according to the child age-in-months – with some variability in its psychometric properties – we analysed each age version separately. The sample size for the different versions ranged

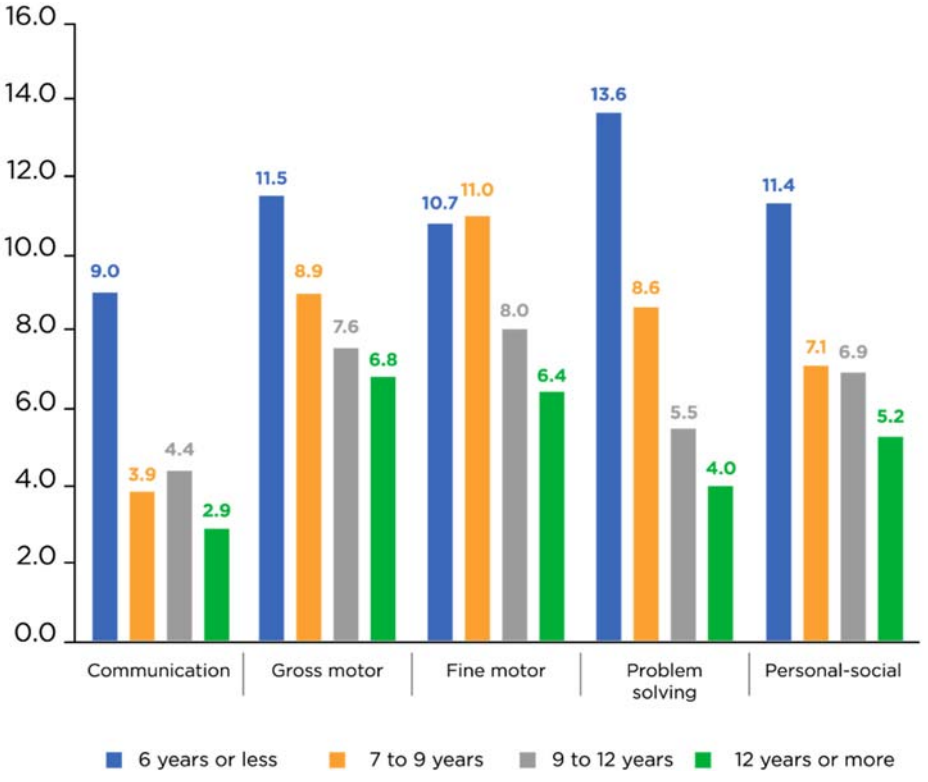


Figure 5. Percentage of children categorized as at risk in Ages and Stages Questionnaire 3rd edition (ASQ-3) according to maternal education.

from 145 (for the 22-month version) to 730 (for the 48-month version), with 4016 total cases. Descriptive statistics and *t*-test for group differences are presented in Supplementary Material 2 (Tables S2.C and S2.D). Girls in versions for older children tended to score better across subscales. The effect sizes were generally small, reaching levels of practical significance that favoured girls in some subscales (see Figure 6, Part A).

Similarly, Figure 6 (Part B) shows the effect sizes of extreme quintile-SES comparisons on ASQ-3 scores across age versions. Children from higher-SES families tend to have better performance, especially when questionnaires since 24 months or older are considered. In most cases, the effects reach the practical significance threshold (<0.41), particularly in problem-solving and fine motor subscales.

Table 2. Effect sizes (Cohen's *d*) in CBCL subscales scores by sex and socioeconomic status.

	Total Problems	Internalized	Externalized
Sex			
1 and 2 years old ($n = 946$)	0.06	−0.05	0.11
3 years old ($n = 1119$)	0.20	0.19	0.18
4 and 5 years old ($n = 2061$)	0.06	0.01	0.11
Total	0.10	0.05	0.13
Quintile (1 vs. 5)			
1 and 2 years old ($n = 371$)	0.61	0.71	0.38
3 years old ($n = 457$)	0.67	0.81	0.47
4 and 5 years old ($n = 783$)	0.66	0.69	0.55
Total	0.65	0.73	0.49

