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RESEARCH ARTICLE

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Reliability and acceptability of web-based administration of Spanish ages and stages questionnaires third edition®

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Abstract

to analyse the reliability of 6 age intervals of Spanish web-based Ages and Stages Questionnaires Third Edition (WB-ASQ-3) and parents' acceptability, in a clinical practice context, during COVID-19 pandemic and lockdown in Chile. Cross-sectional study with a longitudinal component. Internal consistency was analysed by Cronbach's alpha and Pearson product–moment correlation, Pearson's correlations between intervals questionnaires were analysed. Acceptability was determined using a parental satisfaction survey. 1061 children completed 2318 validated questionnaires. Scores were compared with normative sample, except for Gross motor at 8 and 12 months, and Communication at 12, 18 and 24 months, without differences to the previous Chileans sample. In domain analysis, Cronbach's alpha ranged from 0.36 to 0.80 and reached 0.74 to 0.81 for the overall test. Strong positive correlation between the domain and overall score was obtained. Correlation between most questionnaires at different ages was positive and significant. Parental surveys show high satisfaction; parents were thankful for being able to monitor children's development. WB-ASQ-3 is a reliable and feasible screening system, particularly when the test is taken as a whole, rather than by

domains. It is remarkably high acceptability among parents, especially in complex times such as the lockdown and the COVID-19 pandemic.

KEYWORDS
ages and stages questionnaires, developmental delay, developmental screening tool, psychometric properties

1 | INTRODUCTION

The first three years of life are recognised as a critical period for the foundation of cognitive ability and related functioning. Intellectual disabilities and other developmental disabilities (DD) often co-occur and are detectable during infancy and at preschool age. It is estimated that 1 in 5 to 6 children has some DD, with an overall significant increase in the prevalence between 2009 and 2017 (Ricardo-Garcell et al., 2022; Zablotsky et al., 2019). According to Olusanya et al. the global prevalence of developmental intellectual disability was 3.1% (95% CI: 2.3–3.8), autism spectrum disorder 0.4% (95% CI: 0.3–0.5) and cerebral palsy 0.6% (95% CI: 0.5–0.6) (Olusanya et al., 2023). Those disabilities are more prevalent in those children with biological risk factors such as prematurity (Allotey et al., 2018; Heyne et al., 2018; Kerstjens et al., 2012; Schonhaut et al., 2015).

Due to the noticeable impact of early and timely intervention in children with a DD and considering that most of these are subtle and difficult to detect when childcare professionals rely on judgement alone (Sheldrick et al., 2011), scientific societies recommend monitoring children's development using standardised, valid and reliable tools at targeted ages during follow-up visits (American Academy of Pediatrics, 2006). Updated guidelines from the American Academy of Paediatrics (AAP) specify in their recommendation the use of well-validated screening tests completed by parents, such as the Ages and Stages Questionnaires (ASQ), Parents' Evaluation of Developmental Status (PEDS) and its complement Developmental Milestones (PEDS:DM) and the Survey of Well-being of Young Children (SWYC) (Lipkin & Macias, 2020).

The ASQ consists of 21 questionnaires created during the 1980's and updated in 2009 as ASQ-3 (Squires & Bricker, 2009). Its use has increased in recent years in the United States (US) (Hirai et al., 2018; Lipkin et al., 2020). In addition, it has been translated, culturally adapted and validated in several languages and countries (Muthusamy et al., 2022; Rah et al., 2022; Rousseau et al., 2021). Studies have reported that the English and Spanish versions translated by the publisher have comparable psychometric properties and a cultural equivalence, unlike what was described in other translated/adapted versions (Pomés et al., 2016; Velikonja et al., 2016). Regarding the application modality, a previous study showed that the web-based English ASQ's psychometric properties are equivalent to the paper-pencil administration (Yovanoff et al., 2013).

In Chile, the adapted version of the ASQ-3 was validated with minor cultural modifications as ASQ-Cl (Armijo et al., 2015; Schonhaut et al., 2013). In a sub-sample of a medium-high socioeconomic status population, high concurrent validity was demonstrated with the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) (Schonhaut et al., 2013). In the longer term, its application was a significant predictor for the cognitive delay and comparable with Bayley-III (Schonhaut et al., 2020). No significant differences were found in the content and distribution of scores of the original USA version, except for Gross motor skills at eight months, in which the scores were lower for the Chilean cohort and clinically a higher prevalence of developmental delay in this domain was found (Armijo et al., 2015). Due to those results, it was considered that the version translated by the publisher could be used with original standards (Schonhaut & Armijo, 2014).

Despite the promising results, there was a limitation for routine implementation in common clinical practice, since the childcare professional who must deliver the printed material or send it by mail in PDF, without an established feedback and referral pathway and is at risk of violating the indicated age window for a questionnaire, which is a modifier for the interpretation of the results (Janson et al., 2008). Accordingly, we opted for the implementation of the web-based ASQ-3 Spanish version translated by the publisher (WB-ASQ-3).

