ORIGINAL ARTICLE

Test for the Developmental Assessment of Young Children (TADI): Further evidence on the validity in a population sample

Test de Aprendizaje y Desarrollo Infantil (TADI): Evidencia adicional de su validez a nivel poblacional

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What do we know about the subject matter of this study?

The Child Learning and Development Test (TADI) was standardized in a representative sample of 2,862 children and was used as one of the instruments for measuring child development in the Early Childhood Longitudinal Survey (ELPI) 2012. However, there are no scientific publications that analyze its validity in population samples.

What does this study contribute to what is already known?

In a large-scale population sample, the construct validity of the TADI stands out, as well as the significant correlation with socioeconomic variables and with reference tests, with sensitivity and specificity levels close to 70%. This confirms that TADI meets the psychometric properties to be implemented as a standardized instrument for the developmental screening of children from 6 to 72 months of age in Chile.

Abstract

The "*Test de aprendizaje y Desarrollo Infantil*" (TADI) is a developmental screening scale for children aged 6 to 72 months, designed in Chile. **Objective:** To determine the validity of the first edition of the TADI at the population level. **Methodology:** Secondary psychometric analysis of a sample of 11,283 Chilean children who participated in the 2012 Early Childhood Longitudinal Survey (ELPI). Convergent validity was assessed through Confirmatory Factor Analysis (CFA) and verified by Exploratory Factor Analysis (EFA). Social variables were considered for construct

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validity. For concurrent validity, sensitivity, specificity, and correlation we used as references the Battelle Developmental Inventory Screening Second Edition (BDI-2) and the Peabody Picture Vocabulary Test (PPVT). **Results**: Out of the children evaluated, 12.6% were categorized in the Delay or at Risk for Delay category, and 17.3% in the Alert category. The CFA showed good levels of fit of the proposed model to the scale data, particularly in older age groups. The EFA revealed different patterns for different age ranges. The TADI correlated significantly with socioeconomic factors, such as the presence of learning materials in the home, the educational level of the main caregiver, economic income, and the mother's emotional response. Data analysis showed moderately positive correlation of the TADI with the BDI-2 and the PPVT, with sensitivity and specificity values close to 0.70 when including the Alert category. **Conclusions**: The adequate psychometric values of the TADI in a population-based sample ratify its validity as a screening instrument for the development of young children in Chile.

Introduction

Internationally, there is concern about the high percentage of children under 5 years of age in low- and middle-income countries who are at risk of not developing according to their full potential[1,2]. In Latin America and the Caribbean, early childhood development was established as a priority indicator in the 2030 Sustainable Development Goals[3,4]. To understand the magnitude of the problem and plan public policies, in addition to establishing individual interventions, it is essential to have standardized, reliable, and culturally appropriate measurement instruments to identify children who will benefit from further diagnostic assessment[5-7].

In Chile, during the 70's and 80's, the Psychomotor Development Evaluation Scale (EEDP) and the Psychomotor Development Test (TEPSI) were developed. Both scales, which are applied by a trained professional through direct observation, are still in use in the country's public health system[8]. Unfortunately, these instruments have limitations, mainly related to the lack of a cross-cultural approach, the lack of updating of the items, and the absence of revalidation studies[9,10]. Another scale validated in Chile is the Ages and Stages Questionnaire® (ASQ)[11], which is currently used in some private health institutions[12]. However, a barrier to its universal use nationwide is the lack of confidence in the accuracy of parent-report questionnaires[13], in addition to the need for licensing fees. Other widely used child development assessment instruments include the Battelle Developmental Inventory (BDI), the Bayley Scales of Infant Development (BSID), and the Peabody Picture Vocabulary Test (PPVT). However, these scales have not been properly validated at the local level and their application is mainly focused on the diagnosis of developmental difficulties, both in clinical and research contexts.

In order to contribute to a valid assessment of children's development in Chile, the TADI was created which is a scale of reference norms for the assessment of learning and development[14]. This scale was standardized in Chile according to a representative sample of the national population, consisting of 2,862 children between 2009 and 2012[14].

Subsequently, the TADI was implemented as one of the measures of child development in the ELPI[15]. Since then, studies using secondary data from the TADI performance in the ELPI have been published[16,17] and the validity of the TADI in at-risk groups such as infants with Down syndrome has been demonstrated[18]. However, the validity of the TADI has not been studied beyond the research setting. This aspect is highly relevant since it has been suggested that infant developmental screening tests are less accurate and more heterogeneous in population-based studies than those reported in their first validation[19,20].

