Neuroendocrinology Letters Volume 45 No. 7-8 2024
ISSN: 0172-780X; ISSN-L: 0172-780X; Electronic/Online ISSN: 2354-4716
Web of Knowledge / Web of Science: Neuroendocrinol Lett
Pub Med / Medline: Neuro Endocrinol Lett

ORIGINAL ARTICLE

Validation of parental screening tool S-PMV11: Convergent validity with Bayley-III in assessing developmental functioning.

Lucia Ráczová[1], Erika Jurišová[1], Marta Popelková[1], Tomáš Sollár[1]

1 Department of Psychological Sciences, Faculty of Social Sciences and Health Care, Constantine the Philosopher University in Nitra, Slovakia.

Correspondence to: Lucia Ráczová
Department of Psychological Sciences, Faculty of Social Sciences and Health Care, Constantine the Philosopher University in Nitra, Slovakia
e-mail: lraczova@ukf.sk

Submitted: 2024-10-28 Accepted: 2024-12-13 Published online: 2024-12-22

Key words: **psychomotor development; developmental difficulties; S-PMV11; Bayley-III; concurrent validity; parental screening tool**

Neuroendocrinol Lett 2024; **45**(7-8):449–456 **PMID:** 39737495 45072404

Abstract

BACKGROUND: With the increasing use of developmental screening tools, there is a growing need to validate parental screening methods for the early detection of developmental difficulties in children, regarding their psychometric properties. **METHODS:** This study evaluates the convergent validity of the S-PMV11 parental screening tool by comparing its outcomes with the Bayley Scales of Infant and Toddler Development (Bayley-III), the gold standard for direct assessment. **RESULTS:** We analyzed data from 30 children and found significant correlations between S-PMV11 scores and Bayley-III assessments across cognitive, language, and motor skill domains. Notably, expressive communication showed the strongest correlation, indicating that parents are reliable assessors of developmental risks. **CONCLUSION:** Despite limitations related to potential overestimation in Bayley-III, our findings support the S-PMV11 as a valid tool for early identification of developmental challenges, enhancing early intervention strategies in pediatric healthcare.

INTRODUCTION

The first three years of a child's life are considered critical for the early identification of developmental difficulties and the provision of subsequent healthcare and interventions (Richter *et al.* 2017; Black *et al.* 2017). Direct assessment of a child's developmental functioning provides comprehensive information about specific developmental indicators in a controlled testing situation with the child (Fernald *et al.* 2017); however, it is time-consuming, leading to the growing preference for parent-administered screening tools in practice (Rubio-Codina *et al.* 2016). The aim of this study is to examine the convergent validity of developmental functioning in the parental screening tool S-PMV11 by comparing it to direct assessment using the Bayley Scales of Infant and Toddler Development, third edition.

Detecting indicators of developmental difficulties in children, which may be manifestations of neurodevelopmental disorders, is crucial for providing comprehensive healthcare and counseling services. These services aim to support the optimal development of young children. For the purpose of direct assessment of developmental functioning, the Bayley Scales of Infant and Toddler Development (Bayley-III) is widely used. This multidimensional tool is considered the gold standard for measuring a child's developmental

level (Fernandes *et al.* 2014). Psychometric validation studies across various countries have found this tool to be acceptable for assessing child development (McHenry *et al.* 2021; Hanlon *et al.* 2016), though there is an increased risk of false-negative results (Agarwal *et al.* 2024). The main disadvantage of the Bayley-III is its demanding administration, which requires considerable time for preparing the administrator, child, and accompanying person. Additionally, it requires purchased materials and a trained, experienced administrator (Pitchik *et al.* 2023; Rubio-Codina *et al.* 2016; Kwun *et al.* 2015). An experienced administrator typically needs about one hour to administer the Bayley-III (Peyton *et al.* 2020). Such conditions make it impractical for testing all children in the early age population, creating the need for less time-consuming developmental screening tools.

Parental-administered developmental screening is understood as a quick and efficient method used during routine pediatric check-ups to identify risks of potential developmental difficulties (Pitchik *et al.* 2023). The advantage of screening lies in its accuracy and time efficiency, even though it is not a direct assessment of developmental functioning (Abdoola *et al.* 2021). Screening should provide pediatricians and other early childhood development specialists with information within a few minutes of administration about whether the child requires a more comprehensive developmental assessment. The results of a screening method should be consistent with those of direct assessment, for example, in domains such as language or motor skills, where the developmental evaluation should align (Miller *et al.* 2017; Sachse & Suchodoletz, 2008).

