

Validity and reliability of the Neurobehavioral Evaluation of Infant Development (VANEDELA). Screening Instrument from one to 24 months in primary health care in Mexico

Rosa Ivone Martínez-Vázquez,^{1,2} Gerardo Alberto Alvarado-Ruiz,^{1,2} Carmen Sánchez-Pérez,^{1,2} Patricia Muñoz Ledo-Rábago²

¹ Laboratorio de Seguimiento del Neurodesarrollo, Dirección de Investigación, Instituto Nacional de Pediatría, Ciudad de México, México.

² Universidad Autónoma Metropolitana, Ciudad de México, México.

Correspondence:

Rosa Ivone Martínez-Vázquez
Laboratorio de Seguimiento del Neurodesarrollo, Instituto Nacional de Pediatría.
Insurgentes Sur 3000-C, Col. Insurgentes Cuicuilco, Del. Coyoacán, C.P. 04530, Ciudad de México, México.
Phone: 1084 0900 ext. 1438.
Email: ivone.martinez.vazquez@gmail.com

Received: 30 August 2017

Accepted: 21 March 2018

Citation:

Martínez-Vázquez, R. I., Alvarado-Ruiz, G. A., Sánchez-Pérez, C., Muñoz Ledo-Rábago, P. Validity and reliability of the Neurobehavioral Evaluation of Infant Development (VANEDELA) Screening Instrument from 1 to 24 months in primary health care in Mexico. *Salud Mental*, 41(2), 57-63. doi: [10.17711/SM.0185-3325.2018.009](https://doi.org/10.17711/SM.0185-3325.2018.009)



ABSTRACT

Introduction. Early identification of developmental delays or disabilities in children is a challenge and a global concern. In Mexico, the prevalence of childhood disability is 6%, and it is estimated that 25% of the unattended delays will have consequences on their potential. VANEDELA is a rapid screening test to detect and prevent developmental disorders in primary health care. **Objective.** To determine the external validity and test-retest reliability of the behavioral (DB) and reflex (DR) developmental formats of the VANEDELA screening test, compared with the diagnostic test of Gesell's Developmental Schedule Test. **Method.** Descriptive, transversal, and prospective study in 379 infants aged one to 24 months attending the Neurodevelopment Monitoring Laboratory / INP and the ISSSTE Tlalpan Family Medicine Clinic from 2011 to 2014. Measurements: A set of four aspects was evaluated including validity by external criteria: sensitivity, specificity, positive-negative predictive criteria, and test-retest reliability. **Results.** In the DB format, we found a 79% - 89% sensitivity (S) and a 83% - 95% specificity (Sp). In the DR format, a 18% - 35% sensitivity and a 81% - 96% specificity were found. Using both DB-DR formats, we found a 82% - 89% sensitivity and 72% to 91% specificity, and a test-retest reliability .62-1. **Discussion and conclusion.** The VANEDELA increased its validity parameters with respect to the previous assessment with adequate stability. The DB formats and the DB-DR combination of VANEDELA have an adequate validity based on external criteria, making them suitable for use in primary health care.

Keywords: Screening, infant development, diagnostic tests, test-retest, VANEDELA.

RESUMEN

Introducción. La identificación temprana de retrasos o discapacidades del desarrollo en los niños es un reto y una preocupación mundial. En México, la prevalencia de discapacidad infantil es del 6% y se estima que un 25% de los retrasos no atendidos tendrán consecuencias en su potencial alcanzado. El VANEDELA es una prueba de tamizaje rápido para detectar y prevenir alteraciones del desarrollo en el primer nivel de atención. **Objetivo.** Determinar la validez (criterio externo) y confiabilidad (*test-retest*) de los formatos de conductas (CD) y reacciones del desarrollo (RD) de la prueba de tamizaje VANEDELA, contrastado con la Prueba Diagnóstica de Desarrollo de Gesell. **Método.** Estudio descriptivo, transversal y prospectivo en 379 lactantes de uno a 24 meses que asistieron al Laboratorio de Seguimiento del Neurodesarrollo del INP y la Clínica de Medicina Familiar Tlalpan del ISSSTE de 2011 a 2012. Mediciones: Validez por criterio externo, sensibilidad y especificidad, validez predictiva positiva y negativa; confiabilidad *test-retest* (intervalo de siete días). **Resultados.** En el formato CD, se encontró sensibilidad (S) de 79% a 89% y especificidad (E) de 83% a 95%. Utilizando ambos formatos CD-RD, se encontraron una sensibilidad de 82% a 89% y una especificidad de 72% a 91%. *Test-retest* .62-1. **Discusión y conclusión.** El VANEDELA aumentó sus parámetros de validez con respecto a la valoración anterior, estabilidad adecuada. Los formatos CD y la combinación CD-RD del VANEDELA poseen una adecuada validez por criterio externo y estabilidad *test-retest*, para ser utilizada en el primer nivel de atención.