The objective of this study is to determine the validity of the TADI at the population level, based on an analysis of secondary data collected from the ELPI 2012.

Methodology

Cross-sectional study based on secondary analysis of the publicly available database of the ELPI conducted in Chile in 2012[15]. One of the objectives of the survey was to characterize children aged 6 months to 7 years, from diverse socioeconomic statuses, areas of residence, and ethnic contexts. The ELPI design involved a complex sample, stratified by clusters in two stages, consisting of the selection of neighborhoods of a specific socioeconomic level and then the random selection of children. The ELPI currently uses information collected in 2010, 2012, and 2017. The databases used in this study come from the measurement conducted in 2012, which comprises a nationally representative sample of 14,438 children[15].

Only infants between the ages of 6 and 72 months who completed the TADI and baseline scales were included for analysis. Participants who scored > 3

SD above the sample mean on any TADI score for each age segment were excluded. This was considered to control for the influence of extreme cases, which probably stem from incorrect data collection. Cases without sex or incomplete TADI records were also excluded.

Instruments

Child Learning and Development Test (TADI) first edition[14]: scale of reference norms for the evaluation of the development of children between 6 and 72 months of age. It consists of four independent scales: Cognition, Motor, Language, and Socioemotional. It consists of 210 items ordered by increasing difficulty. The TADI evaluates mostly ecologically valid tasks, requested individually by each participant, in the presence of a significant adult for the child. Its application takes up to 30 minutes and should be carried out by a health or education professional who has previously studied the manual.

The TADI has a T-score with an average of 50 and a standard deviation (SD) of 10. To ensure the ability of the TADI to detect possible developmental delays, the analyses relied on the definition of the five categories derived from the total TADI scores: (i) Delay (T-scores < 30 points, with a maximum of two SD below the mean); (ii) At Risk of Delay (lower T-scores between 30 and 39 points, between one and two SD below the mean); (iii) Alert (T-scores between 40 and 45 points, between 1 and 0.5 SD below the mean); (iv) Normal (T-scores between 46 and 59 points, between 0.5 SD below the mean and 1 above the mean); and (v) Advanced (T-scores ≥ 60 points, at least one SD above the mean).

Battelle Developmental Inventory Second Edition (BDI-2). Spanish adaptation[21]: assessment test, in which the items are taken from the full version of the Battelle Developmental Inventory, which assesses child development between the ages of 0 and 8 years. The BDI-2 was standardized in the United States. It analyzes child development in the motor, adaptive, cognitive, personal-social, and communication areas. In the ELPI 2012, it was administered to children between the ages of 6 and 83 months, but only assessments from ages 6 to 72 months were included in this study.

Peabody Picture Vocabulary Test, Spanish American version (PPVT)[22,23]: scale that analyzes cognitive skills, measured by the evaluation of the receptive vocabulary of individuals. The ELPI 2012 applied it to children between the ages of 30 and 83 months, but only assessments performed on children between the ages of 30 and 72 months were considered in this study. Continuous and dichotomous scores were included.

Home Observation for Measurement of the Environment (HOME) (adapted by the ELPI 2012)[24]: a scale that assesses the educational environment of the family, including a couple of questions about maternal sensitivity. In the ELPI 2012, four of the six dimensions of this scale were applied: Maternal Verbal and Emotional Responsiveness, Avoidance of Restraint and Punishment, Maternal Involvement with the Child, and Learning Materials. 21 questions were included for the evaluator to answer based on direct observation of the adult's behavior and household items. The scale scores 1 = true and 0 = false, according to observation or lack of observation of the behavior or item.

Sociocultural assessment: educational attainment of the mother: low schooling was defined as low if she did not complete elementary/high school, medium if she completed high school or technical education, and high if she completed higher or postgraduate education. Household per capita income was classified according to income quintiles, with Q1 being the lowest income quintile and Q5 the highest one.

Statistical analysis

Descriptive statistics were used to present the percentage of retardation in the different age groups, for the global test and the 4 scales. In addition, the distribution of children in the predefined categories of the TADI was described in terms of number and percentage per category.

The internal structure of the TADI was evaluated with a Confirmatory Factor Analysis (CFA) based on maximum likelihood estimators. The model was defined considering the four dimensions of the TADI, each of which encompasses the full set of TADI items for three age ranges: up to 2 years, between 2 and 4 years, and between 4 and 6 years. The CFA is part of the measurement model that examines the relationships between observed variables and factors. Multiple indicators of model fit were considered to determine whether the proposed model is consistent with the empirical data.

