RESEARCH ARTICLE

REVISED Validation of the Dominican system for measuring early childhood development [version 2; peer review: 1 approved with reservations, 1 not approved]

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Abstract

Previous research has indicated that individual differences play a role in group creativity. Group creativity activities have different outcomes, leading to numerous ways to assess the effectiveness of these creative activities. To date, no meta-analysis has been performed on the relationship between the outcomes of the creative activity and personal factors of the group members. In this Registered Report, we conducted a meta-analysis (n = 11, k = 72) on the relationship between personal factors and group creativity outcomes. We found weak support for a positive correlation between self-efficacy and group creativity outcomes, between r = .04 and r = .67. We found weak support for a moderation effect of time constraint, with stronger relationships for conditions limited to 20 minutes as opposed to 10 minutes. Finally, we found that only a few studies could be included in the meta-analysis, because many studies (1) did not directly measure creativity, or (2) measured other, less common personal factors. We call for a more systematic and direct approach to measuring creativity and an improvement of open science practices in the field. Data and analysis can be found at https://osf.io/xwph9.

Keywords

Early childhood development, Dominican Republic, Monitoring, Screening

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Any reports and responses or comments on the article can be found at the end of the article.

This article is included in the Health Services gateway.

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REVISED **Amendments from Version 1**

The manuscript has undergone substantial improvements in response to the reviewers' feedback, including a detailed clarification of the SIMEDID tool's adaptation process from the MDAT tool and other instruments. The methods section now explicitly describes the assessment tool's methodology.

In response to requests for clarification about the assessment process, the manuscript now specifies the availability of a kit to support the SIMEDID tool. It emphasizes the inclusion of pictures and materials for assessment.

The study's limitations, such as the sample's potential lack of representation due to the focus on INAIPI beneficiaries in the metropolitan area, are openly acknowledged. Plans for future data collection activities aim to address this limitation and include a broader sample for greater representation.

The manuscript now offers more comprehensive information on training sessions, including content details and certification processes for facilitators. Quality control analyses have been incorporated to ensure consistency among evaluators.

We clarified that data on children with disability were not included in this analysis, but the discussion section now emphasizes plans for future studies to demonstrate the tool's sensitivity to changes and other well-known variables associated with childhood development, such as disability.

Figures have been appropriately labelled, and their interpretation has been expanded, addressing comments about the presentation of the results. The manuscript now provides insights into plans for future use, including establishing cut-off scores for referral to early intervention services based on age norms.

This new manuscript addresses all suggestions made by the reviewers, resulting in a clearer, more detailed, and transparent presentation of the SIMEDID tool's adaptation, methodology, and future plans.

Any further responses from the reviewers can be found at the end of the article

Introduction

The Dominican Republic confirmed its commitment to achieving the United Nation's sustainable development goal 4.2 for 2030 to guarantee that children are ready for primary education by offering quality early childhood services, including care and early education (United Nations, 2015). One of this goal's indicators is "[the] proportion of children aged 24-59 months who are developmentally on track in health, learning, and psychosocial well-being, by sex" (UNESCO UIS, n.d., para. 1). Although this indicator is conceptually straightforward, and numerous efforts have been conducted to establish a global methodology for measuring it, some challenges associated with determining cut-off points for early childhood development remain (Daelmans *et al.,* 2017; Richter *et al.,* 2017).

First, high-income countries' screening tools might translate poorly to low- and middle-income countries. This poses the risk of either underestimating or overestimating childhood development, which in turn precludes making accurate, evidence-based decisions regarding early childhood interventions and resource allocation (Gladstone *et al.,* 2008; Sabanathan *et al.,* 2015). The second challenge is the need for more funding for monitoring systems in low- and middle-income countries, which translates into needing more sufficiently qualified personnel to conduct periodic childhood development screenings (Lokuketagoda *et al.,* 2016). And third, there is a critical need to obtain a large pool of data from developing children to identify those at risk for developmental delay (Lokuketagoda *et al.,* 2016), which is particularly challenging in low- and middle-income countries (Richter *et al.,* 2017).

In Latin America and the Caribbean, childhood development measurement has attracted attention, evidenced by the creation of the Regional Network for Measuring Childhood Development (REMDI) (Interamerican Dialogue, 2020). This international network of specialists is dedicated to promoting national measurements of childhood development to obtain data for decision-making and comparison between and within countries. Since the year 2000, the Dominican Republic has collected data on childhood development by participating in a series of Multiple Indicator Cluster Surveys (MICS), a household survey methodology designed by UNICEF that analyzes the situation of women and children across the world. The instrument collects data on children's health, education, protection, and environment (such as sanitation), among other variables. The Dominican Republic participated in MICS2 (Molina Achécar and Polanco, 2001), MICS5 (ONE and UNICEF, 2016), and MICS6 (ONE and UNICEF, 2021) survey rounds with an evolving early childhood development measurement (Loizillon *et al.,* 2017).