Palabras clave: Tamizaje, desarrollo infantil, diagnóstico del test, *test-retest*, VANEDELA.

INTRODUCTION

Identification and early intervention in developmental delays or disabilities in children is a global challenge. In Mexico, a 6% prevalence of childhood disability has been reported (Economic Commission for Latin America, 2016; World Health Organization, 2012; World Health Organization, 2009; Watkins, 2016; Walker et al., 2011; National Institute of Statistics and Geography [INEGI], 2016), with 25% of children under five years of age showing mild or moderate developmental delays due to socioeconomic risk factors such as poverty, inadequate health services, lack of health equity, and a culture of prevention that could affect their school and work performance. All of these perpetuate the cycle of lack of opportunities for them (Phillips et al., 2016; Alvarado-Ruiz, Martínez-Vázquez, & Sánchez-Pérez, 2013; Grantham-McGregor et al., 2007). It is important for health personnel at the primary health care level to have an instrument with development indicators for reliable screening that will enable them to monitor the first two years of life, and provide timely care and prevention in order to achieve optimal development. To this end, the American Academy of Pediatrics proposes the use of reliable, validated screening instruments for the detection of child development risks (Rydz et al., 2006; Committee on Children with Disabilities, 1994; Bright Futures Steering Committee and Medical Home Initiatives for Children with Special Needs Project Advisory Committee, 2006; Hamilton & Woodbury, 2006; Phillips et al., 2016).

Bearing this in mind, at the Subdirectorate of Rehabilitation of the National System for Integral Family Development, Benavides, Sánchez, and Mandujano (1985) have designed and used the Neurobehavioral Assessment of Infant Development (VANEDELA) for the detection and timely care of risks of neurological sequelae during the process of childhood growth and development. Benavides et al. (1989) conducted an assessment of the validity of the instrument on a population of 97 high- and medium-risk children enrolled in the pediatric follow-up program of the National Institute of Perinatology (aged one, four, eight, and 12 months). The Amiel-Tison Neurologic Evaluation, used as an external criterion, showed that the sensitivity of the test was excellent (1.0) and the specificity low (.73). Over the years, the VANEDELA has been used in several research projects: Arines (1998), at the Tlaltizapan Morelos Rural Center; Sánchez et al. (2007), at the Tláhuac Mothers' and Children's Hospital; and Martínez-Vázquez (2001) at the CIMIGEN Mothers' and Children's Hospital. Martínez-Vázquez subsequently undertook a second evaluation of the sensitivity and specificity of the behavior formats (DB) and developmental reactions (DR) in the same population, which constitutes the first adaptation of the exploration and qualification criteria published in the second version.

On the basis of the latter, it was used by Ceballos (2007) at an IMSS nursery in Toluca; by Chávez et al. (2012) to monitor premature infants in the NICU at the La Raza Medical Center; and by Alvarado-Ruiz, Martínez-Vázquez, Sánchez-Pérez, and Muñoz-Ledo (2013) for the surveillance and monitoring of low-risk infants at the ISSSTE Tlalpan Family Medicine Clinic. As a result of this experience, as well as feedback from health personnel who use it in their everyday consultations, adaptations were made to the instrument in order to better describe and clarify certain DB and DR items, so that it could be graded more accurately and to ensure that its use not only covered neurological damage risks. Between November 2004 and January 2012, Alvarado-Ruiz et al. (2013) reported part of this new experience in monitoring child development in 3 527 evaluations of 293 newborns and infants taken to a primary health care outpatient clinic on a monthly basis.

The purpose of this new report was to determine the validity (sensitivity and specificity) and reliability (test-retest) of the adaptations made to the behavior forms and development reactions of the VANEDELA screening test in comparison with Gesell's Developmental Schedule Test.