Screening methods like the Ages and Stages Questionnaire (ASQ) and the Parental Evaluation of Developmental Status (PEDS) have demonstrated satisfactory results when their outcomes are compared with those of the Bayley-III (Yue *et al.* 2019; Abdoola *et al.* 2019; Steenis *et al.* 2015). It has even been suggested that the PEDS screening tool can identify more children with developmental difficulties than the direct Bayley-III assessment (Abdoola *et al.* 2019), possibly due to the risk of underestimating developmental difficulties with Bayley-III, as highlighted in other studies (Çelik *et al.* 2020; Goldstone *et al.* 2019). Due to its high efficiency, screening of psychomotor development has become a globally recommended practice in primary pediatric care, with guidelines suggesting the use of screening tools that align with the specific healthcare system and conditions of individual countries (Lipkin *et al.* 2020).

The developmental screening tool used in Slovak pediatric practice, known as the "S-PMV," was created in accordance with preventive check-up protocols established by the Ministry of Health for primary pediatric care. This well-established tool operates on the assumption that parents are suitable assessors of their child's development. The S-PMV is used to detect risks of neurodevelopmental deviations in children (©S-PMV, Prof. K. Matulay n.d. Found). Evidence supporting the tool's convergent validity would be a close correlation between the results of the screening tool and a direct assessment tool measuring the same latent construct. Research by Johnson *et al.* (2008) and Flamant *et al.* (2011) demonstrated that parents can validly assess their child's development when comparing their responses in screenings with direct assessments. Tools such as the Parent Report of Children's Abilities and ASQ were used in these studies. Parents proved to be reliable assessors of their child's development, based on their daily interactions with the child (Frederico, Shi, Bradshaw *et al.* 2021; Johnson *et al.* 2007; Flamant *et al.* 2011). Validation of parental responses using the Minnesota Child Development Inventory (Byrne, Backman, Smith, 1986) for children aged one to six years demonstrated higher accuracy in parental assessments of older children.

Based on the findings outlined above, the aim of this study is to examine evidence of the convergent validity of the S-PMV11 screening, which is part of a set of screenings designed for older children, specifically those aged approximately 26 to 40 months. The S-PMV11 screening will be compared with direct assessments of child development conducted using the Bayley Scales of Infant and Toddler Development – Third Edition (Bayley-III). Establishing a strong relationship between developmental functioning in the S-PMV11 and the Bayley-III across specific domains—cognition, receptive and expressive language, as well as fine and gross motor skills—could significantly highlight the need for Bayley-III validation in our conditions, ensuring that specialists have access to a method that, with its multidimensional nature, can more precisely identify at-risk developmental domains in children.

H1: We hypothesize a significant, positive, and strong relationship between developmental functioning and cognition as measured by the Bayley-III.

H2: We hypothesize a significant, positive, and strong relationship between developmental functioning and receptive communication as measured by the Bayley-III.

H3: We hypothesize a significant, positive, and strong relationship between developmental functioning and expressive communication as measured by the Bayley-III.

H4: We hypothesize a significant, positive, and strong relationship between developmental functioning and fine motor skills as measured by the Bayley-III.

H5: We hypothesize a significant, positive, and strong relationship between developmental functioning and gross motor skills as measured by the Bayley-III.

Research Question: What will be the level of agreement between the classification of children within the normative range in the Bayley-III and the S-PMV11?

MATERIALS AND METHODS

Research Sample and Research Ethics

The research sample was selected through a convenience sampling method, involving both children with suspected developmental delays and children without such suspicions. Parents of children who visited the therapeutic pedagogy clinic and the clinical psychology clinic were informed about the possibility of participating in the study and using anonymized data and results from the assessment of their child's psychomotor level through the Bayley-III and S-PMV11 for research purposes. Parents of children without suspected developmental delays were also invited to participate through children's centers and the Early Intervention Center, which also provided its facilities for the study. All parents signed informed consent forms and agreed to the anonymized inclusion of their children in the research sample.

The final sample consisted of N = 30 children. Given the expected strong correlation between the Bayley-III and S-PMV11 (approximately r = 0.6), a sample size of 30 children can be considered sufficient (Bujang & Baharum, 2017). Parents who participated with their children were provided with consultations on their child's psychomotor development, based on preliminary assessment results, along with information on how to further support their child's developmental functioning. A detailed description of the research sample is presented in Table 1.