The latest data from 2019 reported that 87.1% of Dominican children meet the minimum development indicators. Data generated by MICS have been useful for guiding the advocacy and system-strengthening plans of early childhood development and children's rights institutions, including sustainable investments in the multi-year governmental

planning for 2020-2024. In addition, the MICS data have been used to create predictive models that quantify the impact of multiple sociodemographic and psychosocial factors in childhood development (Sánchez-Vincitore and Castro, 2022).

Household surveys provide useful information on general trends in childhood development, but they are not comprehensive enough to assess development in its various dimensions or sensitive enough to generate alerts to detect developmental delays. These limitations highlight the need for specific child development screening tools that, although quick and cost-effective in the application, have adequate psychometric properties.

Many private, informal, and some public initiatives have been conducted in the Dominican Republic to provide early childhood services. However, until 2019 there were no standardized instruments to measure the impact of such efforts. In 2019, Sánchez-Vincitore *et al.* (2019) initiated the validation of the Dominican adaptation of the Malawi Developmental Assessment Tool (MDAT) (Gladstone *et al.,* 2008, 2010). The MDAT is a childhood development screener in which an evaluator observes the behavior of a child in four different domains: gross motor, fine motor, language, and socio-emotional development. One of the advantages of MDAT is that it optimizes test application time by only presenting items that correspond to the child's expected evolutionary stage according to the child's age. Therefore, providing a more precise item order is crucial to prevent bias in obtaining total scores. The adaptation of the MDAT to the Dominican Republic (MDAT-DR) (Sánchez-Vincitore *et al.*, 2019) presented good psychometric properties. However, some limitations had to be considered before upscaling it as a national surveillance tool. First, as a preliminary pilot implementation within the academic context, research assistants with vast experience and training in data collection administered the instrument, which is unlikely in naturalistic environments. Second, the MDAT-DR adaptation had a small sample size (N = 42), meaning there was no national representation. Therefore, age-standardized norms were not obtained for each item, threatening item presentation order. Finally, the study evaluated children up to 24 months, limiting the age range for which data were available.

To overcome these limitations, the National Institute for Early Childhood Comprehensive Care (INAIPI, for its acronym in Spanish), established as a national state institution in 2013 to ensure quality comprehensive care services to children aged 0 to five and their families, collaborated with the Universidad Iberoamericana (UNIBE) and the United Nations Children's Fund (UNICEF) to develop the Dominican System for Measuring Early Childhood Development (SIMEDID, for its acronym in Spanish). To create SIMEDID, the team re-analyzed the content and structure of the MDAT-DR (Sánchez-Vincitore *et al.,* 2019) and integrated other items from international and national instruments (Alonso *et al.,* 2022). The research team obtained an expert panel's consensus before collecting data to guarantee the instrument's construct definition (Sireci and Sukin, 2013). The expert panel consisted of a group of professionals who represent Dominican institutions that provide early childhood services, including the Early Childhood Education Department and the Special Education Department from the Ministry of Education; the Ministry of Health; the National Health Services (SNS for its Spanish acronym); the National Council for Childhood and Adolescence (CONANI for its Spanish acronym); and the National Council for Disabilities (CONADIS for its Spanish acronym). The experts had the opportunity to revise each item and their definitions.

The team adopted all four of MDAT-DR's dimensions—including fine motor skills, gross motor skills, social and emotional development, and language development—updated them for relevance, created a progressive item list for each developmental dimension through expert input, and revised the instrument twice based on surveys among educators and facilitators for clarity. Next, the team conducted an initial pilot of SIMEDID aimed to assess its application conditions, digital platform functionality, internal consistency, and user experience (INAIPI, 2020; Sánchez-Vincitore, 2020). The pilot study included 100 children aged 45 days to 5 years who were receiving INAIPI services. The study confirmed the platform's offline functionality, speed, and user-friendly interface, along with the willingness of educators and animators to participate. In addition, the instrument showed good internal consistency.