METHOD

This is a descriptive, observational, cross-sectional study. A convenience sample was used, with newborns and infants being recruited from the Neurodevelopment Monitoring Laboratory of the National Institute of Pediatrics and the Tlalpan ISSSTE Family Medicine Clinic from 2011 to 2012 within the following age ranges: one to four months (up to seven days before or after); eight to 12 months (up to a fortnight before or after), 18 to 24 months (up to three weeks before or after). A medical examination was undertaken of the children who, according to their files, met the age criteria and did not have congenital or genetic diseases or syndromes that could severely affect the nervous system. Once the infants had been selected, the parents signed an informed consent letter and then an evaluation was conducted using the VANEDELA test and the Gesell Developmental Schedule Test (GDST) (Gesell & Amatruda, 1981). The same people who had designed the instrument undertook the evaluations of the VANEDELA. The GDST were conducted by the researcher in charge, a trained child development psychologist with 15 years experience using this test. The VANEDELA comprises four sections: somatometry (SM), developmental behavior (DB), developmental reactions (DR), and warning signs (WS) (Sánchez et al., 2007). The tests were conducted during a minimum period of time (15 minutes). This first report describes the sections on DB and DR; the other sections are still being processed for their inclusion in the report.

Table 1
Description of changes made in the items of the form of the area of development behaviors (DB) and development reactions (DR)

Previous	Change
1m	
DB1 "Eats without choking or turning blue" Positive: The child sucks vigorously, adapting to breast or bottle.	Suction with coordinated suction-deglutition-breathing pattern; choking or turning blue is considered a sign of the feeding area.
DB8 "limb flexion, how to explore it: face downwards, their arms are placed backwards and stretched out flat.	The way of exploring this was modified: Stretching the arms backwards was eliminated as this evaluates the arm movement reflex rather than the flexed position. Infants are placed on their stomachs and the position of their limbs and head and trunk is observed.
4m	
DB1 Vigorous suction, does not reject pureed food.	The behavior reference was rephrased in a positive form: Defined suction or/and swallowing of pureed foods. The negative expression is removed: chokes on saliva and makes strange noises, which is reported in signs.
DB4 When playing, babies talk or laugh.	The reference is changed: "When you play with them, they talk and/or smile and/or laugh."
DB9 Babies do not find this position uncomfortable. Positive: When they are lying on their stomachs, (prone), they do not express discomfort or difficulty in remaining in this position.	Modified because the fact that the criterion was left up to the consideration of the evaluator was regarded as vague. Reframed as a positive phrase: They maintain the position on their stomachs, with the head facing forward at 90° observing both sides, with freedom of movement.
8m	
DB1 Eats a cookie without help. Positive: If they put food in their mouth on their own, they show vertical movements of the jaw and swallow.	The reference was made more specific and rephrased as a positive statement: They take food with their hands and eat it. Positive: They eat a piece of fruit, tortilla or cookie by taking it in their hands and putting it in their mouths, chewing it and swallowing.
DB2 They remain sitting without help.	The reference is made more specific: They remain sitting on their own for one minute.
DB3 Sitting without help, they take an object in each hand.	They stand up from the sitting position, remaining there: They take an object in each hand.
DB5 They examine their mothers' face with interest.	The referent and positive behavior are made more specific: They examine their mothers' face with interest either by paying attention, watching it or touching it. Positive: They look carefully at their mothers and/or touches them with their hands.
12m	
DB5 They play a game.	The reference is changed to an evaluation form: While sitting down, they play with the caretaker or examiner by rolling or throwing a ball.
18m	
DB6 They play and understand a game.	The reference is made more specific: They play, following a sequence. Positive: When they throw a ball to their mother intentionally and enjoy the game and when the mother suggests a change, they make this change, even if it is not necessary.
24m	
DB3 They draw a line in any direction.	The reference is made more specific: They draw a single line, whether vertical or horizontal.
DB7 To get something.	The reference is made more specific: They use a chair or another object to reach a high object. This is separated from item 6. Positive: When they use an object as a means of reaching an object out of their reach, they go to a bench, bed, chair, etc., and go directly to the object and take it.
DB10 They refer to themselves by their name or use the term "baby."	The reference is changed: They say their name or call themselves what other people call them.
1m	
DR1 Optical-labyrinthine righting reflex.	Form of exploration specified. In the prone position, they push themselves up, supporting themselves with their chests, without their fingers pressing the paravertebral area.

Infant Development Behavior Form (DB)

This section comprises 60 behaviors evaluated in various areas of development at six age cut-off points: 1, 4, 8, 12,

18, and 24 months. Each cut-off point includes ten items, with one graphic icon assigned rather the seven original ones presented, which could mean that two items had to be reviewed in a graphic icon, which was extremely confusing.