Tab. 1. Characteristics of the Research Sample

Characteristics	n	%
Gender		
Girls	12	40.00
Boys	18	60.00
Screening completed by		
Mother	27	89.91
Father	1	3.33
Both parents	2	6.67
Other person	-	
Child from the psychologist or therapeutic pedagogy clinic		
Yes	20	66.67
No	10	33.33

Notes: The average age of the children was M_age = 30.87 months (*SD* = 4.66; *Mdn* = 30; *min* = 24, *max* = 40).

Research Instruments

S-PMV11

The method for monitoring psychomotor developmental functions and screening developmental difficulties, designed for assessing psychomotor development at the 11th preventive check-up in general pediatric care (referred to as S-PMV11), has been used in Slovakia since 2019. S-PMV11 is the last of a set of ten developmental psychomotor screenings (S-PMV©FOND prof. K. Matulaya n.f., 2016-2021). It is used in pediatric practice and is completed by the child's parent or caregiver in the waiting room. This is a standardized screening tool designed for the early identification of deviations from typical development and behavior in children aged three years. Any identified deviations could indicate the presence of developmental risk affecting the child's functional abilities. It consists of two versions, one for younger children (26–34 months) and another for older children (35–40 months), which are identical except for percentile bands (normal, borderline, risk). The screening is divided into three focus domains: developmental functionality (Cronbach's α = 0.897), specific behavior (Cronbach's α = 0.749), and parental concerns (Cronbach's α = 0.903) (©S-PMV, Prof. K. Matulay n.d. Found,). In this research, we focused on the developmental functionality domain, which includes 20 items with dichotomous responses ("yes" or "not yet") targeting motor skills, social behavior, cognition, language comprehension, speech production, self-care, and preschool readiness. Developmental functioning is considered a unidimensional domain. Some example items are: "Can draw a circle" and "Can feed themselves with a spoon." The total score is 20 points. Cronbach's alpha coefficient in this study was $\alpha_{DF} = 0.791$.

Bayley Scales of Infant and Toddler Development – 3rd Edition

To support the clinical evaluation of children's psychomotor development, we used the 3rd edition of the Bayley Scales of Infant and Toddler Development (Bayley-III), which is not standardized in Slovakia. The goal of the Bayley-III (Bayley, 2006) is to describe the current level of development in diagnosing developmental delays in children aged 16 days to 42 months. The scale is also used for planning appropriate interventions and includes five scales, which cover: fine motor skills, gross motor skills, receptive communication, expressive communication, and cognitive abilities. Two other scales focusing on socio-emotional behavior and adaptive behavior are no longer part of the direct child assessment and were not included in this study. Some example items for motor skills include: "Kicks a ball" and "Cuts paper"; for cognition: "Correctly matches three colors" and "Sorts by size"; for speech: "Uses two-word phrases" and "Names pictures in a book." The scale was used for an objective assessment of direct child performance through tasks recommended for specific age periods. The direct assessment of the child's development using the Bayley-III was conducted by three professionals who were trained in the administration of its items. The Bayley-III scale consistently demonstrates excellent psychometric properties when used in various countries (McHenry *et al.* 2021; Hoskens,

Tab. 2. Comparison of Intercorrelations of Bayley-III Scale Scores in Our Sample of Children Compared to Intercorrelations Reported in the Bayley-III Manual

Domain	RC	EC	FM	GM	C
RC	—	0.53***	0.42***	0.37***	0.50***
EC	**0.77*** **	—	0.41***	0.36***	0.45***
FM	**0.49** **	**0.60*** **	—	0.43***	0.51***
GM	**0.50** **	**0.62*** **	**0.62*** **	—	0.39***
C	**0.80*** **	**0.71*** **	**0.61*** **	**0.49** **	—

Notes: RC = receptive communication in Bayley-III, EC = expressive communication in Bayley-III; FM = fine motor in Bayley-III; GM = gross motor in Bayley-III; COG = cognition in Bayley-III. Statistical significance values: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. Our findings are highlighted in bold, while the original intercorrelations are shown in the second part of the diagonal.