SIMEDID is an electronic platform that hosts an early childhood development screener. This platform allows data collection through mobile devices and connects to INAIPI's servers as part of its monitoring and evaluation system. The mobile application extracts sociodemographic information from the server, configuring individual evaluations for each child's age. As a result, INAIPI personnel already in the field can administer the early childhood development screener time-efficiently with little training. Once the assessment is over and the device connects to the internet, the data sync to the server—reducing the risk of losing the data.

We conducted this study to validate SIMEDID, with three aims: (1) To determine the psychometric properties of SIMEDID; (2) To adjust the sequence of item presentation according to developmental milestones obtained from data from a large sample; (3) To provide age-standardized norms for each item.

Methods

Ethical statement

The Universidad Iberoamericana's ethics committee approved this study (CEI2021-3). Written informed consent was obtained from the participant's parents or guardians before participation in the study.

Study design

This is a cross-sectional, non-experimental, and descriptive study that evaluated children who receive services at INAIPI.

Setting

Data collection occurred in Santo Domingo, Dominican Republic, from November 1st, 2021, to February 17th, 2022. INAIPI participants who attended Comprehensive Care Centers for Early Childhood (CAIPIs, for its Spanish acronym) were assessed at their centers. In contrast, those who participated in Comprehensive Care Centers for Children and the Family (CAFI, for its Spanish acronym) received community and family-based services at their home, which is where children were assessed. The instrument was applied during regular service hours. The evaluation personnel consisted of 20 educational agents (who work at CAIPIs) and 20 community agents (who work at CAFIs).

Participants

An intentional sample of 948 children who live in Santo Domingo was selected from the INAIPI's System of Information and Management for Early Childhood (SIGEPI, for its Spanish acronym) according to their age and type of service received (CAIPI or CAFI, which were kept proportional to the actual service: 36% and 64%, respectively). The inclusion criterion was to be beneficiaries of INAIPI. Participants were 428 girls (45.1%) and 520 boys (54.9%).

Instruments

Sociodemographic variables: This set of questions addressed general demographic variables: sex assigned at birth (male and female), age (in days at the moment of evaluation), and type of service (CAIPI vs CAFI). These variables, obtained directly from SIGEPI, determine the starting item of SIMEDID 's subscales.

SIMEDID: This electronic instrument assesses childhood development in four development areas: gross motor, fine motor, language development, and social development. The assessment tool requires an observation of the child's behavior, either by the evaluator, parent, or the person in charge of the child at a given time. If the child does not show the expected behavior at the time of testing, the informant's report is considered a valid response as long as they have witnessed the expected behavior from the child. The INAIPI team created a kit to support the assessment tool (which includes props, pictures, and everyday objects). Materials are easily found in the Dominican Republic as a strategy for upscaling data collection.

Each subtest comprises 33 items, except for language development, which has 34 items; all are arranged in ascending difficulty levels. The initial presentation of the first item is age-dependent. Once the first item on each dimension is completed, the instrument presents items in reverse until the participant successfully completes three items. Subsequently, the tool proceeds forward until the participant misses three items. This approach enables evaluators to ascertain the child's current developmental state, identifying potential delays (backward presentation) or advanced development (forward presentation). Items must be completed in sequence as they are organized based on increasing difficulty and follow an algorithm that assesses children's development from minimum to maximum levels. Evaluators can easily switch between different developmental areas by clicking on tabs with corresponding names.

The study's primary aim was to determine the age range at which each item is accomplished, utilizing the Malawi MDAT norms for the initial trial. Subsequent data collection will adopt the sequence based on the findings from the present validation study.

The evaluation is conducted using a mobile device with the SIMEDID app that connects to the INAIPI server and instructs the evaluator to assess a specific child. The app calculates the first item in each development area and presents items backward and forward. Passed items were scored 1, while missed items scored 0. Items not shown (for not corresponding to the participant's age range) were automatically completed: items before the three first achieved items were scored 1 (since it is assumed that the child has already passed these), and items after three consecutive misses scored 0 since the child is not ready to perform these.

The variables included in this study are listed in Table 1.

Table 1. Study variables.

Variable	Description
Age at evaluation	Numerical variable. Age is calculated in days for the analyses but displayed in months and years in the figures.
Age group	Ordinal variable. Age group was calculated by merging age in days intervals into the following month interval: 0-2, 2-4, 4-6, 6-9, 9-12, 12-15, 15-18, 18-24, 24-30, 30-36, 36-42, 42-48, 48-54, 54-60.
Service	Categorical variable. CAFI vs. CAIPI
Item success (for each item)	Categorical variable. 0 = no success, 1 = success.
Gross motor development score	Numerical variable. Scores range from 0-33, calculated by the sum of item success from the gross motor development sub-scale.
Fine motor development score	Numerical variable. Scores range from 0-33, calculated by the sum of item success from the fine motor development sub-scale.
Language development score	Numerical variable. Scores range from 0-34, calculated by the sum of item success from the language development sub-scale.
Socioemotional development score	Numerical variable. Scores range from 0-33, calculated by the sum of item success from the socioemotional development sub-scale.