As a result, 10 graphic icons were added to the new rating form for DB to facilitate its use (see Form). The grading criteria for 14 items in the DB form that belong to the various cut-off points and one in the DR were specified (Table 1). To interpret the results in this research, the following risk criterion was established: “10 positive items mean that development is as expected. There is a risk of delay if a doubtful or altered score occurs.” The DR evaluates 10 reactions that enable the infant to organize various movement patterns and achieve the bipedal posture and move during the first two years. Four types of righting are considered: 1. optical-labyrinthine (one month); 2. head acting on the body (one month); 3. Landau (three months); 4. body acting on the body (eight months); three defense movements: 5. forward protection (eight months), 6. lateral protection (12 months), and 7. backward protection (12 months); and three balance movements: 8. sitting (18 months), 9. crawling (18 months), and 10. standing (24 months). Grading: development was regarded as expected when reactions were present at the age cut-off point evaluated, while a risk of delay was thought to exist when they failed to meet the established criteria.

The Gesell Developmental Schedule Test (GDST) assesses a child’s development during the first six years. During the first year, it tests this on a monthly basis and, in the second year, it does so every three months. Four areas are evaluated separately: motor skills (fine and gross), adaptive, language (receptive and expressive), and personal and social. The score is obtained through a development coefficient, dividing the age obtained by the chronological age multiplied by a hundred. A development index of 85% is regarded as normal, while 84% or less in one or more areas is regarded as a delay (Gesell & Amatruda, 1981).

The Gesell Developmental Schedule Test is regarded as a suitable standard for diagnosis because of its extensive review of child development skills in the first two years. This test has been used since the 1960s by Dr. Cravioto and Delicardi, MSc Psy, who have used it in various studies in Mexico and Latin America. This test has been used for 30 years at the Neurodevelopment Monitoring Laboratory of the National Institute of Pediatrics in clinical work to distinguish children with expected development from those with delays (Alvarado-Ruiz et al., 2013). Before the evaluation, the files of possible candidates were reviewed, they were invited to participate, the procedure was explained to parents, and optimal conditions for the exploration were verified (being alert, and not sleepy or hungry). The VANEDELA was applied, followed by the GDST. At the end of the evaluation, parents were informed of the result, and given suggestions on how to stimulate the infants’ neurodevelopment. A week later, the VANEDELA was re-applied.

Cases with a risk of alterations were discussed with trained personnel in specific sessions to provide suggestions for their care and they were referred to secondary health

care. All the evaluations were filmed in 8 mm digital format. Tests were graded at the end of the evaluation and results recorded in the database that same day.

On the basis of the scores obtained, expected results and risks for each form were determined separately. As for the capacity for detection, the following was determined in the DB and DR forms by age cut-off point: no risk if both met the criteria as expected, and at risk, if the established criteria were not met in either of the forms. The Epidemiological Analysis of Tabulated Data program (EPIDAT v4) was used to estimate the sensitivity, specificity, and predictive value indices. Its stability was determined through the correlation of results (absent-present) in the first evaluation and at seven days (test-retest) with JMP13.

The study was part of the research project entitled, “Ages of Acquisition in Mexican Infants of the Evolutionary Sequences of Target Behaviors in the VANEDELA Screening Test,” approved by the National Institute of Pediatrics Research and Ethics Commissions. No funds from private institutions were used for this research and the authors declare no conflict of interest.

RESULTS

The study evaluated 379 infants who met the established criteria and whose primary caregivers agreed to participate. The mean maternal age was 29.32 ± 5.43 , the minimum being 16 and the maximum 43. As for the mothers’ educational attainment, 37% held university degrees and 46% had completed high school. Gender distribution was as follows: 196 (52%) boys and 183 (48%) girls. Validity analyses were performed for DB and DB-DR.

DB: Sensitivity (S) was between 79% and 89%; Specificity (Sp) was between 83% and 95%; positive likelihood ratio (LR+) was between 5.08 and 18.09; and negative likelihood ratio (LR-) between .12 and .24. DR: S was located between 27% and 50%; Sp between 76% and 94%; LR+ between 2.38 and 7.33; and LR- between 54 and 88. DB-DR: S was located between 82% and 89%; Sp between 72% and 91%; LR+ between 2.93 and 9.82, and LR- between .12 and .25 (Table 2).

The stability analysis with the test-retest reliability method for each of the items during the first month yielded a Pearson coefficient between .76 and 1, with the exception of item 4, “visual contact,” which scored .49. At four months, the nine items presented a range of between .80 and 1, with the exception of item 2, “contact grasp,” which scored .74. At eight months, eight of the items showed a coefficient of between .81 and 1; item 5, “explores the mother’s face with their gaze or touches it,” yielded .64, while item 7, “while lying on stomach, stretches out their arms,” yielded a coefficient of .62. At 12 months, nine items scored coefficients of between .82 and 1; while item 4, “Pick up or grab a ball,”