Klingels, Smits-Engelsman, 2018; Cardoso *et al.* 2017; Azari *et al.* 2017; Madaschi *et al.* 2016), although it slightly overestimated the performance of children from Taiwan (Yu *et al.* 2013). Anderson (2016) also reports possible overestimation of children's development. Evidence for the internal validity of Bayley-III is described in the manual, with significant intercorrelations of scale scores, which we also tested in our sample and present in comparison with the original manual values in Table 2. All intercorrelations were significant, with stronger correlations observed in our sample of children (n = 30). We attribute this to the fact that the children in our study formed a relatively homogeneous age group compared to the manual's research sample, where averaged results were reported from 17 age groups after applying Fisher's Z transformation. Additionally, we believe that due to the convenience sampling of children, with 20 children coming from at-risk clinics, the scale scores exhibited greater variability.

Research Design

The facilities visited by the parent and child for the purpose of the research were clinics or rooms adapted to meet the requirements for administering the Bayley-III items. Our effort was to adjust the conditions in the room so that it did not contain too many stimuli (toys, noise, other people) during the testing situation, which could undesirably interfere with the controlled process of assessing the current level of the child's psychomotor development. The parent provided us with the completed S-PMV11, and subsequent testing was conducted using Bayley-III to avoid biasing the results from the information that direct assessment of developmental levels provides. Data were collected through direct assessment from January 2022 to January 2023.

Data Analysis Methods and Statistical Processing

Evidence of the validity of S-PMV11 in determining the correlation with the gold standard Bayley-III was investigated using Spearman's correlations. Partial correlation was also used while controlling for the children's age. Due to the low number of children, we did not separate them into younger and older groups; therefore, we performed the calculation twice. The first time as a Spearman correlation without age control and the second time as a partial Spearman correlation with the variable of the child's age in months controlled. JASP software, version 16.4.0 (JASP Team, 2022), was used for the analysis.

We also conducted an analysis of the agreement in categorizing children according to S-PMV11 and Bayley-III into groups of children in the borderline range of developmental functioning and at risk (label 1) and without the risk of developmental difficulties (label 0). The analysis was repeated with the

Tab. 3. Descriptive Characteristics of Developmental Functioning in S-PMV11 and Bayley-III (n=30)

	M	SD	Mdn	skewness	kurtosis	min	max
DF	12.56	3.89	12	0.32	-0.44	6	20
COG	65.20	11.49	66.5	-2.12	6.11	22	78
RC	28.43	8.01	30	-1.43	2.42	4	40
EC	26.43	9.54	28	-0.58	0.03	3	41
FM	40.23	5.66	40	0.25	1.23	26	54
GM	56.57	5.56	56	-0.28	-0.60	44	65

Notes: DF = developmental functioning in S-PMV11, COG = cognition in Bayley-III; RC = receptive communication in Bayley-III, EC = expressive communication in Bayley-III; FM = fine motor in Bayley-III; GM = gross motor in Bayley-III; M = mean, SD = standard deviation, Mdn = median, min = minimum value, max = maximum value.

Tab. 4. Correlations of Developmental Functioning with Developmental Domains According to Bayley-III

Variable	n	M	SD	Mdn	DF	C	RC	EC	FM
DF	30	12.56	3.89	12	—				
C	30	65.20	11.49	66.5	0.761***	—			
RC	30	28.43	8.01	30	0.694***	0.805***	—		
EC	30	26.43	9.54	28	0.835***	0.725***	0.744***	—	
FM	30	40.23	5.67	40	0.647***	0.737***	0.667**	0.695**	—
GM	30	56.57	5.56	56	0.636***	0.582**	0.693**	0.681***	0.698***

Notes: DF = developmental functioning in S-PMV11, COG = cognition in Bayley-III; RC = receptive communication in Bayley-III, EC = expressive communication in Bayley-III; FM = fine motor in Bayley-III; GM = gross motor in Bayley-III, *** = $p < 0.001$, ** = $p < 0.01$, * = <0.05. The values of Spearman's correlation coefficient are provided for the strengths of the relationships.

Tab. 5. Partial Correlations of Developmental Functioning with Developmental Domains According to Bayley-III, Controlling for Age

Variable	n	M	SD	Mdn	DF	C	RC	EC	FM
DF	30	12.56	3.89	12	—				
C	30	65.20	11.49	66.50	0.785***	—			
RC	30	28.43	8.01	30	0.707***	0.776***	—		
EC	30	26.43	9.54	28	0.839***	0.707***	0.727***	—	
FM	30	40.23	5.67	40	0.661***	0.693***	0.617**	0.673**	—
GM	30	56.57	5.56	56	0.638***	0.533**	0.660**	0.658***	0.664***