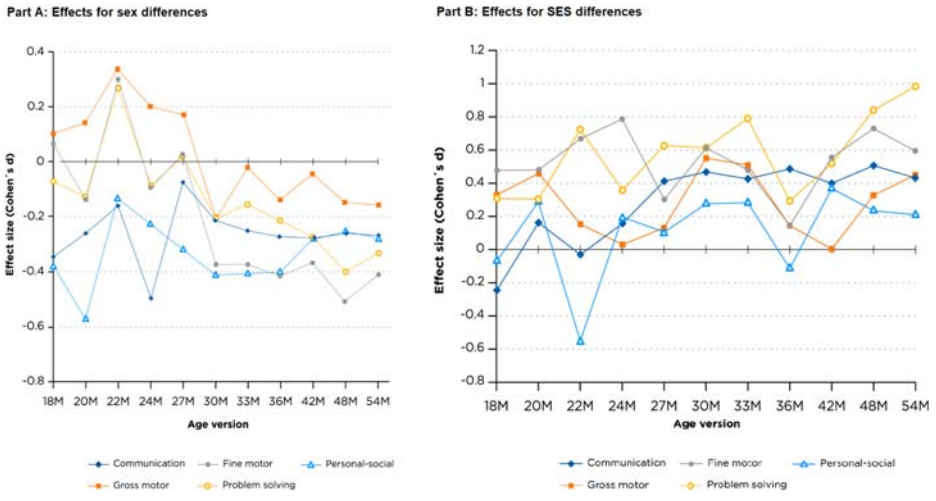


Figure 6. Effect sizes of the differences in ASQ-3 scores by sex (Part A) and by Socioeconomic status (Q1 and Q2, Part B).
Note. M = months. Positive effect sizes represent differences that favour boys and high-SES children, respectively.

3.2. Socioeconomic Status and Sex Differences on INDI's Scores

All mean differences were statistically significant with $p < 0.001$, except for sex differences in internalizing behaviour for level age 4 (at T1 of the 2017 assessment) and in level age 5 (in both 2017 assessments). Descriptive statistics, *t*-test and effect sizes for sex and SES differences are presented in Supplementary Material 3. Effect sizes were relatively consistent across assessments. Thus we selected a fixed-effect model for conducting meta-analysis.

Regarding sex differences, I^2 ranged from 83.37 ($Q = 30.06$, $df = 5$, externalizing behaviour) to 99.20 ($Q = 621.98$, $df = 5$, internalizing behaviour) in level age 4 children; for level age 5 children I^2 ranged from 71.82 ($Q = 17.74$, $df = 5$, language) to 99.97 ($Q = 1719.01$, $df = 5$, internalizing behaviour). Regarding SES differences, I^2 ranged from 96.36 ($Q = 137.26$, $df = 5$, prosocial behaviour) to 99.30 ($Q = 714.62$, $df = 5$, internalizing behaviour) for level age 4 children; for level age 5 children I^2 ranged from 97.70 ($Q = 217.27$, $df = 5$, internalizing behaviour) to 99.34 ($Q = 756.50$, $df = 5$, executive functions).

Forest plots of the effect size differences by sex and SES in INDI subscales by preschool-level (age 4 and 5) are shown in Table 3 and Figure 7. The summary effects of all differences, both for sex and SES and across all six samples and age levels, are highly stable, with the lower and upper confidence intervals ranging, at most, 0.01 from the main effects.

Regarding sex differences, for both age levels, girls outperformed boys in externalizing behaviour ($d = 0.55$ and $d = 0.56$ for level age 4 and 5, respectively), prosocial behaviour ($d = 0.42$ and $d = 0.44$), executive functioning ($d = 0.52$ and $d = 0.54$) and motor skills ($d = 0.47$ and $d = 0.43$). All other INDI's scores fell below the 0.41 threshold, but in all cases favoured girls.

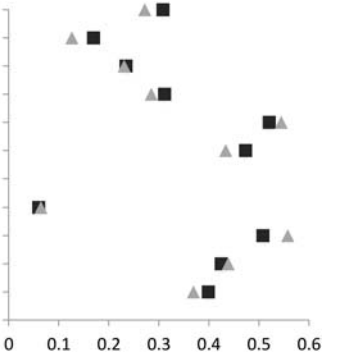
On the other hand, high-SES children showed higher INDI scores compared to their low-SES counterparts in Cognitive scale ($d = 0.48$ and $d = 0.49$ for levels age 4 and 5, respectively) and, specifically, in mathematical skills ($d = 0.58$ and $d = 0.57$) and language (only for level age 5, $d = 0.42$). All other differences in INDI scores fell below the 0.41 threshold, but in all cases favoured high-SES children. Results suggest that SES differences relate more to cognition, such as mathematical skills and language, with all other variables showing no differences between groups. Mathematical skills had a higher effect than language did.