Table 2
Validation results by external VANEDELA criteria

Monthly cut-off point	N	S (%)	Sp (%)	LR+ (%)	LR- (%)	VR+	VR-
D/DB							
1	68	89 (72 - 100)	90 (81 - 99)	76 (56 - 97)	96 (89 - 100)	8.89 (3.81 - 20.74)	.12 (.03 - .46)
4	67	82 (69 - 94)	95 (84 - 100)	97 (90 - 100)	72 (54 - 90)	18.09 (2.65 - 123.3)	.19 (.10 - .35)
8	74	85 (69 - 100)	83 (72 - 95)	73 (56 - 91)	91 (81 - 100)	5.08 (2.64 - 9.76)	.18 (.07 - .46)
12	66	79 (64 - 94)	84 (70 - 98)	84 (70 - 98)	79 (64 - 94)	5.08 (2.23 - 11.58)	.24 (.12 - .48)
18	50	89 (76 - 100)	91 (77 - 100)	93 (81 - 100)	87 (71 - 100)	9.82 (2.60 - 37.05)	.12 (.04 - .35)
24	54	86 (72 - 100)	84 (68 - 100)	86 (72 - 100)	84 (68 - 100)	5.39 (2.17 - 13.38)	.16 (.07 - .41)
D/DB-DR							
1	68	83 (63 - 100)	84 (73 - 95)	65 (44 - 87)	93 (85 - 100)	5.21 (2.67 - 10.16)	.2 (.07 - .56)
4	67	82 (70 - 95)	86 (70 - 100)	93 (83 - 100)	70 (51 - 89)	6.03 (2.09 - 17.41)	.21 (.11 - .39)
8	74	88 (73 - 100)	76 (62 - 89)	65 (47 - 82)	93 (83 - 100)	3.59 (2.15 - 6.00)	.16 (.05 - .46)
12	66	82 (68 - 97)	72 (55 - 89)	76 (61 - 91)	79 (63 - 96)	2.93 (1.65 - 5.21)	.25 (.12 - .52)
18	50	89 (76 - 100)	91 (77 - 100)	93 (81 - 100)	87 (71 - 100)	9.82 (2.60 - 37.05)	.12 (.04 - .35)
24	54	86 (72 - 100)	84 (68 - 100)	86 (72 - 100)	84 (68 - 100)	5.39 (2.17 - 13.38)	.16 (.07 - .41)

Note: D/DB = relationship between the Gesell diagnostic test and the developmental behavior form. D/DB-DR = relationship between the Gesell diagnostic test and behavior forms and developmental reactions. n = number of cases studied; S = sensitivity; Sp = specificity; LR+ = positive likelihood ratio; LR- = negative likelihood ratio; VR+ = positive validity rate and VR- = negative validity rate. The confidence interval is given in parentheses.

presented .70. At 18 months, nine items showed a coefficient of between .84 and 1; item 2, “puts seeds into a jar,” scored .70. At 24 months, the ten items yielded coefficients of between .81 and 1. In score per cut-off month of the DBs, they had coefficients of between .86 and .99.

Of the 10 DRs, eight had coefficients between .80 and 1, DR 2, “Righting the head acting on the body as a block,” and DR 4, “straightening of the body acting on the body,” yielded .70, while the cut-off score was set between .90 and 1 (Table 3).

Table 3
Coefficient of test-retest reliability of behaviors and development reactions items

Items	Months					
	1	4	8	12	18	24
DB1	.80	.94	.81	.95	1	.81
DB2	.86	.74	1	.85	.70	1
DB3	1	.86	1	1	1	.96
DB4	.49	.80	1	.70	.84	1
DB5	.82	.83	.64	.89	1	.95
DB6	.84	.96	1	1	.92	.94
DB7	.76	1	.62	1	1	.81
DB8	1	.93	.82	.89	1	1
DB9	.81	.89	.91	.96	1	.95
DB10	.81	.85	.89	.82	1	.93
DR1	.80					
DR2	.70					
DR3		1				
DR4			.70			
DR5			.92			
DR6				.91		
DR7				.89		
DR8					1	
DR9					1	
DR10						.92
DB rating	.87	.95	.86	.97	.99	.97
DR rating	1	1	.91	.90	1	1

Note: The test-retest reliability coefficient is presented with a time interval of 7 days. The coefficients of the 10 behavioral items graded for each cut-off point are described and for the DR that occur in the monthly cut-off, the blanks are because the reactions are not present because they evolve over time. DB = developmental behavior and item number; DR = Developmental reactions and item number.