The objective is to analyse the reliability of 6 age intervals of Spanish web-based Ages and Stages Questionnaires Third Edition (WB-ASQ-3) and parents' acceptability, in a clinical practice context, during COVID-19 pandemic and lockdown in Chile.

2 | METHODS

A cross-sectional study with a longitudinal follow-up component was implemented on children who consult in the outpatient unit of Clínica Alemana, a private health institution that provides health to medium-high socioeconomic level children, in Santiago, Chile.

After signing the licence with Brookes Publishing, the children were evaluated with the Spanish ASQ-3 translated by the publisher in a web-based format, posted online exactly as published. The whole recruitment process and the feedback for patients were approved by the publisher to confirm an accurate format.

The assessment was made between May 2020 and December 2022, during the COVID-19 pandemic. In Chile, the first epidemic control measures were determined in March 2020 with the closure of kindergartens and schools, giving continuity to one of the harshest lockdowns in the world, which lasted more than 15 months. Even during the second semester of 2022, the return to normal activities was incomplete.

2.1 | Participants

A non-probabilistic sampling of the voluntary response was implemented among patients who accepted the invitation to participate in the study through a web link that led them to fill out a form built in REDCap (Research Electronic Data Capture). The children were recruited at birth or the subsequent health check-ups.

Inclusion criteria: Spanish-speaking parents of children aged 0 to 30 months, that were born and/or received medical attention at Clínica Alemana, owned a tablet or Smartphone with a QR reader and Internet access and who voluntarily enrolled for the monitoring of their children's development. They agreed to participate by signing an informed consent.

Exclusion criteria: The cases in which the parents did not authorise the use of questionnaires and those with incomplete questionnaires were excluded from the analysis.

2.2 | Instrument

2.2.1 | Web-based ages and stages questionnaires® third version in Spanish translated by Brookes publishing (WB-ASQ-3) (Squires & Bricker, 2009)

The ASQ-3 is a validated parent-completed developmental screening tool. Twenty-one questionnaires are available, for 1 to 66 months of age. In this study, only the questionnaires for the ages 4–8–12–18–24 and 30 months were included. In the questionnaires, the parents must answer 30 questions covering five domains of development, including Communication, Gross motor, Fine motor, Problem solving and Personal-social. Each domain contains 6 questions that can be answered with 'Yes' (10 points), 'Sometimes' (5 points), or 'Not yet' (0 points). The different domain scores are obtained by adding these points.

2.2.2 | Parental satisfaction survey

parents who answered the corresponding questionnaire received a 6-question survey based on previous studies (Pomés et al., 2016), plus an open section to express their opinions. The survey was constructed with a 5-point Likert

scale, ranging from 'strongly disagree' to 'strongly agree'. The questions were related to how easy the understanding of the questionnaire was, the appropriateness of the questions for the child's age, the usefulness of the pictures, how recommended was the digital use of the questionnaire, satisfaction about the feedback format and the benefit of the ASQ-3 to understand the progress in the development of their children.

2.3 | Procedure

The patients enrolled voluntarily through a link or a QR code, whether during the neonatal period or in one of the health checks, up until 30 months. The RedCap program was configured to calculate the interval questionnaire submission corresponding to each patient's age with a time window as indicated in the ASQ-3 user guidelines (Squires & Bricker, 2009). The same system sent reminders to the corresponding ages. In case there were any doubts, the patients could communicate with their paediatrician or the responsible researchers via email or telephone.

The digital questionnaires forms were sent at ages 4–8–12–18–24 and 30 months, to the email of the registered parent or guardian. In the case of premature infants, the questionnaire was sent at the corrected gestational age up to Two years.

All parents agreed to participate by signing an informed consent. The Research Ethics Board of Clinical Alemana and Universidad del Desarrollo approved the study.

2.4 | Statistical analyses

We first assessed the background characteristics of the study samples. For assessing internal consistency as a measure of reliability for the test, Cronbach's alpha coefficient was calculated for each of the five domains and then for overall test. The following rules of thumb for Cronbach's alpha were: >0.9 Excellent; >0.8 Good; >0.7 Acceptable; >0.6 Questionable; > 0.5 Poor; and <0.5 Unacceptable (Butts & Michels, 2006). In addition, Pearson product-moment correlation between the domains' scores and the overall score was analysed, to determine the test's internal consistency. For this, a minimum sample of 94 children by age group was considered acceptable (Bonett, 2002).

We compared Cronbach's alpha and the mean scores of ASQ-3 at 4–8–12–18–24 and 30 months with those from the US normative data (Squires & Bricker, 2009) and to the previous results of studies performed in Chile with the paper-pencil 8 and 18-month forms (Armijo et al., 2015). In relation to the average, we follow recommendations from previous publications, that consider significative a difference ≥5 points, given that the ASQ is a range scale, in which a score difference ≥5 points represents a change in the cut point criteria (Kerstjens et al., 2009; Schonhaut et al., 2019).