No other demographic factors were considered for this analysis.

Procedure

A total of 40 evaluators received a six-hour training session and conducted two practice evaluations. The training session comprised both theoretical and practical components. The training, facilitated by experts in training and child development, covered essential topics such as the concept of child development and SIMEDID. It included virtual follow-ups by the Child Development Evaluation Division and certification for facilitators. The module provided insights into SIMEDID's structure, dimensions, and application in INAIPI's service modalities. Evaluators learned about assessment processes in the children's homes, including guidance for parents, system periodicity, and tool specifications. The practical section involved the hands-on use of evaluation kit materials in simulated assessments, emphasizing adherence to standardized data collection. The training concluded with a presentation on the SIMEDID app's functionality, utilizing visual aids and videos to reinforce the covered content. At the end of the training, evaluators were certified as official SIMEDID evaluators.

The team conducted the recruitment through an institutional message indicating that either a CAIPI or CAFI was selected to participate. Children from CAIPI attending services during the data collection day were evaluated after a parent signed the consent form when dropping off their children at the centers. For CAFI participants, evaluation was conducted at home, and the assigned in-field INAIPI personnel contacted their families. Parents signed the informed consent before the interview took place at home. Each evaluation had a duration of 25-30 minutes.

To guarantee uniformity in assessments among evaluators, we conducted an analysis of variance (ANOVA), comparing the mean scores of participants within each age group per evaluator. The results revealed no significant differences between evaluators within each age group across all dimensions.

Statistical methods

To determine the instrument's psychometric properties, which correspond to the first aim, we calculated Cronbach's alpha and split half-parallel reliability. Then, for additional evidence of content validity, we conducted descriptive analyses (means and standard deviations) of each sub-scale score for each age group to confirm the alignment of the instrument with development by age.

To determine the most appropriate item presentation order according to these data (second aim) and age-standardized norms (third aim), we conducted a logistic regression analysis on each item with item success (0 and 1) as the dependent variable and age in days as the independent variable. Following the methodology used by Gladstone *et al.* (2008, 2010), after ensuring a good model fit, the alpha and beta coefficients were used to calculate the cut-off age associated with a.9 probability of success following the formula in Equation 1:

$$P(Y) = \frac{1}{1 + e^{-(\propto + \beta x)}} \quad (1)$$

The formula was also used to calculate the .75, .50, and .25 probabilities of success for each item. We used predictive probabilities from the regressions to calculate ages corresponding to 25%, 50%, 75%, and 90% of children passing each item, as proposed by Gladstone *et al.* (2008, 2010). For the statistical analyses, we used the IBM SPSS Statistics 25 program (https://www.ibm.com/products/spss-statistics). An open-source alternative to SPSS that can conduct the same processes is JASP (https://jasp-stats.org/).

Results

Psychometric properties of SIMEDID (first aim)

To confirm the content validity of SIMEDID, we obtained descriptive statistics on each age group for the evaluated developmental areas. Table 2 shows that mean growth is progressive through age groups.

Two internal consistency indices were calculated for each developmental area to confirm the instrument reliability, Cronbach's alpha, and split-half Spearman-Brown's correlation (see Table 3).

Table 2. Descriptive statistics for total scores by development area and age group.