DISCUSSION AND CONCLUSION

The VANEDELA made it possible to comply with the WHO recommendations as part of prevention programs (World Health Organization, 2009). The DB form has adequate validity for the detection of risk in the six cut off points. When the values obtained in the present study were compared with those of 2001, it was found to maintain adequate levels of sensitivity and improved specificity. At four months, it increased from 75% to 95%; at eight months, from 67% to 83%; at 12 months, from 45% to 84%; and at 18 months, from 67% to 91% (Martínez-Vázquez, 2001). The DR form achieved acceptable specificity (76% - 94%), but low sensitivity (31% - 50%), since the GDST considered skills not directly related to the DRs evaluated that modified its scores. In future studies, it would be useful to include an additional neurological assessment instrument to measure its sensitivity and specificity more accurately. Using the DB and DR forms together, adequate validity was obtained with high sensitivity. Specificity also remained adequate in most of the cut-off points, except at twelve months in the back-protection reaction, which was found to be below the suggested percentage: 75% (Meisels, 1989). In order to increase specificity, the back-protection reaction (DR 7) should be reviewed and the description expanded, since it says, “It is considered normal (1) when the arms are extended backwards protectively,” to which

one should add, “in response to the backward stimulus, the child will be able to turn and put one or both hands out to avoid falling.”

The positive likelihood of DBs, which indicates the possibility of presenting a risk when the test establishes this, is appropriate for all cut-off points; for one, four and 18 months, it is good; and for eight, 12 and 24 months it is moderate. Negative likelihood, which shows the probability of not having a risk when the test establishes it, is adequate, since it discriminates well for all cut-off points and is moderate for 12 months.

The reliability analysis through the test-retest method over a seven day period produced stability. Items were detected that showed rapid changes in the acquisition of behavior: at one month, visual contact was achieved; at four months, contact grasp; at eight months, infants explored their mother’s face with interest and when placed on their stomachs, pushed themselves up with their hands; at 12 months, they grabbed and lifted a ball without body support; and at 18 months, they put seeds in a jar. In DRs, at one month, they were able to raise their heads and after eight months, they were able to right themselves by rolling over. Given that established behaviors are measured, they were probably in transition and, therefore failed to meet the criteria, but the infants continued to exercise and a favorable environment enabled them to structure their behavior. Further analysis is required to determine whether this is part of the variability of development. The evaluation provides indices on the infant for the caregiver to use, which constitutes a significant contribution to early evaluation, since parents observe their children’s abilities and the strategies provided by professionals will enhance the infants’ development. Conversely, in infants who do not do this, it would constitute an obstacle that would have to be determined. Reactions involving head righting acting on the body (at one month) and righting themselves by rolling over were located at .70, considered minimally acceptable by some authors, such as [Devellis \(1991\)](#), and low for others, as in the case of behaviors. These reactions will have to be reviewed to determine a description of observables in an evolutionary sequence that will make it possible to distinguish rapid changes in development resulting from timely interaction as opposed to an alteration indicating neurological damage.

Contrasting the VANEDELA with other instruments used in Mexico highlights the challenges we face in obtaining an instrument that will permit the early detection of developmental delays in order to ensure their timely care. First, we have the EDI, which reports a specificity between 53% and 62% for the groups aged two to 15 months, and between 53% and 71% for those aged 16 to 60 months, which would lead to the saturation of the health system due to a large number of false positives ([Rizzoli-Córdoba et al., 2013](#); [Romo-Pardo, Liendo-Vallejos, Vargas-Lopez, Rizzoli-Córdoba, & Buenrostro-Márquez,](#)

[2012](#)). Conversely, the review of tests designed abroad and widely used by Mexican pediatricians, such as the Denver II test in Tlaltizapan Morelos, showed a low sensitivity of 64% and an adequate specificity of 82% ([Olivera-Moreno, 2010](#)), while the Capute scales showed a low sensitivity between 17% and 72%, and an adequate specificity of 90% ([Cazares-Figueroa, 2008](#)). These reports tally with studies from other countries that have reported this problem ([Song, Zhu, & Gu, 1982](#); [Cairney et al., 2016](#); [Accardo & Capute, 2005](#)). A continuous review of screening instruments would make it possible to obtain an instrument suitable for use with Mexican population.

Although the DB and DR forms of VANEDELA, which allow timely detection at the primary care level, must be continuously adapted, they remain a valid, reliable instrument, as well as an essential tool for health professionals to timely detect children with developmental difficulties and to provide timely strategies, so that the curve changes from low to high adequacy.