For the longitudinal follow-up analysis, in children who participated in more than one questionnaire form, the correlations between the WB-ASQ-3's total score and the score of each domain were measured using the Pearson Correlation. In case follow-up sample was smaller than at least 20 patients, it was excluded from the analysis.

The acceptability of the questionnaires was determined using the Likert scale. The frequency of the answers 'Agree' and 'Strongly Agree' was measured in comparison to the answers 'Disagree' and 'Strongly Disagree'. Afterwards, a qualitative analysis was run on the parents'/caregivers' comments. The comments were then classified as Positive, Negative and Suggestions. For this analysis, a minimum of 100 surveys answered were deemed acceptable.

The analysis was performed on the statistic software R, version 4.2.2.

3 | RESULTS

3.1 | Sample characteristics

We included 1061 children who completed 2318 validated questionnaires. No differences were found between included and excluded participants, except in the percentage of Mother's Education at undergraduate/postgraduate

TABLE 1 Sample characteristics, included and excluded children.

	Total included *n* (%)	Rejected participation *n* (%)	
Total of children included	1061	155	
Total of tests included	2318		
Gender			
Male	521(49.10)	78 (50.30)	$\chi^2 = 0.08$, df = 1, $p = 0.776$
Female	540 (50.90)	77 (49.70)	
Preterm labor			
Yes	106 (9.99)	15 (9.68)	$\chi^2 = 0.01$, df = 1, $p = 0.903$
No	955 (90.01)	140 (90.32)	
Type of delivery			
Vaginal	506 (47.70)	68 (43.87)	$\chi^2 = 2.40$, df = 1, $p = 0.121$
Cesarian	555 (52.30)	87 (54.83)	
Neonatal hospitalization			
Yes	119 (11.22)	14 (9.03)	$\chi^2 = 0.66$, df = 1, $p = 0.416$
No	942 (88.78)	141 (90.96)	
Mother's age at childbirth			
Mean ± SD	34.13 ± 3.97	33.98 ± 4.45	$t_{(df=1214)} = 0.39$, $p = 0.654$
Mother's education			
Undergraduate/postgraduate	1015 (95.66)	141(90.96)	$\chi^2 = 11.73$, df = 2, $p = 0.002$
High school/community/technical	46 (4.34)	13 (8.34)	
Empty	0	1 (0.65)	
Father's age at childbirth			
Average ± SD	36.52 ± 5.65	36.34 + 5.90	$t_{(df=1214)} = 0.36$, $p = 0.639$
Father's Education			
Undergraduate/postgraduate	1004 (94.63)	142 (91.61)	$\chi^2 = 2.96$, df = 2, $p = 0.227$
High school/community/technical	52 (4.90)	11 (7.10	
Empty	5 (0.47)	2 (1.29)	
Siblings			
Yes (range)	464 [1–5] (43.73)	77 (1–4) (49.70)	$\chi^2 = 3.38$, df = 2, $p = 0.184$
No siblings	395 (37.22)	46 (29.68)	
No answer	202 (19.03)	32 (20.65)	

level, which was slightly higher in the sample that answered the survey than in the one that declined their participation (95.66 vs. 90.96%). The distribution by age, the number of assessments and the sample characteristics are detailed in Table 1 and Figure 1. The mean age of mothers at birth was 34.13± 3.97, while the age of fathers was 36.52 ± 5.65. The 49.10% of the sample was male and 9.99% were born prematurely.

3.2 | Comparison of study sample web-based ASQ-3 mean and standard deviation with US normative data and ASQ-validated previously in Chile

Table 2 compares WB-ASQ-3 scores in six ages included with US normative data and previous studies of ASQ in Chile (ASQ-Cl) (paper-pencil version- 8- and 18-month form). The sample scores were compared with those reported