Notes: Controlled variable: age of the child in months, DF = developmental functioning in S-PMV11, COG = cognition in Bayley-III; RC = receptive communication in Bayley-III, EC = expressive communication in Bayley-III; FM = fine motor in Bayley-III; GM = gross motor in Bayley-III, *** = $p < 0.001$, ** = $p < 0.01$, * = <0.05, the values of the Spearman correlation coefficient are presented for the strengths of the relationships.

designation of children only in the at-risk range (label 1) and without the risk of developmental difficulties and in the borderline range (label 0). The agreement of the tools in categorizing children into the suspected developmental difficulty range was assessed using Cohen's kappa coefficient, which is advantageous due to the correction for chance. Kočišová (2022) indicates Cohen's kappa coefficient as suitable when there are two assessors. IBM SPSS software, version 25, was used for the calculations.

RESULTS

The description of the domain of developmental functioning in S-PMV11 and the domains of Bayley-III is provided in Table 3. The results of developmental functioning indicate that the majority of the research sample consisted of children at risk for developmental difficulties.

The aim of the study was to examine the relationship between developmental functioning and the individual domains of direct assessment of the child's current developmental functioning using Bayley-III. All relationships were significant, positive, and strong both before age control (Table 4) and after subsequent age control (Table 5). The tables also display the intercorrelations of the Bayley-III domains, which indicate a statistically significant, positive, and strong relationship. We accept the established hypotheses H1, H2, H3, H4, and H5.

To answer the research question: **RQ:** What will be the agreement rate for classifying children within the normative range in Bayley-III and S-PMV11? We conducted an analysis to assess the agreement between direct testing using Bayley-III and S-PMV11 based on the classification of children according to normative criteria in the mentioned methods. We categorized children as 1 - at risk of developmental difficulties—if they achieved below-average scale scores in Bayley-III in at least one domain (fine motor, gross motor, cognition, receptive communication, expressive communication). The developmental functioning result from S-PMV11 was classified as 1 if the child was screened as being in the borderline or risk zone (0 in the norm, 1 in the borderline or risk of difficulties). This way, we obtained two groups of children labeled as 0 (no risk) and 1 (at risk). We compared the classification agreement using the kappa coefficient. The agreement expressed by the kappa coefficient was 0.322 [SE = 0.151; CI = 0.026-0.618]; p <0.016. This result corresponds to sufficient inter-rater agreement at approximately 73.33% and is considered as fair agreement. The agreement is illustrated in Table 6.

We repeated the calculation, this time only marking those children with suspected developmental difficulties based on the developmental functioning result

Tab. 6. Agreement Between Bayley-III and Developmental Functioning in S-PMV11 (for difficulties identified in the borderline and risk zones)

	Bayley-III - 0	Bayley-III - 1	Total
S-PMV - 0	3	0	3
S-PMV - 1	8	19	27
Total	11	19	30

Tab. 7. Agreement Between Bayley-III and Developmental Functioning in S-PMV11 (for difficulties identified only in the risk zone)

	Bayley-III - 0	Bayley-III - 1	Total
S-PMV - 0	9	0	9
S-PMV - 1	2	19	21
Total	11	19	30

in S-PMV11 who were classified into the risk zone according to the screening. Table 7 shows the agreement of assignments. An excellent agreement was achieved with kappa coefficient = 0.851 [SE = 0.101; CI = 0.653-1.000]; $p < 0.001$. The level of agreement in classifying children based on developmental functioning in the screening and direct assessment of current psychomotor levels using Bayley-III expressed as a percentage was high, reaching up to 93.33% and is considered as almost perfect agreement.

DISCUSSION

With the increasing number of screening tools being developed in various countries, there is also a growing need to verify their psychometric properties and their ability to provide relevant information about the presence of risks for developmental difficulties (Agarwal *et al.* 2024). This study aimed to assess the convergent validity between S-PMV11 and Bayley-III. Our findings align with international literature indicating that parental assessments of child development are often consistent with direct testing methods (Miller *et al.* 2017; Sachse & Suchodoletz, 2008). Specifically, we found strong positive correlations among all developmental domains assessed in S-PMV11 and the overall scores, supporting hypotheses H1 through H5.

