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Psychometric properties of the Spanish version of the *Ages & Stages Questionnaires: Social–Emotional* in a nationally representative sample

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ABSTRACT

The Ages & Stages Questionnaires: Social–Emotional (ASQ-SE) is a developmental screening test used around the world. However, research assessing the psychometric properties of the Spanish version or in nationally representative samples is scarce. The aim of this study is to evaluate the psychometric properties of ASQ-SE in Spanish, and to characterize the socio-emotional scores by sex and socioeconomic status. We administered the ASQ-SE, the Child Behavior Checklist 1 ½ - 5 and the Ages and Stages Questionnaires (3rd version) to a nationally representative sample of children in Uruguay aged 0–3 years old. A floor effect was observed in most of the age ranges for ASQ-SE, specifically in the questionnaires for younger infants. Internal consistency was acceptable. The sensitivity and specificity of the instrument was good when using cut-off scores based on the sample of this study rather than on the original United States sample. Boys and children of lower socioeconomic status had more socio-emotional problems. ASQ-SE in Spanish presents a uni-factorial structure with adequate internal consistency, sensitivity, specificity, and criterion validity. ASQ-SE has adequate psychometric properties to detect children whose social and emotional development requires further evaluation or continuous monitoring.

1. Introduction

The identification of delays in social and emotional development is crucial for timely pediatric and psychosocial interventions in early childhood. The Ages & Stages Questionnaires: Social–Emotional (ASQ-SE) is a screening instrument that can be used to identify children whose social and emotional development requires further evaluation [1]. ASQ-SE is completed by the parents or caregivers of the children [1] and has versions that are appropriate to the age of children in terms of months. ASQ-SE has been translated into many languages and is used internationally [2,3].

Previous studies have explored the psychometric properties of ASQ-SE [1,3,4]. Most results suggest that ASQ-SE presents adequate reliability, sensibility, specificity, and criterion validity. Regarding internal consistency, the values are usually acceptable-to-good, with reduced reliability in the versions for younger children [1]. In addition, higher reliability coefficients have been reported for the English versions in comparison to the translated versions [4]. Despite the ASQ-SE being widely used, only de Wolff et al. [2] have evaluated its internal consistency and validity (for the versions of 6, 14, and 24 months) using nationally representative data.

Traditionally, only a total score for ASQ-SE is computed, as suggested by the test developers [1]. For that reason, researchers have assumed that the test has a uni-factorial structure. However, some studies have debated this assumption. For example, Chieh et al. [3], ran exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) and concluded that a two-factor structure provided a better fit for the data. These factors were labeled *Emotion* (referring to self-control, self-regulation, affect, and somatic reactions) and *Sociality* (referring to social, adaptive, and interactive communication skills). Anunciação, et al. [5] evaluated a seven-factor correlated model as well as second order and bi-factor models for the 60-month ASQ-SE. They found unsatisfactory fit indices for all the CFA models, so they tested an EFA with up to seven factors. The EFA suggested that two factors should be retained, and this model was confirmed in a CFA. The two domains were labeled *Sociality* ($\omega = 0.82$) and *Emotion* ($\omega = 0.87$).

Several studies have assessed ASQ-SE validity using the Child Behavior Checklist (CBCL) as a criterion for socio-emotional development and behavioral problems in children [1,2,6,7]. All these studies determined the cut-off points for the risk categories provided by ASQ-

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SE by calculating Receiver Operating Characteristics curves (ROC). Although most of the results provide evidence of good criterion validity, the specificity and sensibility values are heterogenous across age versions and samples. For example, Squires et al. [1] found that sensitivity ranged from 71% (in the 24-month questionnaire) to 85% (60-months) and specificity ranged from 90% (30-months) to 98% (6-months). Sensitivity and specificity for the translated ASQ-SE were less consistent. Kucuker et al. [7] reported sensitivity ranged from 0.75 (36-months) to 0.93 (48-months), and specificity values ranging from 0.70 (12-months) to 0.95 (24-months). De Wolff et al. [2] and Heo and Squires [6] found high variability in their results between the age versions of the questionnaire. On the one hand, de Wolff et al. [2] determined the cut-off point at 0.90 or higher for specificity indices, and obtained sensitivity indices that varied between 0.28 (6-months) and 0.66 (24-months). On the other, Heo and Squires [6] reported sensitivity values ranging from 0% (6- and 12-months) to 100% (18- and 24-months) and specificity from 80% (30-months) to 96% (36-months). The cut-off score indicative of good sensitivity and specificity in determining risk is still undergoing debate.