Each item was scored dichotomously according to the presence (code 1) or absence (code 0) of the identified behavior. For each age, a starting point was identified, with a continuum ordered by increasing difficulty. If a child successfully completed the behavior identified in an item, it was assumed that she/he would also be able to successfully develop the preceding behaviors, so a score of 1 is assigned to all previous behaviors.

The selection of the items included for the CFA was

based on the following procedure: In each age range, the items that showed no variance were eliminated (all the children in the age range studied answered the same) and a correlation matrix was made between the remaining items to identify cases that could have extreme correlations ($r > 0.98$). Applying the CFA identified items that showed negative variance, which identified cases that did not behave according to the model and filtered out items with low factor loadings ($r < 0.3$).

The goodness of fit was evaluated with the root mean square error of approximation (RMSEA) index, considering as good fit values < 0.05, and acceptable between 0.05 and 0.08[25]; Standardized root mean squared residual (SRMR) was considered as good < 0.05 and as acceptable < 0.10[25,26]; Comparative Fit Index (CFI), if > 0.95 indicates a good fit and > 0.90 acceptable[27]; Tucker-Lewis Index (TLI), > 0.97 represents a good fit and > 0.95 acceptable[27]. Chi-square was evaluated for overall fitness and discrepancy between the sample and adjusted covariate matrices.

To validate the findings, an Exploratory Factor Analysis (EFA) was performed for the items within each age range, with orthogonal varimax rotation. Sample adequacy was measured with Kaiser-Meyer-Olkin (KMO) analysis and Bartlett's test of sphericity, which assesses whether the correlation matrix is different from an identity matrix.

To determine the concurrent validity, the sensitivity and specificity of different cut-off points of the TADI were analyzed, considering the BDI-2 and PPVT scales as reference standards, and the association between the scales was measured by Pearson correlation.

Construct validity was analyzed considering household characteristics, through an Ordinary Least Squares (OLS) linear regression model to detect the relationship between these variables and the detection of risk based on TADI scores. In each case, the variable studied was coded considering whether the value recorded was in the range considered as risk.

All statistical calculations were performed with R statistical software version 2.3.3.3, with CFA analysis performed with the Lavaan package version 0.5-23.1097[28].

Results

The ELPI 2012 comprises a nationally representative sample of 14,438 children. For this study, 1,621 children older than 72 months of age, 1,237 children who scored more than 3 SD above the sample mean on any of the TADI scores, and 297 children with incomplete sex registration were excluded, resulting in a final sample of 11,283 children (Table 1).

TADI scores were categorized into 11 age groups,

each starting on the first day of their respective initial age. The mean of each age group was centered around T = 50, with an SD close to 10, which aligns with the expected value in a standardization (Supplementary Table 1, available online version).

Table 2 shows the frequency and relative prevalence of each of the TADI interpretive categories. Overall, 12.6% of the children assessed were categorized as Delayed or At Risk, and 17.3% were classified as Alert.

The CFA yielded good levels of fit to the proposed model for the data ($\chi2$ (gl = 2) = 27,895, p < 0.01, CFI =0.99, TLI =0.99, RMSEA = 0.03, 90%CI for RMSEA = [0.02;0.04], SRMR = 0.01) (Table 3). Figure 1 shows the standardized weights of the items included in the model for each age group. The analysis shows that the model fits better at older ages; up to the age of 4 years, it is not replicated in the data, assuming a model with 4 subdimensions of development. However, from age 4, the data suggest a separation of different areas of development based on a latent dimension of general development.

As a verification step, EFA was performed for items within each age range. The results revealed distinguished patterns for different age ranges. For children up to 2 years of age, despite having a configuration conducive to factor detection (KMO = 0.87, Bartlett's $\chi2$ = 25226.2, df = 1711, p < 0.001), in the maximum likelihood factor analysis with Varimax rotation, only one factor was identified that explained 16% of the variance. It should be mentioned that this factor encompasses items of varied theoretical subdimensions. In the case of the age range corresponding to children between 2 and 4 years old, a good configuration of the data was observed for factor analysis (KMO = 0.94, Bartlett's χ^2 = 65496.8, gl = 1770, p < 0.001), and produces two factors that together explain 22.7% of the variation, made up of items from all dimensions.

In relation to concurrent validity, the TADI showed a positive correlation with the BDI-2 (r = 0.49) and PPVT (r = 0.46). When considering the BDI-2 as a reference, the sensitivity of the TADI was 0.25 and the specificity 0.93, values that reached levels above 0.60 when including the Alert category as a risk. The results were similar when taking the PPVT as a reference (Table 4).