The VANEDELA makes it possible to assess children quickly through its six age cut-off points. Since it is a screening test, it contains the expected milestones for all children under normal conditions for the age cut-off point. Accordingly, a child with 10 positive items is regarded as not being at risk, while one with nine or less items is regarded as being at risk of delay, with two conditions: nine or eight means a mild risk, which was previously called doubtful, and seven or less means a high risk, formerly called altered. Its main limitation was revealed when the child reached an intermediate age, meaning that one had to wait for the cut-off point for confirmation of expected development or a risk of delay. Work is currently underway on intermediate milestones that will enable professionals to determine the moment of evolution of a particular behavior.

Given the sociocultural variability existing in Mexico, it is important to expand training in the application of this test so that other professionals can use it and thereby obtain data from a larger sample encompassing various social groups. The VANEDELA is a suitable, user-friendly tool for the timely detection of risks of developmental delays, which will provide health professionals with an useful tool for monitoring infants and advising their families in the event they require a diagnostic evaluation and early intervention services to ensure optimal growth. The DBs and reactions sections have sufficient validity and reliability in general for them to be used for the detection of risks of developmental delays in primary health care.

Funding

No financing was received.

Conflict of interests

The authors declare they have no conflict of interests.

REFERENCES

- Accardo, P. J. & Capute, A. J. (Eds.). (2005). *The Capute Scales: Cognitive Adaptive Test/Clinical Linguistic & Auditory Milestone Scale (CAT/CLAMS)*. Baltimore: Brookes Pub.
- Alvarado-Ruiz, G. A., Martínez-Vázquez, R. I. & Sánchez-Pérez, C. (2013). Modelo de vigilancia y seguimiento del neurodesarrollo infantil experiencia en la Clínica de Medicina Familiar Tlalpan. *Revista de Especialidades Médico-Quirúrgicas*, 18(1), 19-30.
- Arines, A. G. (1998). *Detección de alteraciones del desarrollo en niños de 0 a 24 meses en una comunidad del estado de Morelos* (Master's thesis). Universidad Autónoma Metropolitana Xochimilco, México.
- Benavides, G. H., Sánchez, C., & Mandujano, V. M. (1985). *El desarrollo del niño normal de 1 a 24 meses*. México: Universidad Autónoma Metropolitana.
- Benavides, H. M., Fernández, L. A., Venta, J. A., Bravo, Z., Ibarra, M. D. P., & Barroso, J. (1989). Utilidad de una valoración neuroconductual de tamiz en el primer año de vida. *Perinatología y Reproducción Humana*, 3(4), 193-198.
- Bright Futures Steering Committee & Medical Home Initiatives for Children with Special Needs Project Advisory Committee. (2006). Identifying Infants and Young Children with Developmental Disorders in the Medical Home: An Algorithm for Developmental Surveillance and Screening. *Pediatrics*, 118(1), 405-420. doi: 10.1542/peds.2006-1231
- Cairney, J., Clinton, J., Veldhuizen, S., Rodriguez, C., Missiuna, C., Wade, T., ... Kertoy, M. (2016). Evaluation of the revised Nipissing District Developmental Screening (NDDS) tool for use in general population samples of infants and children. *BMC Pediatrics*, 16(1), 42. doi: 10.1186/s12887-016-0577-y
- Cazares-Figueroa, A. (2008). *Evaluación de la validez por criterio externo de las escalas - Clinical Adaptive Test & Clinical Linguistic Auditory Milestone scale CAT/CLAMS en niños de 0-12 meses en Tlaltizapan Morelos* (Master's thesis). Universidad Autónoma Metropolitana, México.
- Ceballos, S. F. (2007). *Riesgos para alteraciones del neurodesarrollo detectados a través de una prueba tamiz (VANEDELA) y su relación con el criterio de optimidad obstétrica de Prechtl, en guarderías del IMSS de Toluca, México* (Master's thesis). Universidad Autónoma Metropolitana Xochimilco, México.
- Chávez, T. R., Sánchez, C., Elorza, P-T. H., Flores, H. S., Klünder, K. M., Ruiz-Chavez, J.,...Maldonado, J. G. (2012). Secuelas de encefalopatía perinatal identificadas con una escala de desarrollo neuroconductual. *Revista Médica del Instituto Mexicano del Seguro Social*, 50(2), 147-155.
- Committee on Children with Disabilities. (1994). Screening Infants and Young Children for Developmental Disabilities. *Pediatrics*, 93(5), 863-865.