The ASQ-SE was developed as a counterpart to the Ages and Stages 3rd version (ASQ-3) [1]. However, few studies have explored the associations between ASQ-SE and ASQ-3. Research suggests that there is a negative and statistically significant correlation between the domains of the two instruments [8]. Koledin [9] found non-significant negative correlations between the ASQ-SE and fine motor or problem solving skills. This result could indicate that the domains differ between the instruments or that self-regulation and interaction (evaluated by ASQ-SE) are not related to the fine motor and problem-solving skills of ASQ-3. On the other hand, in the two-factor model, Sociality presented stronger associations with the ASQ-3 domains than did Emotion [8]. These results suggest that children with lower ASQ-3 scores tend to have lower ASQ-SE Sociality scores. Finally, it has been shown that the 36- and 45-months questionnaires of ASQ-SE are positively associated with the Child Behavioral Checklist (CBCL) [10].

Considering sociodemographic variables, it has been shown that problems in socio-emotional development are associated with a lower household income [11,12]. The link between these two dimensions could be associated with parental psychological stress, unemployment or fear of unemployment [12]. The relationship between sex and socio-emotional development has also been studied. Research suggests that there is no difference across sex, except for the 30 month version of the questionnaire in which boys reported a higher average than did girls [7].

In this study we intend to enrich the literature on the psychometric properties of ASQ-SE in Spanish by: (a) evaluating its reliability and dimensionality in Spanish for the first time (b) evaluating the sensitivity and specificity of the ASQ-SE risk cut-off scores using the CBCL as a reference; and (c) characterizing the levels of socio-emotional development in Uruguay according to sex and socioeconomic level. To do this, we used a nationally representative sample from Uruguay.

Uruguay is a country with a small population of just over 3 million inhabitants and moderate-to-high life expectancy at birth (77 years, 44th in global rank) [13]. According to the 2011 Uruguayan census, individuals of self-reported European ancestry represent the majority of the population (93,9%) while individuals with African and Indigenous ancestry make up approximately 13,2% of the population. The census also shows that only 1.7% of the population did not have access formal education. In relation to the child population, 7.,4% of the total population is aged between zero to four years old and 7.82% between 5 and 9 years old. 44% of children grow up in poverty [14]. In comparison to other countries in South America, Uruguay has a low rate of population growth, low percentage of people living in poverty, high life expectancy, and high literacy rate [15].

Assessing the psychometric properties of ASQ-SE in Spanish, and specifically in Uruguay, would be important because there are few psychometrically validated screenings instruments capable of assessing socio-emotional development in a cost-efficient manner. Furthermore, according to some, in Uruguay the prevalence of various developmental diseases including autism spectrum disorder would have a higher rate of prevalence than in other countries [16].

2. Materials and method

2.1. Participants and procedure

The database used in this study was provided by the National Survey of Child Health and Development (ENDIS). This is a panel survey developed by the National Statistics Institute of Uruguay. The first cohort included children from 0 to 59 months, who were surveyed twice (in 2013 and in 2015). The second cohort included children from 0 to 47 months who were surveyed once (in 2018).

In the first ENDIS cohort (2013), children were selected from households participating in the Continuous Household Survey (CHS) of the National Statistics Institute, that had children under four years of age. The CHS is a survey about employment, cost and conditions of living, household compositions that is regularly administered by the government. For the second ENDIS cohort (2018) households were selected from the Child Birth Registry. In the first cohort, the selected sample size was 4943 children, of whom 3077 were interviewed in the first wave (response rate = 62,25%) and 2.611 in the second wave (response rate = 52,82%). In the second cohort, the selected sample size was 6.371 children, of whom 2.599 were interviewed (response rate = 40,80%). The stratification was carried out by geographic region, population of cities and socioeconomic status of households.

In all waves, the surveys were conducted face-to-face in the homes of the interviewees. The number of interviewers were 68, 107 and 49 for the waves of 2013, 2015 and 2018 respectively. Informants were the main caregivers of the child (95.8% mothers, 2.6% fathers, 1.8% grandmothers, 0.4% other). Questionnaires were administered by university students trained for this task. The interviewer asked the survey questions and recorded the interviewee's responses on a tablet. Interviews lasted on average 1 h and 15 min. Datasets and technical information about survey design can be accessed at ine.gub.uy/endis [17].

The ASQ-SE was administered in all editions of the survey. Children were assessed with the version appropriate to their age. Data fusion across waves was performed to increase the sample size and to test psychometric properties in all the age versions of the ASQ-SE. This study analyzed the data issued from 5.652 completed ASQ-SE questionnaires (52% girls). Age ranged from three to 65 months (M = 36.7; SD = 17.0). Table 2 shows the sample size by ASQ-SE age version.