Table 5 shows that the TADI scores show statistically significant variations in relation to the presence of the different risk factors identified at home and by the HOME, with the scarcity of learning materials (b = -3.29, p<0.001), the low emotional and verbal response form the mother (b = -3.27, p < 0.001), and the low educational achievement of the mother (b = -2.98, p < 0.001) having the greatest effect.

Table 1. Sample characteristics

Gender	Female	5.538
	Male	5.745
Household income per capita quintiles	Q1	1.569
	Q2	1.592
	Q3	1.420
	Q4	1.495
	Q5	1.533
	Missing data	3.674
Mother's educational achievements	Low education	3.633
	Middle education	5.483
	High education	1.945
	Missing data	222

Household income per capita was classified by income quintiles (Q), from the lowest income (Q1) to the highest income (Q5). Low education: did not complete school education; medium education: completed school or technical education; high education: completed higher or postgraduate education.

Discussion

This study presents additional evidence of the psychometric properties of the TADI in a large-scale population sample, derived from the analysis of secondary data extracted from the ELPI 2012[15]. This study confirmed the validation results of the first version, such as internal structure fit, concurrent validity, and convergence with measures of child development, cognitive skills, and household characteristics[14].

The importance of having an early childhood development screening instrument created specifically for the country is due to its cultural appropriateness and representativeness of children from different realities. Evidence of cultural validity suggests that the TADI is not biased in the assessment of indigenous or Spanish-speaking immigrant populations at the national level[14,29].

Table 2. Frequency and relative percentage of prevalence of TADI scores, according to interpretive categories by dimension

	TADI Scales								Total TADI	
	Cognition		Language		Motor skills		Socioemotional			
Categories and scoring	n	%	n	%	n	%	n	%	n	%
Delay + Risk (< 39)	2292	20.31	2243	19.88	1700	15.07	1873	16.60	1423	12.61
Alert (40-45)	1483	13.14	1678	14.87	1603	14.20	1995	17.69	1959	17.36
Normal (46-59)	6098	54.05	5864	51.97	5943	52.67	5972	52.93	7147	63.34
Advanced (60 o más)	1410	12.50	1498	13.28	2037	18.05	1443	12.79	754	6.68

Table 3. Confirmatory Factorial Analysis performed considering three age ranges

		Model Fit Measures			
Children's age	Dimension	CFI	TLI	RMSEA	SRMR
0-2 years (n = 1.480)	Cognition Motor Skills Language Socioemotional	0.91*	0.90	0.05*	0.17
2-4 years (n = 4.628)	Cognition Motor Skills Language Socioemotional	0.84	0.83	0.05*	0.14
4-6 years (n = 6.248)	Cognition Motor Skills Language Socioemotional	0.95**	0.95*	0.02**	0.08*