Table 3. Sex differences among grade 4 and 5 children for INDI's scores.

Sex differences among grade 4 and 5 children for INDI's scores

	Level 4 years			Level 5 years		
		95% CI			95% CI	
	d	Lower	Upper	*d*	Lower	Upper
Cognitive	0.31	0.31	0.31	0.27	0.27	0.27
Maths	0.17	0.17	0.17	0.13	0.12	0.13
Language	0.23	0.23	0.24	0.23	0.23	0.23
Self-projection	0.31	0.31	0.31	0.29	0.28	0.29
Executive function	0.52	0.52	0.52	0.54	0.54	0.55
Motor	0.47	0.47	0.48	0.43	0.43	0.44
Socioemotional	–	–	–	–	–	–
Internalizing	0.06	0.06	0.06	0.05	0.04	0.05
Externalizing	0.51	0.50	0.51	0.56	0.55	0.56
Prosocial	0.42	0.42	0.43	0.44	0.44	0.44
Attitudes	0.40	0.40	0.40	0.37	0.37	0.37

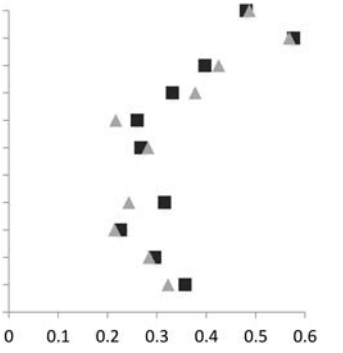
Notes: Black data points = 4 years, grey data points = 5 years, effect sizes for Int. and Ext. are in absolute values



SES differences among grade 4 and 5 children for INDI's scores

	Level 4 years			Level 5 years		
		95% CI			95% CI	
	d	Lower	Upper	*d*	Lower	Upper
Cognitive	0.48	0.48	0.49	0.49	0.48	0.49
Maths	0.58	0.57	0.58	0.57	0.56	0.57
Language	0.40	0.39	0.40	0.42	0.42	0.43
Self-projection	0.33	0.33	0.34	0.38	0.37	0.38
Executive function	0.26	0.26	0.26	0.22	0.21	0.22
Motor	0.27	0.26	0.27	0.28	0.28	0.29
Socioemotional	–	–	–	–	–	–
Internalizing	0.32	0.31	0.32	0.24	0.24	0.25
Externalizing	0.23	0.22	0.23	0.21	0.21	0.22
Prosocial	0.30	0.29	0.30	0.28	0.28	0.29
Attitudes	0.36	0.35	0.36	0.32	0.32	0.33

Notes: Black data points = 4 years, grey data points = 5 years, effect sizes for Int. and Ext. are in absolute values.



4. Discussion

This article's objective was to describe two comprehensive early childhood assessment initiatives conducted in Uruguay, and to analyse child development disparities based on sex and socioeconomic level variables. Compared with other LAC countries, Uruguay is in a favourable position in terms of early development assessment. Both ENDIS and INDI provide population-based, highly powered samples, particularly relevant because of its potential to identify early childhood risk factors on a preventive level. This potential is also enhanced by the initiatives' collaborative nature, including several governmental institutions, academic research groups, and policymakers. When comparing ENDIS' and INDI's results, we intended to analyse early child development disparities in Uruguay through a multi-informant approach based on parental observations and teacher reports.

Results indicate that sex-related and SES differences were, overall, consistent in both studies. At early stages and for some developmental areas, girls are better-positioned than boys and low-SES is a relevant developmental risk factor in our population. However, beyond these general statements, more specific considerations can be made.