2.2. Measures

2.2.1. Socio-demographic questionnaire

Parents of the participants provided information on the child's sex, date of birth and household income per capita.

2.2.2. Ages & Stages Questionnaires: Social–Emotional (ASQ-SE)

We used the Spanish adaptation and translation of the ASQ-SE that was carried out by the original authors of the instrument [1]. The instrument consists of eight questionnaires, named by the targeted age range: 6 months (from 3 to 8; 19 items), 12 months (from 9 to 14; 22 items), 18 months (from 15 to 20; 26 items), 24 months (from 21 to 32; 26 items), 30 months (from 27 to 32; 29 items), 36 months (from 33 to 41; 31 items), 48 months (from 42 to 53; 33 items) and 60 months (from 54 to 65; 33 items) [1].

The ASQ-SE assesses seven behavioral areas: self-regulation, compliance, communication, adaptive functioning, autonomy, affect, and interaction with people. Sample items from the 30-month-old questionnaire include "*Does your child look at you when you talk to her*?" and "*When upset, can your child calm down within 15 minutes*?" In all the ASQ-

SE age versions, the informants have three response options (0 = most of the time; 5 = sometimes; 10 = rarely or never). The ASQ-SE total score is calculated as the sum of the answers provided by the participants. Higher scores indicate higher risk of delays in development in the areas evaluated by ASQ-SE [1]. The additional option "Mark if this is a concern" was not used in this study.

2.2.3. Child Behavior Checklist (CBCL)

The 1½ to 5 years old version of the CBCL (CBCL 1½-5) was used, which has been adapted and translated into Spanish [18]. The CBCL 1½-5 was developed as a screening instrument to assess behavioral, emotional, and social problems in pre-school children [18,19].

It is composed of 99 items with three response options (0 = Not true, as far as I know; 1 = Somewhat or sometimes true; 2 = Very true or often true). This version consists of seven subscales, two second-order scales (internalization and externalization), and a total score. The CBCL presents adequate reliability and validity [19,20]. Vásquez-Echeverría et al. [21] reported good internal consistency and very good fit indices for the factor solution of the CBCL in Uruguay. All McDonald's omega (ω) coefficients were above 0.70, with the exception of aggressive behavior (ω = 0.66).

2.2.4. Ages and Stages Questionnaire – Third Edition (ASQ-3)

The Spanish version of the ASQ-3 was used [22]. This instrument evaluates the risk of developmental delay in children from 2 to 66 months using 21 age-specific questionnaires. Items have three possible answers (0 = No; 5 = Not yet, 10 = Yes). We computed a total score, and the five scores for each subscale. Sample items from each subscale of the 48-month-old questionnaire are as follows: Communication (*Does your child use all of the words in a sentence to make complete sentences, such as "I am going to the park,"*), Gross motor (*Does your child climb the rungs of a ladder of a playground slide and slide down without help*?), Fine motor (*Does your child unbutton one or more buttons*?, Problem solving (*When shown objects and asked, "What color is this*?" *does your child name five different colors*?) and Personal-social (*Does your child tell you the names of two or more playmates, not including brothers and sisters*?). In a study using ENDIS data, the ASQ-3 subscales of Communication (ω between 0.73 and 0.81) and fine motor (ω between 0.70 and 0.77) had adequate internal consistency across age intervals. However, reliability was suboptimal for the personal social subscale in 70% of questionnaires, for the Problem-solving subscale in 30% of questionnaires and for the Gross motor subscale in 10% of questionnaires. [23].

2.3. Analysis plan and data treatment

From the total sample, we excluded 440 cases where no items of ASQ-SE were answered or where the interviewer administered the version for an incorrect age. The percentage of evaluations with at least one missing value ranged between 0% and 2.5% by questionnaire.

The data were analyzed using SPSS version 20 and MPLUS 8.1. Descriptive statistics, percentage of children at risk, comparison of means, Spearman correlations and ROC were estimated with SPSS. For the descriptive analysis, the total ASQ-SE score was used. In these analyses, the missing values were imputed using the expectation maximization method. With MPLUS, the factor structure and internal consistency of the ASQ-SE were evaluated. The dimensionality was evaluated by Confirmatory Factor Analysis (CFA), using the WLSMV weighted least squares — mean and variance adjusted (WLSMV) estimator and the Full Information Maximum Likelihood (FIML) estimator to work with the missing data.