Table presents the measures of model fit for TADI in three age groups. The fit measures include Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Residual (SRMR). These measures provide information about the adequacy of the model for different age ranges, with improved fit observed in older age groups. *Indicates acceptable fit. **Indicates good fit
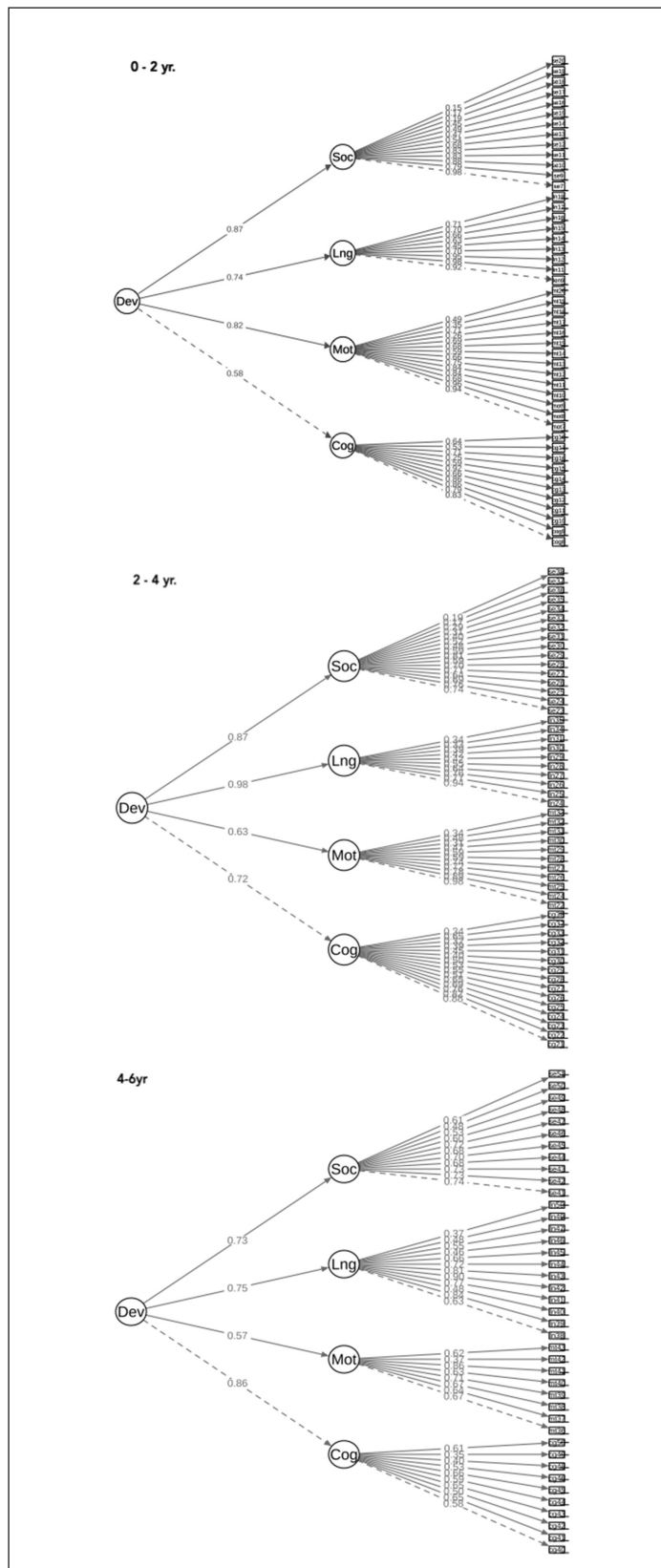
Figure 1. Flowchart of the Confirmatory Factor Analysis at different ages. Note: Numbers are the standardized weights of each latent variable in the measured variables. All were significant. Legends: Dev: Child development; Soc: Socioemotional; Lng: Language; Mot: Motor Skills; Cog: Cognition.

Overall, 12.6% of the children assessed were categorized as Delay or At Risk, while 17.3% into the Alert category, which coincides with the expected prevalence according to previous studies in the population studied[11,30]. In addition, significant correlations were found between TADI scores and socioeconomic variables, such as lack of learning materials at home, low educational achievement of the caregiver, lower per capita income, and poor emotional response of the mother, coinciding with previous publications[16,17]. A higher proportion of delay is to be expected in children with social risk factors[30-32].

When reviewing the construct validity, it stands out that the CFA fits better for the TADI at older ages, possibly because at a younger age the developmental domains are more interconnected, therefore, it is recommended the use of the instrument as a whole instead of separating it by items[12]. The same occurs with psychometric analyses; it has been postulated that developmental tests are more accurate the older the age of the children evaluated[33].

In the concurrent validity analysis, there is a positive correlation between the BDI-2 reference scales (for children from 6 to 72 months) and the PPVT (in preschoolers from 30 to 72 months), with similar sensitivity and specificity values, being the most appropriate (close to 0.70) when including the Alert category. These values are close to what is expected for developmental screening scales[7] and are within the ranges described when applying the tests in the "real world"[20].

It should be considered that the risk of forcing a higher sensitivity is to compromise the specificity of the test and increase false positives, with the family and social impact and overload of the health system[34]. This is why studies recommend screening in two stages or combining different tests to improve diagnostic accuracy[35,36].

Among the limitations of this study, it should be mentioned that only some of the aspects for the analysis of the construct validity of the TADI were included, leaving out variables that may be relevant, such as biological risk factors. Also, there is currently a second edition of the TADI (TADI-2), which was not evaluated in the study[29,37]. However, our analysis was of great relevance in strengthening the psychometric properties of the scale. It is worth mentioning the large sample included in the analysis, which allowed us to know the performance of the test on a population scale and invites us to repeat the exercise with other scales used, many of which have not been validated in Chile.