Age group	n		Gross motor	Fine motor	Language	Social-emotional
0-2 month	2	Mean	*	*	*	*
		SD	*	*	*	*
2-4 month	30	Mean	**4.97**	**5.13**	**5.53**	**7.23**
		SD	2.62	3.75	1.36	3.73
4-6 month	43	Mean	**6.49**	**8.98**	**6.84**	**9.74**
		SD	2.10	2.20	1.29	3.07
6-9 month	65	Mean	**9.31**	**11.66**	**8.31**	**13.88**
		SD	2.66	2.94	2.08	4.24
9-12 month	52	Mean	**12.35**	**13.00**	**9.52**	**16.23**
		SD	1.61	1.61	1.41	2.58
12-15 month	48	Mean	**15.94**	**14.54**	**11.23**	**18.90**
		SD	4.25	2.82	2.89	3.45
15-18 month	37	Mean	**19.16**	**18.03**	**14.19**	**21.86**
		SD	4.36	5.16	5.33	3.96
18-24 month	82	Mean	**22.44**	**21.27**	**17.23**	**22.95**
		SD	3.90	4.49	6.70	4.30
24-30 month	85	Mean	**25.74**	**24.42**	**21.61**	**25.96**
		SD	4.50	4.56	6.57	4.36
30-36 month	89	Mean	**27.61**	**25.79**	**25.90**	**27.78**
		SD	3.98	3.75	5.56	3.99
36-42 month	111	Mean	**28.86**	**28.38**	**28.86**	**30.50**
		SD	3.75	3.11	4.98	3.26
42-48 month	101	Mean	**28.98**	**28.76**	**29.85**	**31.33**
		SD	4.29	3.44	5.34	2.50
48-54 month	117	Mean	**31.67**	**30.89**	**32.05**	**32.05**
		SD	3.27	3.06	3.59	2.98
54-60 month	86	Mean	**32.20**	**32.14**	**33.30**	**32.22**
		SD	1.83	1.16	1.42	2.12

*Sample size for this group was insufficient for an accurate representation.

Table 3. Reliability of the instrument.

Development area	Cronbach's α	Split-half correlation
Gross motor	0.97	0.78
Fine motor	0.96	0.79
Language development	0.97	0.88
Socioemotional development	0.96	0.73