- Comisión Económica para América Latina y el Caribe. (2016). Informe regional sobre la medición de la Discapacidad. Una mirada a los procedimientos de medición de la discapacidad en América Latina y el Caribe. Retrieved from: <http://www.cepal.org/deype/noticias/documentosdetrabajo/0/53340/LCL3860e.pdf>
- Devellis, R. F. (1991). *Scale development, The theory and applications*. Newbury Park, CA: Sage publishing.
- Gesell, A. L. & Amatruda, C. S. (1981). Diagnóstico del desarrollo normal y anormal del niño: evaluación y manejo del desarrollo neuropsicológicos normal y anormal del niño pequeño y preescolar. Madrid: Paidós.
- Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L. & Strupp, B. (2007). Developmental potential in the first 5 years for children in developing countries. *The Lancet*, 369(9555), 60-70.
- Hamilton, S. & Woodbury, N. J. (2006). Screening for developmental delay: reliable, easy to use tools. *Journal of Family Practice*, 55(5), 415-422.
- Instituto Nacional de Estadística y Geografía (INEGI). (2016). *Datos de discapacidad en México al 2014*. Retrieved from: http://conadis.gob.mx/gob.mx/transparencia/transparencia_focalizada/La_Discapacidad_en_Mexico_datos_2014.pdf
- Martínez-Vázquez, R. I. (2001). *Evaluación de la sensibilidad y especificidad del instrumento de detección Valoración Neuroconductual del desarrollo del Lactante* (Master's Thesis). Universidad Autónoma Metropolitana, México.
- Meisels, S. J. (1989). Can developmental screening test identify children who are developmentally at risk? *Pediatrics*, 838(4), 578-585.
- Olivera-Moreno, M. (2010). *Valoración de la sensibilidad y especificidad de la prueba de tamizaje Denver II* (Master's Thesis). Universidad Autónoma Metropolitana, México.
- Organización Mundial de la Salud. (2009). *Subsanar las desigualdades en una generación. Determinantes sociales en salud*. Buenos Aires: Organización Mundial de la Salud.
- Phillips, C., Fisher, M., Baum, F., MacDougall, C., Newman, L., & McDermott, D. (2016). To what extent do Australian child and youth health policies address the social determinants of health and health equity? A document analysis study. *BMC Public Health*, 16(1), 2-12. doi: 10.1186/s12889-016-3187-6
- Rizzoli-Córdoba, A., Schnaas-Arrieta, L., Liendo-Vallejo, S., Buenrostro-Márquez, G., Romo-Pardo, B., Carreón García, J., ... Robles-Anaya, O. (2013). Validación de un Instrumento para la detección oportuna de problemas de desarrollo en menores de 5 años en México. *Boletín médico del Hospital Infantil de México*, 70(3), 195-208.
- Romo-Pardo, B., Liendo-Vallejos, S., Vargas-López, G., Rizzoli-Córdoba A., & Buenrostro-Márquez, G. (2012). Pruebas de tamizaje de neurodesarrollo global para niños menores de 5 años de edad validadas en Estados Unidos y Latinoamérica: revisión sistemática y análisis comparativo. *Boletín médico del Hospital Infantil de México*, 69(6), 450-462.
- Rydz, D., Srour, M., Oskoui, M., Marget, N., Shiller, M., Birnbaum, R., ... Shevell, M. I. (2006) Screening for developmental delay in the setting of a community pediatric clinic. *Pediatrics*, 118(4), e1178-e1186. doi: 10.1542/peds.2006-0466
- Sánchez, M. C., Benavides, H., Mandujano, M., Rivera, R., Martínez-Vázquez, R. & Alvarado-Ruiz, G. (2007). *Valoración Neuroconductual del Desarrollo del Lactante (VANEDELA)*. México: Universidad Autónoma Metropolitana Xochimilco.
- Song, J., Zhu, Y. M., & Gu, X. Y. (1982). Restandardization of Denver Developmental Screening test for Shanghai children. *Chinese Medical Journal*, 95(5), 375-380. doi: org/10.1016
- Walker, S. P., Wachs, T. D., Grantham-McGregor, S., Black, M. M., Nelson, C. A., Huffman, S. L., ... & Gardner, J. M. M. (2011). Inequality in early childhood: risk and protective factors for early child development. *The Lancet*, 378(9799), 1325-1338. doi: 10.1016/S0140-6736(11)60555-2.
- Watkins, K. (2016). *Estado mundial de la infancia 2016, una oportunidad para cada niño*. Nueva York: Fondo de las Naciones Unidas. Retrieved from: www.unicef.org/spanish/publications/files/UNICEF_SOWC_2016_spanish.pdf
- World Health Organization. (2012). *Developmental difficulties in early childhood. Prevention, early identification, assessment and intervention in low and middle-income countries*. Geneva: World Health Organization. Retrieved from: http://apps.who.int/iris/bitstream/10665/97942/1/9789241503549_eng.pdf