The challenge for future updates of the instrument is to include indications on its epidemiological use with categories that consider different cut-off points, depending on the uses and objectives of the evalua-

Tabla 4. Analysis of the diagnostic capacity of TADI Total scores, using as external criteria the results of the tests associated with development, comparing different cut-off points

	TADI Cutt of T= 40*					TADI Cutt of T= 45*				
	n	Sens	Esp	VPP	VPN	n	Sens	Esp	VPP	VPN
BDI- 2 <-1,5DS	11056	0.25	0.94	0.62	0.79	11056	0.60	0.69	0.40	0.84
TVIP <-1DS	9295	0.35	0.93	0.49	0.88	9295	0.67	0.67	0.28	0.91

SD: standard deviation; Sens: sensitivity; SP: specificity; PPV: Positive Predictive Value; NPV: Negative Predictive Value; BDI-2: Battelle Developmental Inventory Second Edition; TVIP: Peabody Picture Vocabulary Test. T= standard T-score

Table 5. Prevalence and impact of risk factors on TADI scores

Risk factors	Prevalence		Impact
	f	(%)	b
Home measurements			
Educational achievement of primary caregiver (n = 11061): Low achievement	3633	(32.84%)	-2.98 (p < 0.001)
Per capita income (n = 7609): Income quintiles Q1 and Q2	3161	(41.54%)	-1.35 (p < 0.001)
HOME inventory indicators (n = 11190)			
Low emotional and verbal response from mother	683	(6.10%)	-3.27 (p < 0.001)
Poor avoidance of restraint and punishment	1670	(14.92%)	0.06 (p = 0.772)
Scarcity of learning materials	5888	(52.62%)	-3.29 (p < 0.001)
Low involvement	368	(3.29%)	-1.78 (p < 0.001)

n= indicates the total number of cases in which the presence or absence of each risk factor was recorded. f= indicates the number of cases reporting the presence of the risk among the recorded cases. % = indicates the percentage of presence of the risk. b = Ordinary Least Squares Regression Coefficient (OLS). Indicates the expected average variation in the Total TADI score with the presence of the identified risk factor.

tions. At the same time, the reference standards used should continue to be examined in order to fairly assess their levels of sensitivity and specificity, since there is no consensus on the perfect standard and most of the tests used as reference in this and other publications also have limitations, both in terms of their own diagnostic accuracy, lack of clarity regarding their cut-off points, as well as the lack of national validation[38-40].

Conclusion

The findings of the study confirm previous evidence on the validity of the TADI[14,29,37]. Its construct validity and internal structure were consolidated, and compliance with the psychometric criteria for the identification of TADI lags was verified. Convergence was demonstrated with other developmental measures considered as reference, as well as with social risk fac-

tors. It is concluded that the TADI is a valid instrument for the evaluation of the development of children between the ages of 6 and 72 months in Chile.

Ethical Responsibilities

Ethics Committee: The study is based on data obtained from a public open-access database. Data available at: https://observatorio.ministeriodesarrollosocial.gob.cl/elpi-segunda-ronda

Conflict of interest

Marta Edwards and Marcela Pardo have potential conflicts of interest as authors of the Child Learning and Development Test (TADI).

References

1. Wondmagegn T, Girma B, Habtemariam Y. Prevalence and determinants of developmental delay among children in low- and middle-income countries: a systematic review and meta-analysis. Front Public Health. 2024;12:1301524. doi: 10.3389/fpubh.2024.1301524.

2. Olusanya BO, Smythe T, Ogbo FA, et al. Global prevalence of developmental disabilities in children and adolescents: A systematic umbrella review. Front Public Health. 2023;11:1122009. doi: 10.3389/fpubh.2023.1122009.

3. UNICEF. Briefing Note Series on SDG global indicators related to children. 2018. [Consultado 11.05.24] Disponible en https://data.unicef.org/resources/briefing-notes-on-sdg-global-indicators-related-to-children/

4. Chile - Ministerio de Salud. Estrategia Nacional de Salud para los Objetivos Sanitarios al 2030. 2022. [consultado 11.05.24] Disponible en https://www.minsal.cl/wp-content/uploads/2022/03/Estrategia-Nacional-de-Salud-2022-MINSAL-V8.pdf

5. Lipkin PH, Macias MM; Council on children with disabilities, section on developmental and behavioral pediatrics. Promoting Optimal Development: Identifying Infants and Young Children With Developmental Disorders Through Developmental Surveillance and Screening. Pediatrics. 2020;145(1):e20193449. doi: 10.1542/peds.2019-3449.

6. Faruk T, King C, Muhit M, et al. Screening tools for early identification of children with developmental delay in low- and middle-income countries: a systematic review. BMJ Open. 2020;10(11):e038182. doi: 10.1136/bmjopen-2020-038182. Erratum in: BMJ Open. 2021;11(11):e038182corr1. doi: 10.1136/bmjopen-2020-038182corr1.