We also align with the findings that parents can be considered competent assessors of a child's potential risk for developmental difficulties (Vitrikas, Savard, Bucaj, 2017; Flamant *et al.* 2011). The strongest correlation with developmental functioning was found in expressive communication. This domain is considered significant for further academic, social, and psychological development of the individual (Agarwal *et al.* 2024). We believe that a child's speech has a clearer onset compared to other indicators, which can be captured more precisely than cognitive processes in children. Authors Chung *et al.* (2011) indicate that parents of children with global developmental delays expressed more concerns about the child's speech than about the overall delayed psychomotor development. This suggests that parents notice deficiencies in speech, which are the first signs of developmental delays at the age of two. Similar findings regarding the strong correlation of a child's speech in direct assessments and parental assessments were noted by Miller *et al.* (2017). One possible justification is that a child uses speech throughout the testing situation, while other skills (such as stacking blocks in Bayley-III) do not provide as many opportunities for expression as speech does. We believe that the longer opportunity for expressing speech-related developmental milestones in Bayley-III, which may occur throughout the testing (such as using three or more words), supports the high agreement with parental assessment in S-PMV11 compared to other domains like motor skills.

Our study confirms that classifying children into risk and borderline risk zones for developmental difficulties using the S-PMV11 and the Bayley-III direct method provides a reliable approach for identifying these difficulties in everyday pediatric practice. The high agreement between the classifications of children according to S-PMV11 and Bayley-III indicates low inaccuracies in completing the screening tool, especially for children suspected of having risk in developmental functioning. We can state that the results for the domain of developmental functioning in S-PMV11 correspond with the direct assessment of the child using the gold standard Bayley-III. As described by Vitrikas, Savard, and Bucaj (2017), a parent can be a reliable source of information about a child's psychomotor development based on everyday interactions with the child. The near-perfect agreement between identifying children at risk for developmental functioning with the S-PMV11 and below-average performance on the Bayley-III provides evidence that these methods align well in severe cases.

When considering the reservations of some authors (Anderson & Burnett, 2017; Yu *et al.* 2013), who pointed out the overestimation of a child's performance in Bayley-III, our research has also shown that children classified as borderline only in S-PMV11 and not at risk in Bayley-III. Capturing children in the borderline zone is important for further inquiries by pediatricians about specific items perceived by parents, as these may indicate biases on the parent's part, as well as possible overestimation of the child's performance when using Bayley-III. We perceive an advantage of Bayley-III in educational and advisory contexts. During the testing using Bayley-III, the parent had the opportunity to see our method of interaction with the child and how the testing situation was established. At the same time, they were informed about ways to support the child's development in the following age period. In this regard, we see a clear educational benefit of Bayley-III over the screening method S-PMV11. For children identified

in the risk zone, we recommend further investigation of their development using another method of direct testing for developmental functioning based on our findings.

LIMITATIONS

It has been noted that parents with lower education levels often overestimate their child's abilities and that parental age and household income are related to parents' knowledge of their child's psychomotor development (McCune, Richardson, Powell, 1984). Although we did not specifically focus on these indicators in our research, we believe that pediatricians have access to this information, which can be useful in assessing any overestimation of the child's assessed development by the parents in S-PMV11 during ongoing monitoring of the child's development. Also, it is important to note that, to date, direct assessment method Bayley-III has not been standardized with norms specific to the Slovak population. Addressing this gap could enhance the reliability and applicability of assessments, ultimately improving outcomes for children at risk of developmental difficulties.

CONCLUSION

Our findings provide strong evidence for the convergent validity of direct assessments of children's psychomotor development. However, this evidence should be generalized with caution, as our research sample primarily consisted of children suspected of having developmental difficulties. The universal identification of potential risks for developmental difficulties in all children presents significant benefits for early intervention and support. Therefore, it is essential to complement screening tools with methods of direct assessment.

ACKNOWLEDGMENTS

The study was supported by the VEGA project 1/0534/22: "Psychometric properties and validity of the Screening of Psychomotor Development (S-PMV) as a monitoring method for early detection of developmental difficulties in children," and by the UGA IX/5/2024 project: "Validation of Selected Psychometric Properties of Developmental Screening Tools from the S-PMV Set for Early Childhood.