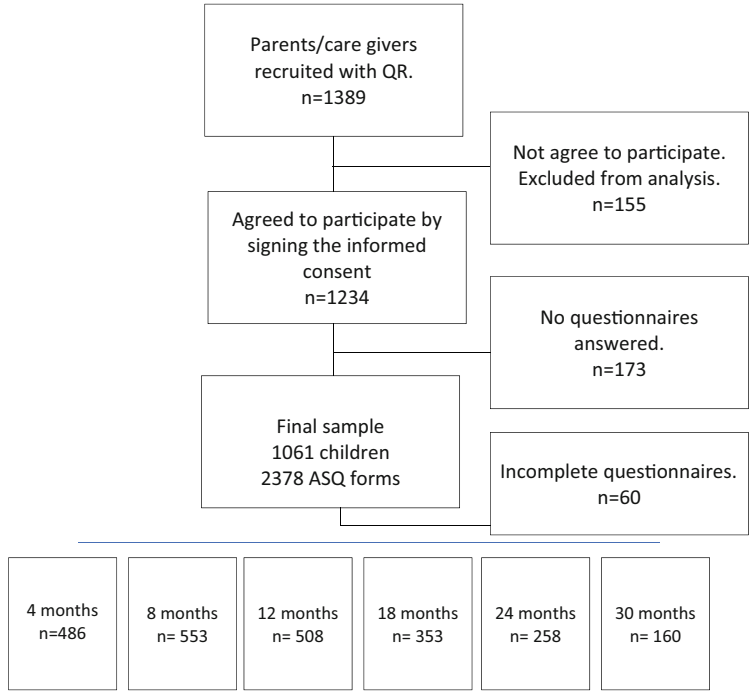


FIGURE 1 Study participation flowchart.

in the US, except for Gross motor at 8 and 12 months and Communication at 18 and 24 months, which was significantly lower in the sample of WB-ASQ-3. The exception was Communication at 12 months, which was higher in the WB-ASQ-3 sample (deemed significant >5 points in difference). Overall, all scores were very similar to the previous Chileans sample.

3.3 | Reliability analysis for each domain and overall score

Cronbach's alpha for the sample of WB-ASQ-3 scores was computed for each domain and for the overall score. Item deletion did not improve alpha coefficients in any domain. Scores ranged from 0.36 (Fine motor domain 24-month) to 0.8 (Gross motor domain 12-month), with most of Cronbach's alpha values lower than those obtained in the USA validation and in the previous Chilean study. In the analysis by domain, only 16.66% of Cronbach's alpha were appropriate (>0.7) all of them in the Communication (50% of Cronbach's alpha) and Gross Motor domains (20%), while in none of the ages, it was appropriate in the Problem solving and Personal-social domains. On the contrary, when the global analysis was conducted, we obtained a Cronbach's alpha of 0.74 and 0.81 that indicated acceptable-good internal consistency for an overall test at all studied ages. (Table 3).

3.4 | Pearson correlation coefficients between the domain scores and the overall score for each interval questionnaire

Figure 2 shows the Product–moment Pearson correlation between domain scores and the overall score for WB-ASQ-3. Strong positive correlation between domain scores and overall score is obtained. The correlation between

TABLE 2 Comparison of study sample web-based ASQ-3 mean and standard deviation with US normative data and ASQ-validated previously in Chile.

	WB-ASQ-3 mean (SD)	ASQ-3 mean (SD)	ASQ-Cl mean (SD)
ASQ-4 month	$n = 486$		
Communication	52.6 (6.9)	52.3 (8.9)	
Gross motor	54.7 (6.6)	54.6 (8.1)	
Fine motor	48.4 (10.8)	51.6 (11.0)	
Problem solving	53.0 (7.8)	53.8 (9.4)	
Personal social	52.7 (7.8)	51.9 (9.4)	
ASQ-8 month	$n = 553$		$n = 1007$
Communication	51.4 (9.0)	52.4 (9.7)	53.4 (7.7)
Gross motor	43.4 (12.7)[a]	52.1 (10.7)	44.8 (12.7)
Fine motor	54.7 (8.1)	55.8 (7.8)	54.9 (7.9)
Problem solving	53.6 (7.8)	53.9 (8.9)	54.7 (7.3)
Personal social	51.0 (8.9)	53.4 (8.8)	52.2 (9.2)
ASQ-12 month	$n = 508$		
Communication	49.2 (10.5)[a]	43.2 (13.8)	
Gross motor	42.8 (15.3)[a]	49.9 (14.2)	
Fine motor	52.1 (7.9)	52.2 (8.9)	
Problem solving	49.5 (9.3)	49.0 (10.8)	
Personal social	45.0 (11.7)	45.7 (12.0)	
ASQ-18 month	$n = 353$		$n = 889$
Communication	35.6 (13.3)[a]	42.3 (14.6)	39.3 (12.8)
Gross motor	57.2 (7.3)	55.5 (9.0)	56.7 (5.8)
Fine motor	52.4 (8.1)	52.4 (9.1)	50.7 (9.6)
Problem solving	47.1 (10.0)	46.0 (10.1)	47.3 (10.1)
Personal social	49.8 (8.5)	47.9 (10.3)	51.6 (7.9)
ASQ-24 month	$n = 258$		
Communication	44.4 (14.7)[a]	51.2 (13.0)	
Gross motor	53.7 (6.7)	54.7 (8.3)	
Fine motor	52.4 (7.3)	51.7 (8.3)	
Problem solving	49.8 (9.0)	49.4 (9.8)	
Personal social	48.4 (9.9)	51.1 (9.8)	
ASQ-30 month	$n = 160$		
Communication	53.1 (10.1)	53.8 (10.3)	
Gross motor	55.3 (6.3)	53.5 (8.7)	
Fine motor	47.5 (11.7)	46.8 (13.8)	
Problem solving	50.2 (10.6)	50.2 (11.6)	
Personal social	48.7 (7.9)	51.9 (9.9)	

Note: Different study ages.