In the CFA the one-factor and the two-factor solution proposed by Chieh et al. [3] were tested. The results were interpreted according to the criteria given by Hu and Bentler [24] (comparative adjustment index (CFI) > 0.90, Tucker–Lewis index (TLI) > 0.95, root mean error (RMSEA) ≤ 0.06 and standardized root mean residual (SRMR) ≤ 0.08). In this analysis, models with all the ASQ-SE items were tested. After this, we tested models that excluded items that had factor loadings with p greater than 0.05, negative valence or loadings less than 0.30. In these models, up to 15% of the items in the ASQ-SE questionnaire were excluded. Internal consistency was assessed using McDonald's omega, with values greater than or equal to 0.70 considered adequate, between 0.80 and 0.89 good, and greater than or equal to 0.90 excellent [25,26].

The ROC analysis was performed with the cut-off scores proposed by Squires et al. [1], and at the same time cut-off points were evaluated using the database for this study. The specificity and sensitivity cut-off points for the study sample were selected in two steps. First, the lowest cut-off point was selected so that the sensitivity and specificity were greater than 0.70. Second, the case-by-case scores were analyzed, to observe when changes in the cut-off scores produced an improvement in both sensitivity and specificity. The sensitivity and specificity values were calculated using the total ASQ-SE score.

The ROC analysis and the estimates of the correlation coefficients of ASQ-SE with ASQ-3 and CBCL were performed for the data for children aged 18 months and over because all three instruments were administered to children at this age range.

3. Results

3.1. Factor structure and internal consistency

Table 1 shows the results for the CFA and the coefficients of internal consistency. The 12-month questionnaire presents adequate fit indices in the one and two factor solutions. For the 6-, 18- and 24-month questionnaires, the two-factor model presents a better fit than the one-factor model. The one factor model had depleted model fit among children older than 30 months. However, all these questionnaires (excluding the 12-month questionnaire) have suboptimal fit indices. When comparing the models with all the items and the reduced models, similar fit indices and internal consistency are observed. In the models with less items, all factor loadings are positive. However, factor loadings lower than 0.30 were still observed in most of these models and some the items in these shortened models had non-significant loadings.

In sum, mixed results were observed regarding the factor structure of the ASQ-SE in Spanish. However, the majority of the evidence shows that the one-factor solution provides a better fit to the data than the two-factor solution and consequently, the subsequent analyzes were carried out using the original one-factor scoring procedure.

Appropriate internal consistency was observed across the ASQ-SE questionnaires (ω > 0.70) with the exception of the two subscales in the 6- and 12-month versions. When comparing the results of the total model (including all items) and the reduced model (excluding items with suboptimal loadings), no differences are observed that merit the use of the reduced model.

3.2. Descriptive statistics and correlations

Table 2 shows the sample size and mean score for each ASQ-SE questionnaire of Squires et al. [1], and the sample size, mean and floor effect of our sample. The Uruguay averages are lower than those reported by Squires et al. [1], showing a high floor effect (few problems), particularly in children under 24 months.

The correlations between ASQ-SE, the ASQ-3 subscales and the CBCL 1½-5 broad-band subscales are presented in Table 3. The correlations between ASQ-SE and CBCL are moderate and positive (they range from 0.22 to 0.65), while the correlations between ASQ-SE and ASQ-3 are small to moderate and negative (ranging from −0.11 to −0.52). All the correlations between ASQ-SE and CBCL or ASQ-3 are statistically significant. In supplementary material number 1, we present the table of correlations between the two domains of the ASQ-SE with the ASQ-3 and CBCL subscale scores.

Table 1
Fit indices of the confirmatory factor analysis and internal consistency of ASQ-SE.