REFERENCES

1 Abdoola S, Swanepoel DW, Van der Linde J, Glascoe FP. Detecting developmental delays in infants from a low-income South African community: comparing the BSID-III and PEDS tools. Early Child Dev Care.
2 Agarwal PK, Xie H, Rema ASS, Meaney MJ, Godfrey KM, Rajadurai VS, et al. (2024) Concurrent validity of the ages and stages questionnaires with Bayley scales of infant development-III at 2 years: Singapore cohort study. Pediatr Neonatol. 2024; **65**(1): 48–54.
3 Anderson PJ, Burnett A. (2017) Assessing developmental delay in early childhood—concerns with the Bayley-III scales. Clin Neuropsychol. 2017; **31**(2): 371–381. doi:10.1080/13854046.2016.1220526.
4 Azari N, Soleimani F, Vameghi R, Sajedi F, Shahshahani F, Karimi H, et al. (2017) A psychometric study of the Bayley scales of infant and toddler development in Persian language children. Iran J Child Neurol. 2017; **11**(1): 50–56.
5 Bayley N. (2006) Bayley scales of infant and toddler development, third edition: administration manual. San Antonio, TX: Harcourt.
6 Black MM, Walker SP, Fernald LC, Andersen CT, DiGirolamo AM, Lu C, et al. (2017) Advancing early childhood development: from science to scale 1: early childhood development coming of age: science through the life course. Lancet. 2017; **389**(10064): 77.
7 Bujang MA, Baharum N. (2017) A simplified guide to determination of sample size requirements for estimating the value of intraclass correlation coefficient: a review. Arch Orofac Sci. 2017; **12**(1).
8 Byrne JM, Backman JE, Smith IM. (1986) Developmental assessment: the clinical use and validity of parental report. J Pediatr Psychol. 1986; **11**(4): 549–559.
9 Cardoso FG, Formiga CKMR, Bizinotto T, Tessler RB, Rosa F. (2017) Concurrent validity of the Brunet-Lézine scale with the Bayley scale for assessment of the development of preterm infants up to two years. Rev Paul Pediatr. 2017; **35**: 144–150.
10 Çelik P, Sucaklı İA, Yakut Hİ. (2020) Which Bayley-III cut-off values should be used in different developmental levels? Turk J Med Sci. 2020; **50**(4): 15. doi:10.3906/sag-1910-69.
11 Chung CY, Liu WY, Chang CJ, Chen CL, Tang SFT, Wong AMK. (2011) The relationship between parental concerns and final diagnosis in children with developmental delay. J Child Neurol. 2011; **26**(4): 413–419. doi:10.1177/0883073810384926.
12 Federico A, Shi D, Bradshaw J. (2021) Agreement between parental report and clinician observation of infant developmental skills. Front Psychol. 2021; **12**: 734341.
13 Fernald LC, Prado E, Kariger P, Raikes A. (2017) A toolkit for measuring early childhood development in low and middle-income countries.
14 Fernandes M, Stein A, Newton CR, Cheikh-Ismail L, Kihara M, Wulff K, et al. (2014) The INTERGROWTH-21st Project neurodevelopment package: a novel method for the multi-dimensional assessment of neurodevelopment in preschool age children. PLoS One. 2014; **9**(11). doi:10.1371/journal.pone.0113360.
15 Flamant C, Branger B, Nguyen The Tich S, de La Rochebrochard E, Savagner C, Berlie I, Rozé JC. (2011) Parent-completed developmental screening in premature children: a valid tool for follow-up programs. PLoS One. 2011; **6**(5).
16 Goldstone AB, Baiocchi M, Wypij D, Stopp C, Andropoulos DB, Atallah J, et al. (2020) The Bayley-III scale may underestimate neurodevelopmental disability after cardiac surgery in infants. Eur J Cardiothorac Surg. 2020; **57**(1): 63–71.
17 Hanlon C, Medhin G, Worku B, Tomlinson M, Alem A, Dewey M, Prince M. (2016) Adapting the Bayley scales of infant and toddler development in Ethiopia: evaluation of reliability and validity. Child Care Health Dev. 2016; **42**(5): 699–708. doi:10.1111/cch.12371.
18 Hoskens J, Klingels K, Smits-Engelsman B. (2018) Validity and cross-cultural differences of the Bayley scales of infant and toddler development in typically developing infants. Early Hum Dev. 2018; **125**: 17–25.
19 Johnson S, Wolke D, Marlow N, Preterm Infant Parenting Study Group. (2008) Developmental assessment of preterm infants at 2 years: validity of parent reports. Dev Med Child Neurol. 2008; **50**(1): 58–62.
20 Kwun Y, Park HW, Kim MJ, Lee BS, Kim EAR. (2015) Validity of the ages and stages questionnaires in Korean compared to Bayley scales of infant development-II for screening preterm infants at corrected age of 18–24 months for neurodevelopmental delay. J Korean Med Sci. 2015; **30**(4): 450.
21 Lipkin PH, Macias MM, Norwood KW, Brei TJ, Davidson LF, Davis BE, et al. (2020) Promoting optimal development: identifying infants and young children with developmental disorders through developmental surveillance and screening. Pediatrics. 2020; **145**(1).