Abbreviations: ASQ-3, United States normative data; ASQ-Cl, ASQ-3 pencil validated in Chile; WB-ASQ-3, web-based ages and stages ASQ third edition in Spanish.

[a]Differences greater than 5 in relation to original ASQ-3 validation. A 5+ score difference represent a change in the cutpoint criteria, because for individual tests scores ranges from 0 to 60 with a 5 point step.

TABLE 3 Reliability analysis for each domain and overall score using Alpha Cronbach.

Age	ASQ	*n*	Communication	Gross motor	Fine motor	Problem solving	Personal-social	Overall score
4 months	WB-ASQ-3	486	0.41 (0.33–0.49)	0.44 (0.36–0.51)	0.66 (0.61–0.70)	0.49 (0.42–0.56)	0.43 (0.35–0.51)	0.79 (0.76–0.81)
	ASQ-3	1194	0.60	0.64	0.73	0.73	0.60	
8 months	WB-ASQ-3	553	0.57 (0.51–0.62)	0.65 (0.60–0.69)	0.62 (0.57–0.67)	0.51 (0.45–0.57)	0.42 (0.34–0.49)	0.74 (0.71–0.77)
	ASQ −3	1328	0.69	0.68	0.70	0.69	0.54	
	ASQ-Cl	1007	0.66	0.76	0.81	0.74	0.69	
12 months	WB-ASQ-3	508	0.56 (0.5–0.62)	0.80 (0.78–0.83)	0.42 (0.34–0.50)	0.51 (0.44–0.57)	0.58 (0.52–0.63)	0.81 (0.79–0.84)
	ASQ-3	2035	0.68	0.82	0.55	0.61	0.63	
18 months	WB-ASQ-3	353	0.70 (0.65–0.75)	0.77 (0.73–0.81)	0.45 (0.36–0.54)	0.51 (0.42–0.58)	0.42 (0.32–0.51)	0.77 (0.74–0.81)
	ASQ-3	592	0.74	0.77	0.58	0.54	0.56	
	ASQ-Cl	889	0.69	0.85	0.74	0.72	0.71	
24 months	WB-ASQ-3	258	0.77 (0.72–0.81)	0.36 (0.23–0.47)	0.45 (0.34–0.55)	0.44 (0.32–0.54)	0.52 (0.43–0.61)	0.80 (0.77–0.84)
	ASQ-3	1371	0.8	0.64	0.51	0.53	0.58	
30 months	WB-ASQ-3	160	0.71 (0.63–0.77)	0.38 (0.22–0.52)	0.67 (0.58–0.74)	0.56 (0.45–0.66)	0.42 (0.27–0.55)	0.79 (0.74–0.84)
	ASQ-3	935	0.75	0.62	0.75	0.65	0.65	

Note: Comparison of study sample web-based ASQ-3 with US normative data and ASQ-validated previously in Chile. Different study ages.

Abbreviations: ASQ, ages and stages; ASQ-3, United States normative data; ASQ-Cl, ASQ-3 pencil validated in Chile; WB-ASQ-3, web-based ages and stages ASQ third edition in Spanish.

the different domains was significant but lower for almost all domains. We found no differences in the correlation pattern between the domains and the overall score when reviewing each of the included ages separately.

3.5 | Analysis of the WB-ASQ-3 correlations between the different questionnaire intervals

For those children with more than one assessment, we analysed the correlation between questionnaires at different ages. In the analysis by domains, when comparing the tests at 4 months and at 8 months to the rest of the ages, we obtained positive yet lower correlations in most of the analyses. The amount of positive and significative correlations grew together with the children's age and between closer ages. On the contrary, the overall score was positive and significant in most of the studied ages (Figure 3).

3.6 | Parent's acceptability

We obtained a total of 281 surveys answered, which represents 26.4% of all participants, showing high satisfaction with the questionnaire. 84.70% of respondents mentioned that the questionnaire allowed them to understand the