7. Council on Children With Disabilities; Section on Developmental Behavioral Pediatrics; Bright Futures Steering Committee; Medical Home Initiatives for Children With Special Needs Project Advisory Committee. Identifying infants and young children with developmental disorders in the medical home: an algorithm for developmental surveillance and screening. Pediatrics. 2006;118(1):405-20. doi: 10.1542/peds.2006-1231. Erratum in: Pediatrics. 2006;118(4):1808-9. PMID: 16818591.

8. Ministerio de Salud, Gobierno de Chile. Norma técnica para la supervisión de niños y niñas de 0 a 9 años en la Atención Primaria de Salud. 2da Edición 2021. [consultado 11.05.24] Disponible en https://www.minsal.cl/wp-content/uploads/2021/12/Capi%CC%81tulo-3-Web.pdf

9. Angulo-Ramos M, Merino-Soto C. TEPSI en cuestión: ¿usarlo mejor o reemplazarlo? Rev enferm Herediana. 2014;(7):107. https://doi.org/10.20453/renh.v7i2.2534

10. Rivas Riveros E, Catalán MY, Flores FN, et al. Vivencias y expectativas de los actores sociales partícipes en evaluación del desarrollo psicomotor, en relación a las Escalas EEDP y TEPSI utilizadas en la Araucanía, Chile, durante los años 2017-2018. Enfermería (Montevideo). 2019;8(1):4-21. https://doi.org/10.22235/ech.v8i1.1783

11. Armijo I, Schonhaut L, Cordero M. Validation of the Chilean version of the Ages and Stages Questionnaire (ASQ-CL) in Community Health Settings. Early Hum Dev. 2015;91(12):671-6. doi: 10.1016/j.earlhumdev.2015.10.001.

12. Schonhaut L, Armijo I, Rojas P, et al. Reliability and acceptability of web-based administration of Spanish ages and stages questionnaires third edition®. Inf Child Dev. 2023;32(4):e2425. https://doi.org/10.1002/icd.2425

13. Eugenin MI, Moore R, Martinez-Gutierrez J, et al. Screening for autism in Santiago Chile: Community perspectives. Int J Child Adolesc Health. 2015;8(4):439-48.

14. Pardo M, Gómez M, Edwards M. Test de Aprendizaje y Desarrollo Infantil (TADI) para niñas y niños de 3 meses a 6 años. Editorial Universitaria. Santiago de Chile. 2012

15. Chile -Ministerio de Desarrollo Social y Familia. ELPI, Encuesta Longitudinal de Primera Infancia. Segunda Ronda 2012. [consultado 11.05.24] Disponible en http://observatorio.ministeriodesarrollosocial.gob.cl/elpi-segunda-ronda

16. Narea M, Arriagada V, Allel K. Center-Based Care in Toddlerhood and Child Cognitive Outcomes in Chile: The Moderating Role of Family Socio-Economic Status. Early Educ Dev. 2020;31(2):218-33. https://doi.org/10.1080/10409289.2019.1626191

17. Rodríguez-Garcés C, Muñoz-Soto J. Delay in child development: The importance of education quality of family atmosphere. Rev Int Investig Cienc Soc. 2017;13(2):253-70. https://doi.org/10.18004/riics.2017.diciembre.253-270

18. Tenorio M, Bunster J, Arango PS, et al. Reliability and validity evidence for Test De Aprendizaje y Desarrollo Infantil (TADI) in a Chilean sample of children with Down syndrome. Psykhe. 2020;29(1):1-16. https://doi.org/10.7764/psykhe.29.1.1378

19. Guthrie W, Wallis K, Bennett A, et al. Accuracy of Autism Screening in a Large Pediatric Network. Pediatrics. 2019;144(4):e20183963. doi: 10.1542/peds.2018-3963.

20. Rah SS, Jung M, Lee K, et al. Systematic Review and Meta-analysis: Real-World Accuracy of Children's Developmental Screening Tests. J Am Acad Child Adolesc Psychiatry. 2023;62(10):1095-109. doi: 10.1016/j.jaac.2022.12.014. Epub 2022 Dec 30.

21. de la Cruz MV, González-Criado M. Battelle, Inventario de Desarrollo (adaptación española). Madrid: TEA. Primera edición 1996.