4.1. Developmental disparities based on sex

Cognitive and motor development data extracted from ENDIS suggests that sex-related effects in the cognitive domains were small and, in general, favoured girls. Regarding ASQ-3 results, risk incidence was higher for boys, consistent with Squires et al.'s (2009) results, who also found significant differences between boys and girls in the questionnaires for ages 30, 36, 48 and 60 months. It is worth noticing that the largest sex-related effect sizes correspond to the fine motor subscale, particularly favouring girls beyond 30 months of age. Interestingly, INDI results also suggest that preschool girls seem to have better motor skills than boys. It should be highlighted that two-thirds of the INDI motor subscale items refer to fine motor skills. Some reviews suggest boys outperform girls in a wide range of gross-motor tasks through childhood and adolescence (Barnett et al., 2016; Thomas & French, 1985). However, Peyre et al. (2019) explored longitudinal data regarding the preschool period, finding enhanced fine motor skills in girls compared to boys as early as age two and non-significant differences in gross motor domains before and after adjusting for environmental factors. This is consistent with our results since we found no sex differences in gross motor skills risk groups using ASQ-3 scores.

Concerning other cognitive areas, while sex-related effects found through ENDIS' ASQ-3 were modest, INDI's results show effects of practical significance only in the executive function subscale (not available in ENDIS' data for comparison). A similar pattern has been shown in previous studies where girls outperform boys in executive function variables such as inhibitory control tasks (Berlin & Bohlin, 2002; Carlson & Moses, 2001). Overall, our results show that sex differences in cognitive abilities are small during the preschool years, tending to favour girls. Previous studies also found that girls perform better than boys in their verbal and non-verbal communication during the preschool years (Toivainen et al., 2017).

Both INDI's and ENDIS' data show a similar pattern regarding socioemotional development: close-to-zero effects for sex differences in internalizing subscales and a stronger presence of externalizing behaviours in boys. Regarding externalizing behaviour problems, it should be noted that the effect sizes were above practical significance for the case of INDI's data but below that threshold for ENDIS' CBCL data. These results are in line with Frigerio et al. (2004), when comparing the results from CBCL and the Teacher's Report Form. This study also found that boys outperformed girls in externalizing behaviour problems, both rated by parents and teachers, even though only teachers' ratings presented a size effect above practical significance. Considering differences between informants, one hypothesis is that the school setting may provide broader socialization situations in which more explicit behavioural responses may occur (e.g. larger groups, peer interaction and negotiation,

and interaction with adults outside the family). Besides, teachers' have more experience in child development observation than parents' – which may also explain differences between informants' reports. These hypotheses rely on the possible influence of informants' bias as a product of contextual factors both at the parent and teacher level. Some of these are mother's age (e.g. younger mothers tend to rate less externalizing behaviour problems than their children's teachers) (Stone, Speltz, Collett, & Werler, 2013), teacher–child conflict (where teachers tend to rate children's disruptive behaviour higher than parents) or same-gender child preference, where female teachers (prevailing in Uruguay) tend to rate less externalizing behaviour problems in girls than in boys (Berg-Nielsen, Solheim, Belsky, & Wichstrom, 2012).

Higher rates of externalizing problems in boys than girls were also found previously (Chen, 2010) based on CBCL parental report and in samples aged below 18 years old (Berlin & Bohlin, 2002; Bongers, Koot, Van Der Ende, & Verhulst, 2004). Some of the origins of the sex-based gap may be related to: (a) biological differences in brain structure and functioning, as well as differences in the developmental processes; (b) differences in the socialization process, such as differing attitudes from parents (parental styles) towards boys and girls; (c) demands from formal education systems align better to girls than boys, and thus, promote the development of skills in which girls are better than boys (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Shaywitz et al., 1995).

Interestingly, girls' tendency to outperform boys was also observed in educational achievement internationally (Buchmann et al., 2008), and in Uruguay (Ineed, 2017). To confirm that gender differences in educational achievement are rooted in early childhood sex differences, developmental studies should be addressed through longitudinal designs.

4.2. Developmental disparities based on socioeconomic status

The effects of poverty on child development have been widely reported in the literature (Bradley & Corwyn, 2002; Duncan et al., 2017; Fletcher & Wolfe, 2016). In this study, the effects based on SES were, in general, larger than those based on sex-related differences. Specific areas within the cognitive domain showed the largest effects, and more modest within the socioemotional domain. Furthermore, differences based on SES seem to increase as children grow, particularly beyond 36 months of age. The results suggest that SES-related developmental gaps in Uruguay are observable from the early stages of development and tend to increase throughout the preschool years.