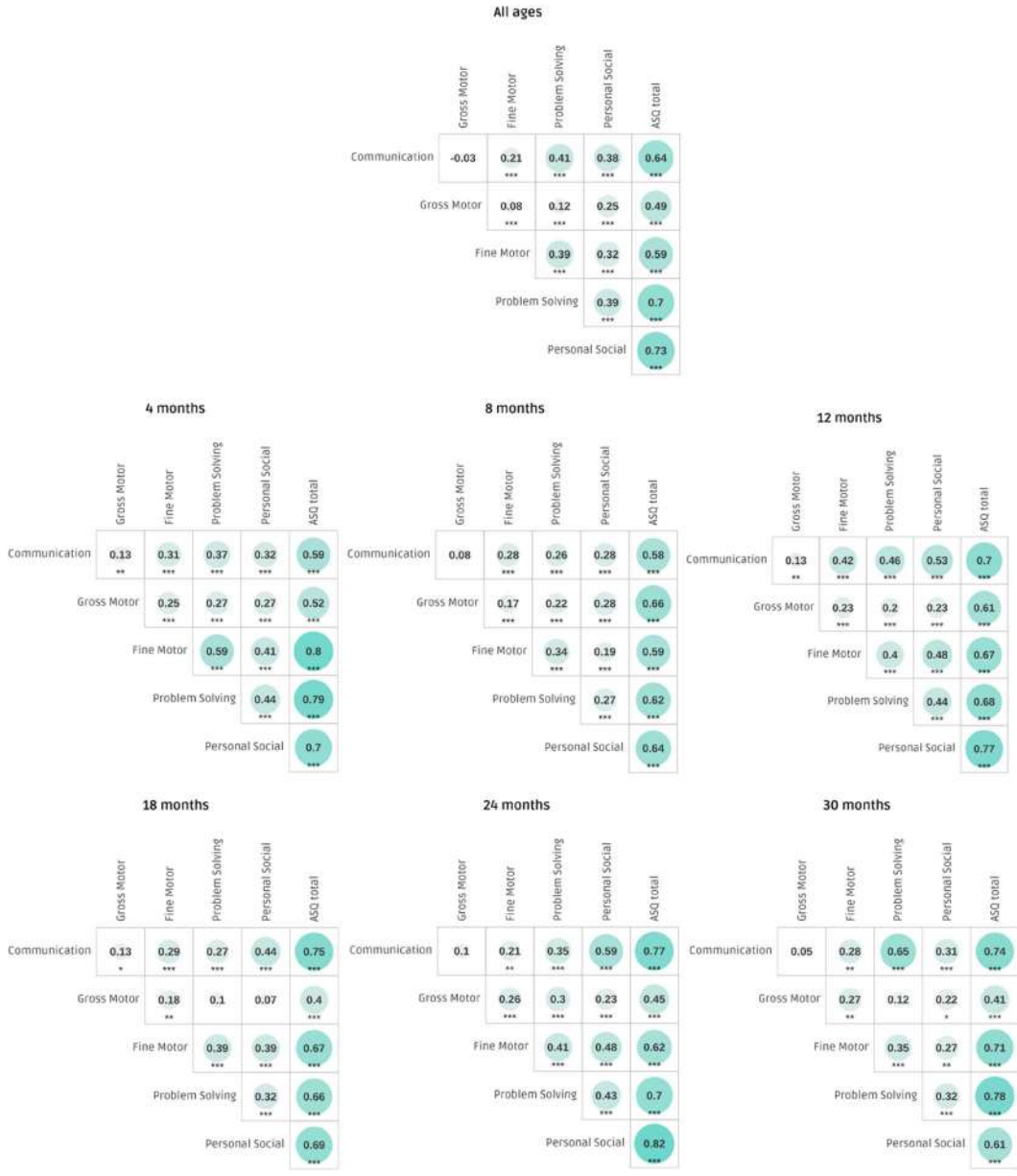
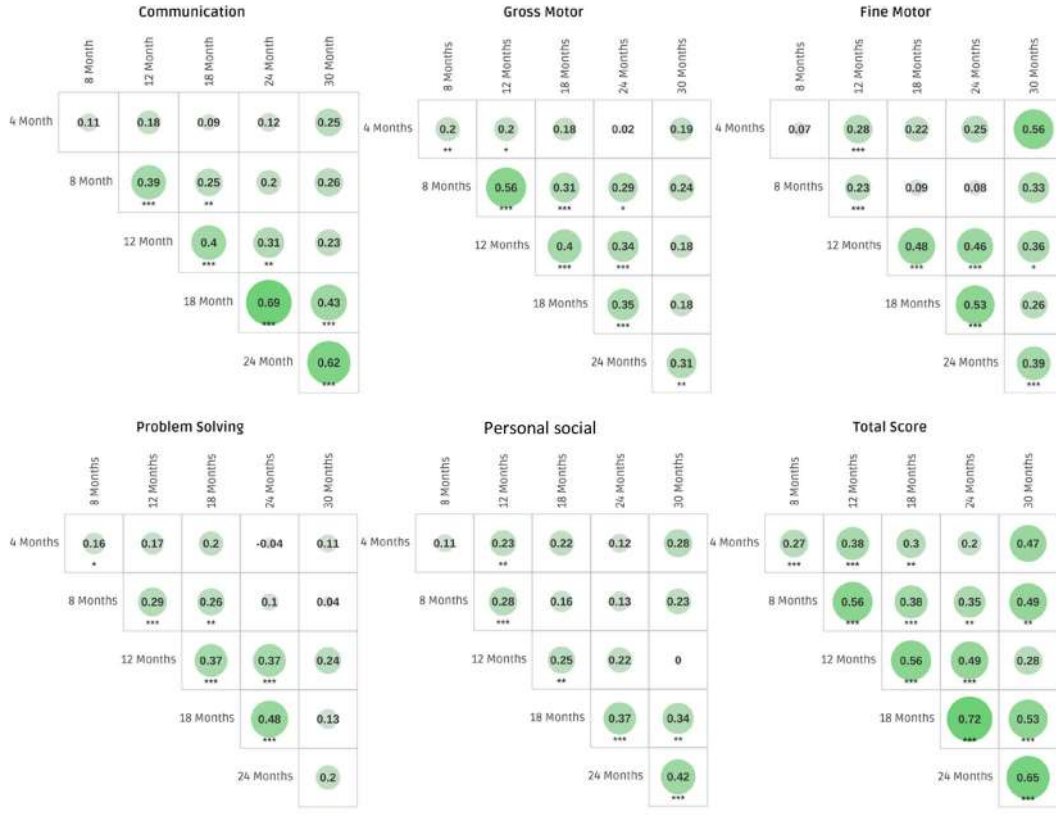