22. Dunn LM, Padilla E, Lugo D. Manual del examinador para el Test de Vocabulario en Imágenes Peabody. Pearson 2006.

23. Olabarrieta-Landa L, Rivera D, Ibáñez-Alfonso JA, et al. Peabody Picture Vocabulary Test-III: Normative data for Spanish-speaking pediatric population. NeuroRehabilitation. 2017;41(3):687-94. doi: 10.3233/NRE-172239.

24. Caldwell BM, Bradley RH. Home

Observation for Measurement of the Environment: Administration Manual (ASIN: B0006RZAO8). 3rd ed. Arizona: Family & Human Dynamics Research Institute, Arizona State University. USA. 2001.

25. Hu LT, Bentler PM. Evaluating model fit. In R. H. Hoyle (Ed.), Structural equation modeling: Concepts, issues, and applications (ISBN 13: 978-0803953185). 1st ed. Sage Publications 1995;76-9.

26. Wolf MG, McNeish D. dynamic: An R Package for Deriving Dynamic Fit Index Cutoffs for Factor Analysis. Multivariate Behav Res. 2023;58(1):189-94. doi: 10.1080/00273171.2022.2163476.

27. Bollen K. Structural Equations with Latent Variables (ASIN: B008UBJT0I). Wiley, John & Sons; 1990.

28. Rosseel Y. lavaan: An R Package for Structural Equation Modeling. J Stat Softw. 2012;48(2):1-36. https://doi.org/10.18637/jss.v048.i02

29. Edwards M, Pardo M. Test de Aprendizaje y Desarrollo Infantil, 2° Edición (TADI-2). Manual del Examinador. Santiago, Chile; 2023.

30. Bedregal P, Hernández V, Mingo MV, et al. Desigualdades en desarrollo infantil temprano entre prestadores públicos y privados de salud y factores asociados en la Región Metropolitana de Chile [Early child development inequalities and associated factors between public and private providers at metropolitan region in Chile]. Rev Chil Pediatr. 2016;87(5):351-8. Spanish. doi: 10.1016/j.rchipe.2016.02.008.

31. Farkas C, Girard LC, MacBeth A. Predictors of emotional problems in 5-year-old children: an international comparison between two cohorts in Chile and Scotland. Current Psychology. 2023;42(1):390-405. https://doi.org/10.1007/s12144-020-01336-5

32. Sania A, Sudfeld CR, Danaei G, et al. Early life risk factors of motor, cognitive and language development: A pooled analysis of studies from low/middle-income countries. BMJ Open. 2019;9(10):9(10):e026449. doi: 10.1136/bmjopen-2018-026449.

33. Schonhaut L, Armijo I, Schönstedt M, et al. Validity of the ages and stages questionnaires in term and preterm infants. Pediatrics. 2013;131(5):e1468-74. doi: 10.1542/peds.2012-3313.

34. Zou KH, O'Malley AJ, Mauri L. Receiver-operating characteristic analysis for evaluating diagnostic tests and predictive models. Circulation. 2007;115(5):654-7. doi: 10.1161/CIRCULATIONAHA.105.594929.

35. Robins DL, Casagrande K, Barton M, et al. Validation of the modified checklist for Autism in toddlers, revised with follow-up (M-CHAT-R/F). Pediatrics. 2014;133(1):37-45. doi: 10.1542/peds.2013-1813.

36. Camp BW, Bonnell LN. Combining Two Developmental Screening Tests to Improve Predictive Accuracy. Acad Pediatr. 2020;20(3):413-20. doi: 10.1016/j.acap.2019.06.010.

37. Schonhaut Berman L, Edwards M, Pardo M, et al. Propiedades del Test de Aprendizaje y Desarrollo Infantil "TADI", en el contexto de las políticas de validación de escalas para niños y niñas menores de 6 años en Chile y Latinoamérica. Andes pediatr. 2024;95(4):353-63. doi: https://dx.doi.org/10.32641/andespediatr.v95i4.5149

38. Cunha ACB, Berkovits MD, Albuquerque KA. Developmental Assessment with Young Children: A Systematic Review of Battelle Studies. Infants Young Child. 2018;31(1):69-90.

39. Hallam RA, Lyons AN, Pretti-Frontczak K, et al. Comparing Apples and Oranges: The Mismeasurement of Young Children Through the Mismatch of Assessment Purpose and the Interpretation of Results. Topics Early Child Spec Educ. 2014;34(2):106-15. https://doi.org/10.1177/0271121414524283

40. Luque de Dios SM, Sánchez-Raya A, Moriana JA. Quality of Child Development Scales. A Systematic Review. Int J Educ Psychol. 2023. 24;12(2):119-48.