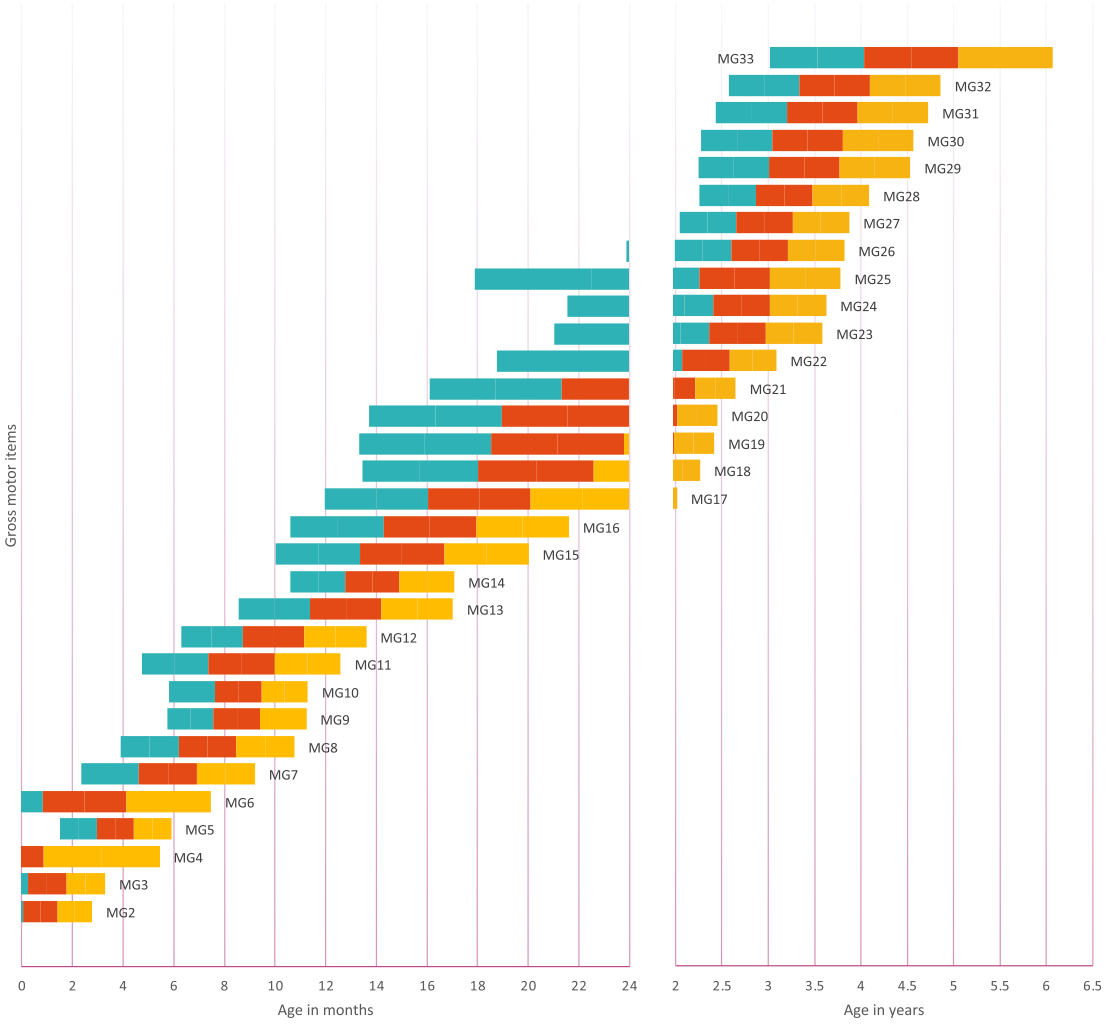

Figure 1. Age reference values for gross motor items. ***Notes:*** **MG1** Hold their head when carried; **MG2** Lift their chin off the floor; **MG3** From the prone position, they can lift their head to 90 degrees; **MG4** Support head when lifted by hands; **MG5** Flip over; **MG6** Raise head, shoulders, and chest from a prone position; **MG7** Start creeping; **MG8** Start crawling position; **MG9** Stand up with support; **MG10** Sits up unassisted; **MG11** Crawl with displacement alternating knees and hands; **MG12** Take steps with help; **MG13** Stand up unassisted; **MG14** Walk without help; **MG15** They crouch and stand up; **MG16** Walk well with cross-scroll; **MG17** Run, they may fall; **MG18** Throw ball; **MG19** Kick the ball; **MG20** Run showing coordination in their movements; **MG21** Run well, stops and start again without falling; **MG22** Jump with feet together; **MG23** Jump moving with both feet; **MG24** Stand on one foot for 3 seconds; **MG25** Stand on tiptoe with both feet; **MG26** Walk on tiptoe; **MG27** Walk in a straight line keeping balance; **MG28** Jump on one foot without support; **MG29** Can catch a ball with both hands; **MG30** Bounce and catch the ball; **MG31** Stand on one foot for 5 seconds; **MG32** Jump moving with one foot; **MG33** Jump alternating feet. The turquoise range signifies a probability of success between .25 and .50, the red range indicates a probability of success between .50 and .75, and the yellow range denotes a probability of success between .75 and .90. The y axis represents the distribution of the probability of success as explained by the color ranges.

Adjustment of items order presentation (second aim) and age references per item (third aim)

To complete the second and third aims, we conducted a logistic regression analysis on each item with independent variable age and dependent variable item success. The results show a good fit ($p < .05$), except for the first item in the gross motor area and three of the first four items in the language development area.

The item presentation order was determined by sorting the age at which each item had a .9 probability of success from the results of logistic regression analyses on each item. To describe the expected evolution of item success probability across age, we also determined the .75, .50, and .25 probability of success. We thus provided the range amplitude for each item's success predicted by age. Figures 1 to 4 contain a visual representation of sorted items and corresponding probabilities of success. Note that results are presented in two scales for the X axis: for the first two years, the X axis corresponds to age in months, and for the following age ranges, in years.