FIGURE 2 Product–moment Pearson correlation between ASQ domains and total score. All questionnaires interval. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$)

progress in their children's development. Additionally, 92.53% would recommend the use of the questionnaire in a digital format (Table 4).

A total of 11 positive comments, 20 negatives and 18 suggestions were received. The qualitative analysis showed that the parents were thankful for being able to participate in monitoring the children's development, especially during lockdowns 'A very useful questionnaire, especially in the context of the pandemic, in which—because the children were not attending their kindergarten—it is difficult to establish a parameter in your child's motor and cognitive development'.



	8 months	12 months	18 months	24 months	30 months
4 months	319	216	124	62	21
8 months	348	198	109	51	
12 months	234	138	70		
18 months	183	101			
24 months	115				

FIGURE 3 Correlation between ASQ at different ages, analysis by domains and overall score. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

TABLE 4 Parents' satisfaction survey ($n = 281$).

	% Agree/Strongly agree	% Disagree/Strongly disagree
This questionnaire was easy to understand.	95.65	2.17
The questions are appropriate to the age of the child.	90.36	2.86
The way the questions are structured makes it easy to understand.	94.66	1.42
The drawings and examples are useful to answer the questions.	93.59	2.49
Recommends the use of the digital questionnaire.	92.53	2.13
The way the results are delivered is friendly and easy to understand.	86.12	5.34
The questionnaire allows an understanding of the advances in the development of the child	84.70	4.27

Among the suggestions, parents ask for more feedback and complementary learning activities. Some even asked for more questionnaires at different ages. Among the negative comments, most of them were related to the parents not remembering having received the test feedback (although the results were sent automatically).

4 | DISCUSSION

The WB-ASQ-3 version was proven to be reliable in the assessment of children ranging from 4 to 30 months old, as well as receiving a strong acceptance among parents, which supports the feasibility of implementing this kind of screening system (Bergman et al., 2009).

Although the reliability between items was lower than that reported in the US and in a previous study conducted in Chile with national representation and using a paper-pencil modality (Armijo et al., 2015; Squires & Bricker, 2009), Cronbach's alpha between items and total score was significant. Studies performed in different countries reported variable results, depending on the heterogeneity of the sample (Helms et al., 2006), which might explain the differences between results in the current sample with WB-ASQ-3 versus the previous study carried out in a national sample, in the original validation in the USA, at Daycare centers in Brazil or Italy (Armijo et al., 2015; Filgueiras et al., 2013; Manti et al., 2023; Squires & Bricker, 2009), which is different from more homogenous samples (Charafeddine et al., 2013; Lopes et al., 2015; Schonhaut et al., 2019). In a systematic review, Velikonja y cols reported that the reliability of the ASQ was generally 'positive' for the original versions of the ASQ-3, compared to the translated/adapted questionnaires, for more culturally specific domains in particular (Velikonja et al., 2016). On the other hand, it should be noted that the size of alpha depends on the number of items in the scale (Streiner, 2003). The ASQ includes only 6 questions with different skills tested in the domains, which perhaps limits some of the domain alphas. For the same reason, when considering the entire test, with the 30 questions, Cronbach's alpha increased to 0.74/ 0.81, a value considered acceptable-good.

Another way to analyse the reliability of a questionnaire is through correlation coefficients between the domain score and the overall score for each questionnaire. In this analysis, we found high correlations between the domains and the total score, while the correlation between the different domains was significant but lower, coinciding with previous publications (Lopes et al., 2015; Schonhaut et al., 2019). This result was to be expected, because the domains aim to analyse different developmental fields and reaffirms the importance of the analysis of the ASQ, rather than separated by specific domains.