Model	χ2	df	CFI	TLI	RMSEA (IC 90%)	SRMR	ω	Mean FL	EI
6 months									
One factor - T	266.020	152	0.604	0.554	0.043 (0.034–0.051)	0.146	NA	NA	
One factor - R	160.675	104	0.687	0.639	0.037 (0.025–0.138)	0.138	0.79	0.52	3, 12, 16
Two factors - T	198.334	134	0.766	0.733	0.034 (0.024–0.044)	0.136	0.65 - NA	0.41 - NA	
Two factors - R	**147.737**	**103**	**0.768**	**0.73**	**0.033 (0.020–0.044)**	**0.131**	**0.67–0.92**	**0.45–70**	**3, 12**
12 months									
One factor- T	239.622	209	0.933	0.926	0.020 (0.000–0.031)	0.12	NA	NA	
One factor- R	**144.398**	**135**	**0.961**	**0.955**	**0.014 (0.00–0.003)**	**0.106**	**0.83**	**0.49**	**1, 6, 12, 21**
Two factors - T	216.401	209	0.915	0.906	0.021 (0.000–0.032)	0.115	0.43 - NA	0.26- NA	
Two factors - R	145.855	134	0.951	0.944	0.016 (0.000–0.031)	0.099	0.31–0.64	0.46–0.82	1, 12, 21
18 months									
One factor- T	422.395	299	0.745	0.723	0.031 (0.024–0.037)	0.137	0.85	0.45	
One factor- R	343.750	230	0.754	0.729	0.034 (0.026–0.041)	0.134	0.85	0.49	13, 23, 26
Two factors - T	328.597	274	0.888	0.877	0.021 (0.010–0.030)	0.121	0.72–0.84	0.46–0.57	
Two factors - R	**304.516**	**251**	**0.889**	**0.878**	**0.022 (0.011–0.030)**	**0.119**	**0.73–0.84**	**0.50–0.57**	**23**
24 months									
One factor- T	350.515	299	0.893	0.884	0.020 (0.008–0.029)	0.117	0.85	0.45	
One factor - R	304.597	252	0.891	0.881	0.022 (0.011–0.031)	0.115	0.85	0.47	2,3
Two factors - T	**346.869**	**299**	**0.901**	**0.892**	**0.020 (0.007–0.028)**	**0.118**	**0.73–0.80**	**0.45–0.52**	
Two factors - R	301.620	252	0.898	0.888	0.022 (0.010–0.030)	0.118	0.74–0.80	0.48–0.55	2, 3
30 months									
One factor- T	702.495	377	0.69	0.666	0.041 (0.036–0.046)	0.134	0.88	0.48	
One factor- R	**376.259**	**252**	**0.856**	**0.843**	**0.031 (0.024–0.037)**	**0.109**	**0.87**	**0.55**	**3, 7, 8, 26, 28**
Two factors - T	783.512	377	0.613	0.583	0.046 (0.041–0.050)	0.148	0.76–0.82	0.43–0.60	
Two factors - R	582.582	324	0.726	0.703	0.039 (0.034–0.044)	0.134	0.77–0.82	0.47–0.60	7, 28
36 months									
One factor- T	1002.579	434	0.746	0.728	0.037 (0.034–0.04)	0.12	0.88	0.46	
One factor- R	**779.818**	**324**	**0.782**	**0.764**	**0.038 (0.035–0.041)**	**0.12**	**0.88**	**0.51**	**4, 6, 12, 30**
Two factors - T	1016.128	434	0.74	0.722	0.037 (0.034–0.040)	0.128	0.77–0.83	0.44–0.60	
Two factors - R	840.912	350	0.765	0.746	0.038 (0.035–0.041)	0.13	0.78–0.83	0.48–0.60	4, 6, 12
48 months									
One factor- T	1180.277	495	0.848	0.837	0.031 (0.029–0.033)	0.085	0.91	0.53	
One factor- R	**872.799**	**377**	**0.878**	**0.869**	**0.030 (0.028–0.033)**	**0.08**	**0.91**	**0.58**	**2, 6, 16, 32**
Two factors - T	1817.493	495	0.707	0.687	0.043 (0.041–0.045)	0.114	0.82–0.85	0.50–0.63	
Two factors - R	1650.977	405	0.704	0.682	0.046 (0.044–0.049)	0.118	0.83–0.85	0.56–0.63	2, 6, 32
60 months									
One factor- T	883.245	495	0.866	0.857	0.027 (0.024–0.030)	0.099	0.90	0.50	
One factor- R	**632.951**	**377**	**0.904**	**0.896**	**0.025 (0.022–0.028)**	**0.095**	**0.89**	**0.54**	**2, 6, 16, 32**
Two factors - T	1114.982	495	0.787	0.772	0.034 (0.031–0.037)	0.116	0.82–0.84	0.48–0.59	
Two factors - R	963.106	405	0.798	0.783	0.036 (0.033–0.039)	0.118	0.82–0.84	0.54–0.59	2, 6, 32

Notes. EI = Excluded items; T = Total; R = Reduced; Mean FL = Mean of factor loads; NA = Not applicable; In the two-factor model of the ASQ-SE, the Omega of Emotion is observed first and then that of Sociality; In bold is indicates the most appropriate adjustment rates by age range of the ASQ-SE.