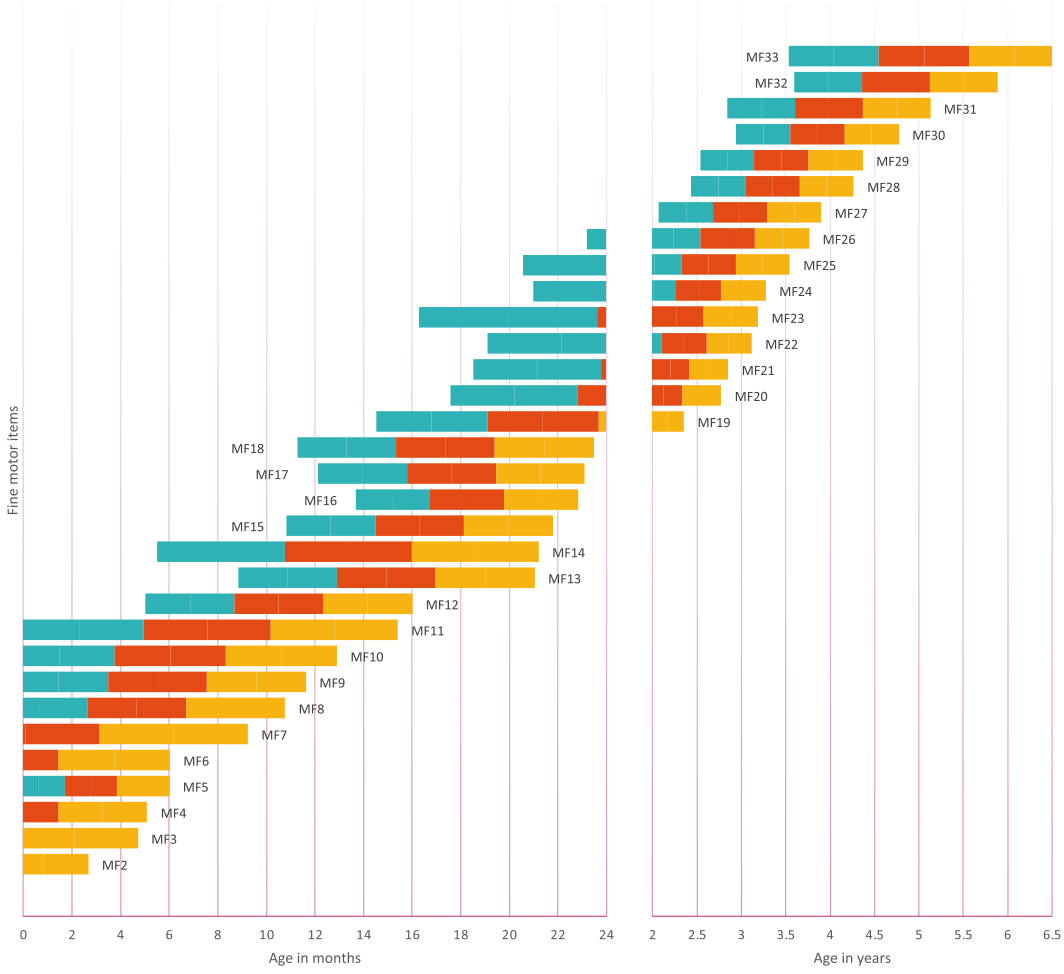

Figure 2. Age reference values for fine motor items. ***Notes:*** **MF1** Palmar grasp reflex; **MF2** Stare the midline; **MF3** Visually focuses on an object and tracks it horizontally; **MF4** Keep hands open when awake; **MF5** Hold an object in hand; **MF6** Show interest in putting an object in their mouth; **MF7** Visually focus on an object and follow it from top to bottom; **MF8** Grasp large objects voluntarily; **MF9** Hold an object in each hand; **MF10** Pass an object from one hand to another; **MF11** Pick up small objects as if their fingers were a rake; **MF12** Find the object under a blanket; **MF13** Put and take out objects from the container; **MF14** Grasp with thumb and forefinger (tweezers); **MF15** Pick up a spoon and brings it to their mouth; **MF16** Scribble; **MF17** Push a car; **MF18** Turn pages of a book; **MF19** Make a tower of two cubes; **MF20** Put nails on a board; **MF21** Make a tower of six cubes; **MF22** Make a ball of paper; **MF23** Tear paper with both hands; **MF24** Make shapes with putty; **MF25** Rotate hand to unscrew; **MF26** String; **MF27** Copy a horizontal and vertical line; **MF28** Copy a circle; **MF29** Copy a cross; **MF30** Know how to button and unbutton; **MF31** Color without leaving the outline of the drawing; **MF32** Draw a human figure; **MF33** Cut paper with scissors. The turquoise range signifies a probability of success between .25 and .50, the red range indicates a probability of success between .50 and .75, and the yellow range denotes a probability of success between .75 and .90. The y axis represents the distribution of the probability of success as explained by the color ranges.