ENDIS' ASQ-3 data indicate problem-solving and fine-motor skills present larger SES-related effects for the oldest children in the sample. On the other hand, INDI's results suggest there are SES effect sizes in the cognitive domain, particularly regarding language and, to a greater extent, logic-mathematical subscales. Therefore, it seems that, in our samples, SES may be displaying a particular influence in early fluid reasoning abilities, such as the ones captured in ASQ-3's problem solving and INDI's logic-mathematical subscales. Previous findings relating SES and child development found similar results. For instance, Richards et al. (2018) found that SES was related to cognitive and language development and, to a lesser extent, to socioemotional development in a sample of children from East Asia-Pacific countries. In Latin America, Rubio-Codina et al. (2015) found similar results in a sample of Colombian children (aged 6–42 months), with larger effect sizes between the top and bottom income quartiles in cognitive and language development and smaller effects in socioemotional and fine motor scores (no differences were found in gross motor skills). Similar to our results, these differences tended to increase in older cross-sectional samples, as also seen in five other Latin American countries (Schady et al., 2015).

Regarding SES-differences in socioemotional development, we found effects of practical significance for internalizing, externalizing and total problems CBCL's scores, while SES effects on the externalizing behaviour increased with age. These results were also observed when comparing children at risk both by income quintile and maternal education using ENDIS data. SES differences based on INDI's socioemotional scores, though more modest, still favoured high-SES children. Many studies

documented SES's effects on children's socio-emotional development, behavioural adjustment, and mental health (Ravens-Sieberer, Erhart, Gosch, & Wille, 2008; Reiss, 2013; Richards et al., 2018).

A wide array of studies has shown the predictive value of school readiness scores, with further consequences on children's academic outcomes and well-being (Duncan et al., 2007; Duncan et al., 2017; Feinstein, 2003; Hattie, 2008). According to these studies, cognitive skills predict academic outcomes from primary education to higher education, with mathematical skills, language, and attention, respectively, showing the larger effect sizes (Duncan et al., 2007). Of particular concern is that the highest developmental inequity we found in INDI results was in logic-mathematical skills, which was found the strongest predictor of later academic achievement (Duncan et al., 2007; Watts et al., 2014). As such, the SES gap in cognitive skills found in our studies may relate to later academic failure and dropout rates, which are also ostensible in Uruguay, for instance, in the probability of completing secondary education (Ineed, 2017).

Previous studies also based on Uruguayan representative samples, indicate that the most severe profiles of internalizing and externalizing behaviour assessed with the CBCL were associated with lower maternal age and education, increased violence in parenting practices, and maternal depression – the effect of the latter being almost five times greater than the effect of parental violence (Vásquez-Echeverría et al., 2020). Adverse effects of maternal depression in child development have also been described elsewhere (Liu et al., 2017; Petterson & Albers, 2001). Also based on ENDIS' datasets, previous research found that another mediator of the association between SES and child development, with modest effects, are the HOME (Bradley & Caldwell, 1984) acceptance and receptivity subscales scores, even after controlling for other variables such as the mother's personality and her level of depressive symptoms (Vásquez-Echeverría et al., under review).

4.3. Policy implications and final comments

Developmental disparities in the Uruguayan population are present from the early stages of development. We have found that these inter-individual differences become more consistent as children grow older. This gap is most systematically observed in cognitive development areas, particularly in early arithmetic thinking and problem solving, with SES being an apparent risk factor. These findings reveal the need to prevent and address early childhood developmental problems in Uruguay long before primary school entry. In other words, school readiness policies should consider developmental gaps that are noticeable before entering the compulsory preschool system (age 4 in Uruguay). For instance, through the analysis of sex and SES effects, it is possible to define priority groups to focus attention efforts. For the case of SES, disparities appear to be most critical in terms of cognitive skills, remarkably fluid intelligence, an aspect for which specific interventions for this population are scarce and often not included in the priority intervention agenda. Implementing policies and intervention strategies using research results is the natural path following these large-scale early childhood assessment efforts.

4.4. Limitations and future directions

This study is not exempt of limitations. First, we could not determine any causal relations between variables. For this purpose, a longitudinal study would be best suited. Further studies should consider, in a more complex model, other variables (e.g. perinatal factors, caregivers' characteristics, parenting practices), to explore their mediating role in the association between sex or SES and child development outcomes. Second, for INDI data, intra-individual variability was not accounted for. Finally, the ASQ-3 presented some psychometric limitations that may impede identifying effects or correctly estimating their magnitude.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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