22 Madaschi V, Mecca TP, Macedo EC, Paula CS. (2016) Bayley-III scales of infant and toddler development: transcultural adaptation and psychometric properties. Paidéia (Ribeirão Preto). 2016; **26**: 189–197.
23 McCune YD, Richardson MM, Powell JA. (1984) Psychosocial health issues in pediatric practices: parents' knowledge and concerns. Pediatrics. 1984; **74**(2): 183–190.
24 McHenry MS, Oyungu E, Yang Z, Hines AC, Ombitsa AR, Vreeman RC, et al. (2021) Cultural adaptation of the Bayley scales of infant and toddler development for use in Kenyan children aged 18–36 months: a psychometric study. Res Dev Disabil. 2021; **110**: 103837.
25 McHenry MS, Oyungu E, Yang Z, Hines AC, Ombitsa AR, Vreeman RC, et al. (2021) Cultural adaptation of the Bayley scales of infant and toddler development, 3rd edition for use in Kenyan children aged 18–36 months: a psychometric study. Res Dev Disabil. 2021. doi:10.1016/j.ridd.2020.103837.
26 Miller LE, Perkins KA, Dai YG, Fein DA. (2017) Comparison of parent report and direct assessment of child skills in toddlers. Res Autism Spectr Disord. 2017; **41**: 57–65.
27 Peyton C, Msall ME, Wroblewski K, Rogers EE, Kohn M, Glass HC. (2021) Concurrent validity of the Warner Initial Developmental Evaluation of Adaptive and Functional Skills and the Bayley scales of infant and toddler development, third edition. Dev Med Child Neurol. 2021; **63**: 349–354. doi:10.1111/dmcn.14737.
28 Pitchik HO, Tofail F, Akter F, et al. (2023) Concurrent validity of the Ages and Stages Questionnaire Inventory and the Bayley scales of infant and toddler development in rural Bangladesh. BMC Pediatr. 2023; **23**: 93. doi:10.1186/s12887-022-03800-6.
29 Richter LM, Daelmans B, Lombardi J, Heymann J, Boo FL, Behrman JR, et al. (2017) Investing in the foundation of sustainable development: pathways to scale up for early childhood development. Lancet. 2017; **389**(10064): 103–118. doi:10.1016/S0140-6736(16)31698-1.
30 Rubio-Codina M, Araujo MC, Attanasio O, Muñoz P, Grantham-McGregor S. (2016) Concurrent validity and feasibility of short tests currently used to measure early childhood development in large scale studies. PLoS One. 2016; **11**(8). doi:10.1371/journal.pone.0160962.
31 ©S-PMV, Prof. K. Matulay (n.d.). Found. (2015) Skríning S-PMV11. Príručka ku skríningovej metóde navčasné odhalenie vývinových ťažkostí pri 11. preventívnej prehliadke S-PMV11. [(Guide to the Screening Method for Early Detection of Developmental Difficulties during the 11th Preventive Checkup S-PMV11.)] Bratislava.
32 Sachse S, Von Suchodoletz W. (2008) Early identification of language delay by direct language assessment or parent report? J Dev Behav Pediatr. 2008; **29**(1): 34–41.
33 Steenis LJ, Verhoeven M, Hessen DJ, Van Baar AL. (2015) Parental and professional assessment of early child development: the ASQ-3 and the Bayley-III-NL. Early Hum Dev. 2015; **91**(3): 217–225.
34 Vitrikas K, Savard D, Bucaj M. (2017) Developmental delay: when and how to screen. Am Fam Physician. 2017; **96**(1): 36–43.
35 Yu YT, Hsieh YJ, Shih YF, Lee HC, Yang Y, Wang ZJ. (2022) The Chinese version of the Bayley scales of infant and toddler development, third edition: validation in children with developmental delays. BMC Pediatr. 2022; **22**(1): 81.
36 Yue A, Jiang Q, Wang B, Abbey C, Medina A, Shi Y, et al. (2019) Concurrent validity of the Ages and Stages Questionnaire and the Bayley scales of infant development III in China. PLoS One. 2019; **14**(9). doi:10.1371/journal.pone.0221675.