Another relevant aspect of this study is the correlation between the different ages in which the questionnaire was applied, which can also be considered as a measurement of reliability because most infants showed generally positive and stable normative developmental pathways (Hornman et al., 2017; Salinas et al., 2022; Valla et al., 2017). A previous study in a sample of children from Barcelona reported a positive and significant correlation for the overall score and for most of domains of ASQ-3 24 and 48 months (Schonhaut et al., 2019). In our analysis, we highlight that the amount of positive and significative correlations grew together with the children's age, between closer ages and is better when the overall score was considered. This result reinforces the importance of using the ASQ as a whole test, rather than the analysis by domains.

Although we only found differences in the means of the Gross motor domains at 8 and 12 months and Communication at 18 and 24 months, at 12 months in which the scores of the study population were lower than those described in the normative ASQ-3 and were very similar to the results reported in the previous Chilean's study, which considered only the ages of 8 and 18 months in modality paper pencil. The exception was Communication at 12 months which was higher in WB-ASQ-3 sample. While our study was not designed to compare development within the pre-pandemic period, it was surprising that no significant differences were found in scores distribution, which puts into question the impact of COVID-19 and confinement measures on children's development in middle to high socio-economic status, as reported by other authors (Shuffrey et al., 2022).

Finally, even though only 26.4% of all participants answered the Parents' satisfaction survey, a high acceptability of the questionnaire stood out, in accordance with other publications (Baker et al., 2020; Kendall et al., 2019; Pomés et al., 2016; Valla et al., 2019). The ASQ, alike other parent's report screening tools, provides empowerment for parents in assessing their children (Schonwald et al., 2009). This aspect was highlighted by those parents who responded to the survey during times of pandemic. Among the advantages of its online application stands out generates algorithms for the calculation of age, to prevent the risk of violating the age windows of administration, which may tamper with the developmental delay risk detection ratio (Janson et al., 2008). Furthermore, an automatic calculation of scores allows the parents to receive immediate feedback, while reducing entry data errors for the statistical analysis (Squires et al., 2022) and may increase parent's satisfaction.

Among the limitations of our research is the homogeneity of the sample, which was studied in a quite particular period such as the COVID pandemic, with a greater risk of sampling bias, as well as over-representation of families highly educated, probably with more concerns about their children's development (Squires et al., 2022), making difficult the generalization to a larger and more diverse sample. Given that the participation in screening programs was voluntary, a certain amount of non-adherence was to be expected; in this study, it stood out that 86% of enrolled children answered at least one development assessment, which is above the participation reported in other survey studies (Janson, 2003) and it was certainly encouraged by the web-based modality. In addition, the low proportion of incorrectly fulfilled questionnaires indirectly confirmed that the ASQ-3 was relatively easy to complete (Manti et al., 2023). Although we do not take a gold standard test as a reference, the dimensions analysed allow us to conclude that the instrument is reliable and feasible to apply.

Our results are especially significant as the WB-ASQ-3 was implemented coinciding with the pandemic and confinement of children, which was very hard and prolonged in Chile. During this period preventive health check-ups fell by more than 50%, as well as worldwide (Moynihan et al., 2021). To date, there are few publications on web-based development monitoring (Baker et al., 2020). Surely, this reality changed in a drastic manner during and after the COVID-19 pandemic, in which telehealth and web screening tools played the leading role in Well Child Care (Curfman et al., 2021).

In order to obtain more generalised results, it is necessary to expand the sample to a population more diverse, representative and random sample, including the entire ASQ series up to five years and incorporating other dimensions, for a complete monitoring child development (Lipkin & Macias, 2020).

5 | CONCLUSION

The Spanish WB-ASQ-3 appears to be a reliable screening system for psychomotor development and for the follow-up of children, especially when the test is taken as a whole, rather than in the analysis by domains. Is remarkable the equivalence between the scores obtained in the web-based administration, with normative ASQ-3 scores and the previous validation in paper-pencil modality in Chile (Armijo et al., 2015; Squires & Bricker, 2009). Together with reliability and the correlation between the application ages, as well as the high acceptability among parents who completed the WB-ASQ-3 administration, it supports the feasibility of this method of application. The validation of the web-based administration provides a contribution to child developmental monitoring and screening, especially in complex times such as the lockdown caused by the COVID-19 pandemic.

AUTHOR CONTRIBUTIONS

Luisa Schonhaut: Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; supervision; validation; writing – original draft; writing – review and editing. **Ivan Armijo:** Conceptualization; data curation; formal analysis; methodology; writing – review and editing. **Paula Rojas B.** Conceptualization; methodology; writing – review and editing. **Leonardo Cabrera:** Data curation; methodology; software; writing – review and editing. **Roberto Boisier:** Conceptualization; software; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest relevant to this article to disclose.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

Data available on request from the authors

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