3.3. Sensitivity and specificity

Table 4 summarizes the sensitivity and specificity of the ASQ-SE in relationship to clinical ranges of the CBCL. The ROC analysis shows that ASQ-SE has good discrimination, with the area under the ROC curve (AUC) values over 0.80 for all questionnaires. Discrimination is higher in the 36-, 48- and 60-month questionnaires, with AUC values close to 0.90.

ASQ-SE showed good specificity in detecting socioemotional problems, as measured by the CBCL, but the sensitivity is low, with values

Table 2
Descriptive statistics and floor effect of the ASQ-SE for ENDIS sample and Squires et al. (2002).

Questionnaire	Squires et al. (2002)		ENDIS			
	N	M	*N*	M (SD)	% FE (=0)	% FE (≤25)
6 months	331	22.5	407	18.4 (15.4)	11.1	79.4
12 months	339	27.7	353	22.8 (18.1)	9.6	69.1
18 months	307	34.6	447	22.8 (19.8)	12.3	67.3
24 months	441	35.4	428	25.9 (19.8)	5.8	61.4
30 months	289	48.6	523	40.6 (25.8)	2.7	31.4
36 months	408	49.9	985	38.7 (25.0)	1.7	37.5
48 months	447	55.7	1424	39.5 (29.4)	2.6	39.3
60 months	299	47.5	1085	38.1 (25.9)	3.1	39.1

Notes. ENDIS = National Survey on nutrition, child development and health; M = Mean; M (SD) = Mean (Standard Deviation); % = percentage; FE = floor effect; % FE (= 0) = Percentage of children who score zero on the total ASQ-SE score; % FE (≤25) = Percentage of children with 25 points or less in the total CBCL; In Squires et al. 2002 standard deviation is not reported.

Table 3
Correlations between ASQ-SE scores with ASQ-3 and CBCL.

ASQ-SE	ASQ-3						CBCL									
	C	GM	FM	PSol	PSoc	TS	ER	A/D	SC	W	SP	AP	AB	I	E	TS
18 months	−0.27	−0.41	−0.45	−0.30	−0.33	−0.47	0.38	0.42	0.36	0.47	0.27	0.33	0.43	0.54	0.44	0.52
24 months	−0.27	−0.23	−0.29	−0.28	−0.23	−0.37	0.35	0.32	0.25	0.37	0.29	0.32	0.44	0.42	0.45	0.50
30 months	−0.37	−0.29	−0.29	−0.39	−0.35	−0.45	0.37	0.33	0.28	0.46	0.24	0.43	0.46	0.45	0.49	0.51
36 months	−0.42	−0.30	−0.31	−0.32	−0.43	−0.47	0.42	0.41	0.30	0.41	0.30	0.43	0.56	0.49	0.57	0.60
48 months	−0.42	−0.32	−0.40	−0.42	−0.39	−0.52	0.48	0.44	0.29	0.52	0.39	0.48	0.61	0.55	0.62	0.65
60 months	−0.24	−0.20	−0.15	−0.20	−0.11[(1)]	−0.26	0.46	0.40	0.22	0.41	0.33	0.47	0.59	0.48	0.60	0.59

Notes. ASQ-SE: Ages & Stages Questionnaires: Social-Emotional; ASQ-3 = Ages and Stages Questionnaires-3rd edition; CBCL = Child Behavior Checklist; C = Communication; GM = gross motor; FM = Fine motor; PSol = Problem solving; PSoc = Personal-Social; TS = Total Score; ER = Emotionally reactive; A/D = Anxious/depressive; SC = Somatic complaints; W = Withdrawal; SP = Sleep problem; AP = Attention problems; AB = Aggressive behavior; I = Internalizing; E = Externalizing; All correlations are statistically significant at $p < .01$ level, except for [(1)], $p < .05$.

generally below 0.70 (except in the 36-month version). The 36 months version had good sensitivity with the original thresholds, whereas for the other versions lower thresholds were necessary in order to obtain adequate sensitivity. Table 4 shows the ASQ-SE cut-off scores proposed for the Spanish version.

3.4. Socio-emotional development, socioeconomic status and sex

To characterize socio-emotional development in Uruguay we used the total score, because overall it presented better-fit indices and reliabilities. Table 5 shows the percentage of children at risk on the basis of the cut-off scores of the normative sample (from the United States). The percentage of children at risk ranges between 7% and 20% for the different age questionnaires. A higher percentage of boys are at risk than girls in all age ranges of ASQ-SE with the exception of 6 months.

Households with lower incomes have a higher percentage of children at risk. Statistically significant differences are observed by household income level per capita starting at 18 months of age (18 months: F (4, 442) = 6.68; 24 months: F (4, 423) = 7.63; 30 months F (4, 518) = 10.42; 36 months: F (4, 975) = 11.36; 48 months: F (4, 1414) = 24.10; 60 months: F (4, 1075) = 13.66, all $p < .01$). The Tamhane post hoc test reports statistically significant differences between incomes among the most extreme groups; that is: quintile 1 versus quintile 5 and quintile 2 versus quintile 5. Children in quintile 1 and quintile 2 have higher ASQ-SE scores than quintile 5 in all age questionnaires. Table 5 also reports the average ASQ-SE according to sex. Boys have a higher average ASQ-SE than do girls, with the difference being statistically significant after 30 months of age.

4. Discussion

This study aimed to assess the dimensionality, reliability, sensitivity, specificity, and validity of the ASQ-SE questionnaire in Spanish in a nationally representative sample and additionally, to characterize the socio-emotional development of children in Uruguay according to their sex and socioeconomic level.

In the CFA, the 12-month questionnaire was the only one to present adequate fit indices for both the one- and two-factor solutions, but better fit provided for the one factor solution. For the 6-, 18- and 24-month questionnaires, results suggested that the two-factor solution fit the data adequately and better than the one factor model. For questionnaires adapted to age groups over 30 months, a unifactorial model with the exclusion of poorly performing items provided the best fit to the data. However, results suggested that all the ASQ-SE questionnaires had at least one suboptimal fit index, with the exception of the 12-month questionnaire. Previous studies have also reported suboptimal or barely acceptable fit indices for ASQ-SE [3,5]. The models we ran that excluded poorly performing items provided better model fit with the exception of the 24-month version. However, in both models with all items and abridged models that excluded poorly performing items, some items had factor loadings inferior to 0.30. In summary, we observe mixed evidence on the dimensionality of ASQ-SE. In general, our data supported a one-factor solution for the Spanish version, a result that is consistent with the original proposal of Squires et al. [1]. However, the two-factor solution of Chieh et al. [3] was found to be more suitable for some age groups. Differences in psychometric properties of the ASQ-SE across countries and age versions could be due to cross-cultural differences in socioemotional development. Cultural values and norms may regulate and influence individual socio-emotional functioning, and in turn, expectations of “normative” development of children socio-emotional skills at different ages [27]. For instance, it has been shown that cultural differences affects how children interact with each other and their forms of expression [28,29]. To help resolve debates about the dimensionality of ASQ-SE, more research would need to be carried out across countries and samples, preferably using all age versions of the instrument. In addition, researchers should consider whether to use all the items, since some have suboptimal psychometric properties in the Spanish version.

With respect to internal consistency, the values of ω for all the one-factor solutions were greater than 0.79. These values are consistent with the results of Squires et al. [1] and higher than those reported in other studies with translated versions of the instrument [2,6,7].

Table 4
ROC analysis of ASQ-SE with cut-off scores of Squires et al. (2002) and with suggested cut-off scores for the Spanish version.

Questionnaire	AUC (SE)	ROC with original cut-off scores			ROC with suggested cut-off scores		
		Threshold	Sen	Spe	Threshold	Sen	Spe.
18 months	0.85 (0.05)	50	0.54	0.92	26	0.77	0.75
24 months	0.81 (0.06)	50	0.53	0.88	36	0.82	0.76
30 months	0.84 (0.03)	57	0.68	0.83	46	0.80	0.73
36 months	0.91 (0.02)	59	0.87	0.85	56	0.87	0.85
48 months	0.89 (0.02)	70	0.66	0.91	51	0.81	0.80
60 months	0.86 (0.02)	70	0.62	0.92	46	0.81	0.75

Notes. AUC (SE): area under the ROC curve (Standard Error); ROC = Receiver Operating Characteristics; Sen = sensitivity; Spe = Specificity.

Table 5
Percentage of children at risk by sex and income quintiles per capita of the household, and average ASQ-SE score by sex.

Questionnaire	Percentage of children at risk								Mean and standard deviation of ASQ-SE by sex			
	Sex		Quintile					T	Boys	Girls	d-Cohen	*t*
	B	G	Q 1	Q 2	Q 3	Q 4	Q 5		M (SD)	M (SD)		
6 months	7.0	7.3	10.2	2.9	12.3	5.5	4.2	7.1	18.7 (16.1)	18.1 (14.5)	0.03	0.34
12 months	8.1	7.1	13.7	3.9	5.0	9.2	5.4	7.6	22.8 (19.4)	22.8 (16.6)	0.00	0.04
18 months	10.5	8.8	18.8	11.5	11.8	4.7	3.1	9.6	23.5 (20.1)	22.0 (19.5)	0.07	0.79
24 months	13.8	12.9	21.8	12.4	16.9	13.9	2.2	13.3	27.0 (20.0)	24.8 (19.6)	0.11	1.17
30 months	23.9	17.4	30.6	25.8	18.8	14.8	13.5	20.7	43.2 (25.5)	37.9 (25.9)	0.20	2.34*
36 months	21.6	16.0	25.4	27.9	17.6	17.7	7.2	18.9	41.7 (26.3)	35.4 (23.2)	0.25	4.00*,[a]
48 months	14.8	10.4	18.5	18.4	11.0	9.8	5.2	12.6	42.4 (32.5)	36.5 (25.4)	0.20	3.79*,[a]
60 months	13.8	9.0	18.5	12.9	12.4	9.1	4.7	11.6	40.7 (26.6)	35.1 (24.7)	0.22	3.62*

Notes: *B* = boys; G = Girls; Q = Quintile; T = Total; M (SD) = Mean (Standard Deviation)
[a] The assumption of homoscedasticity is rejected according to the Levene's test.
* $p < .05$.

For all the ASQ-SE questionnaires, Uruguayan children present a lower mean score than the normative sample [1]. The number of children without problems (the floor effect) was high, especially in children aged under 24 months. Boys had more socioemotional problems from the 30-month questionnaire onwards. These results are consistent with the previous literature [7,11,12,30]. Boys would present worse adjustment and more externalizing problems because of the faster physical maturation of girls, prior language development and adults' expectations for girls to self-regulate earlier than boys [31]. We also observed that household income was linked to socio-emotional development such that children living in low-income families reported worse socio-emotional development. This results may be explained by physical stressors (for example, precarious housing), and psychosocial factors (e.g.: violence, stress) which are more frequently present in low-income families [32].

The present study provides evidence of association between ASQ-SE and ASQ-3, and ASQ-SE and CBCL, in the expected direction and magnitude. The Sociality subscale was more strongly related to ASQ-3 than the Emotion subscale. The content of the sociality subscale includes interaction with partners, expression of emotion, and exploration of the environment. These components require more cognitive skills, as do constructs that are related more strongly to ASQ-3 such as language or curiosity [8]. By contrast, the Emotion subscale refers to self-regulation and impulse control, which are similar to the behavioral symptoms evaluated by the CBCL.

The ROC analysis showed that ASQ-SE has acceptable discrimination in relation to CBCL. Using the original, normative sample thresholds identified risk in CBCL with high specificity, but low sensitivity. Sensitivity calculated using the cut-off scores for the normative sample ranges from 53% to 87%, which is a lower range than reported in the original study [1] but similar to what was found in studies using translated versions of ASQ-SE [2,6,7]. Suboptimal sensitivity values were observed in most of the questionnaires, with the exception of the 36-month version. The specificity was adequate and similar to that found in previous studies [1,2,6,7]. In our sample, lower thresholds balance the specificity and sensitivity indices to be both good. The sensitivity and specificity obtained using the cut-off points of our sample were greater than 70% in all questionnaires. Therefore, we suggest that researchers and professionals using ASQ-SE in Spanish should use the cut-off scores we suggested herein.

Although we worked with a nationally representative sample, this research has certain limitations. First, the instruments were administered orally in an interview, and not self-administered as suggested in the manuals. Second, we observe a strong floor effect, which reduces variability, and this could affect the interpretation of the results. Third, we worked with a general sample, not a clinical one. The results may vary if a reference sample is used and in particular, the cut-off scores for specificity and sensitivity may change. Fourth, although the results of this study are from a representative sample and that Uruguay presents similar characteristics to the other countries of the southern cone (e.g.: Argentina or Chile), the results of this study cannot be generalized to other Spanish-speaking countries given some sociodemographic differences between the countries. Nonetheless, our results may provide a baseline of cut-off scores more appropriate to the South American context than the original United States data. Fifth, we do not provide data on test-retest and inter-rater reliability. Finally, in this study we used the first version of ASQ-SE and not the second version currently available [33].

In sum, our results suggest the ASQ-SE in Spanish presents adequate psychometric properties. The ASQ-SE can be used as a screening instrument for socio-emotional development by main caregivers or home-visitors interviewing caregivers. Despite the mixed results regarding the factor solution, the preponderance of evidence suggests that the instrument has a unifactorial structure. We suggest to be cautious with the use of the questionnaires for 6 to 12 months and to use the cut-off scores from this study to recommend referral or further assessment.

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