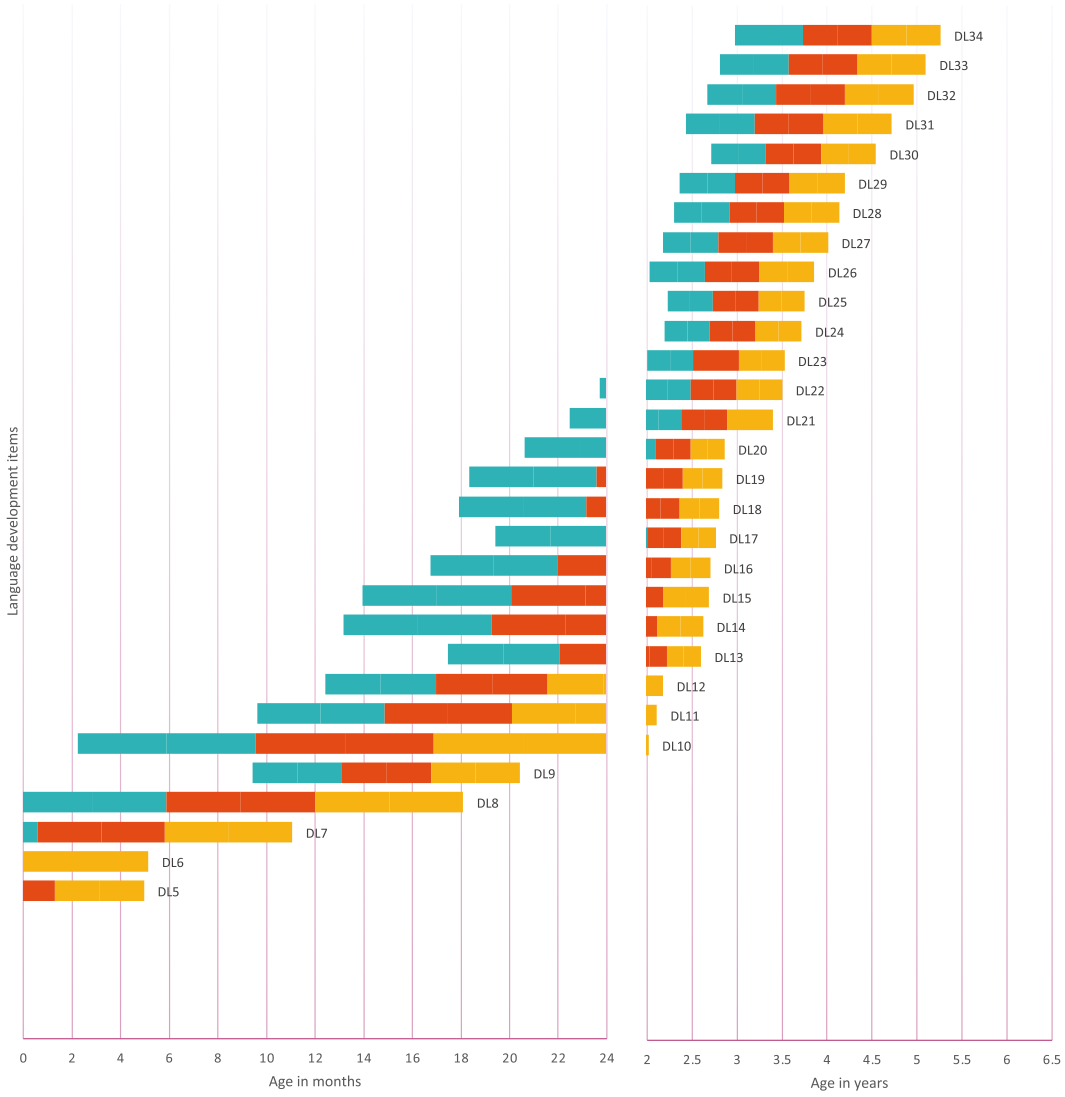

Figure 3. Age reference values for language development items. ***Notes:*** **DL1** Calm down when speaking to them; **DL2** Startle or jump in response to sounds; **DL3** Cry to express needs; **DL4** They laugh; **DL5** Make sounds with the throat; **DL6** Turn their head when they search for a sound; **DL7** React when called by their name; **DL8** Pronounce syllables like Ma, Pa, Ba, Ta; **DL9** Point with their finger when they want something; **DL10** Repeat the same syllable twice "Dada, Mama, Mimi, Tata, Papa, Yaya, Baba"; **DL11** Understand the meaning of the word no; **DL12** Follow one-step commands; **DL13** Follow two-step instructions; **DL14** Answer with yes or no; **DL15** Pronounce their first words with communicative intention; **DL16** Recognize at least 6 objects; **DL17** Point to 5 parts of their body; **DL18** Use a two-word phrase; **DL19** Say 6 words; **DL20** Say their name; **DL21** Know the use of three or more objects; **DL22** Can identify 10 objects by name; **DL23** Pronounce sentences of three words; **DL24** Use more than 15 words; **DL25** Use long sentences; **DL26** Know the qualities or characteristics of an object; **DL27** Pronounce the sounds of words correctly; **DL28** Describe the drawing; **DL29** Name at least three things in a category; **DL30** Recognize opposites; **DL31** Can count up to 5 or more objects; **DL32** Answer two comprehension questions; **DL33** Compare objects; **DL34** Tell a story from a sequence of images. The turquoise range signifies a probability of success between .25 and .50, the red range indicates a probability of success between .50 and .75, and the yellow range denotes a probability of success between .75 and .90. The y axis represents the distribution of the probability of success as explained by the color ranges.

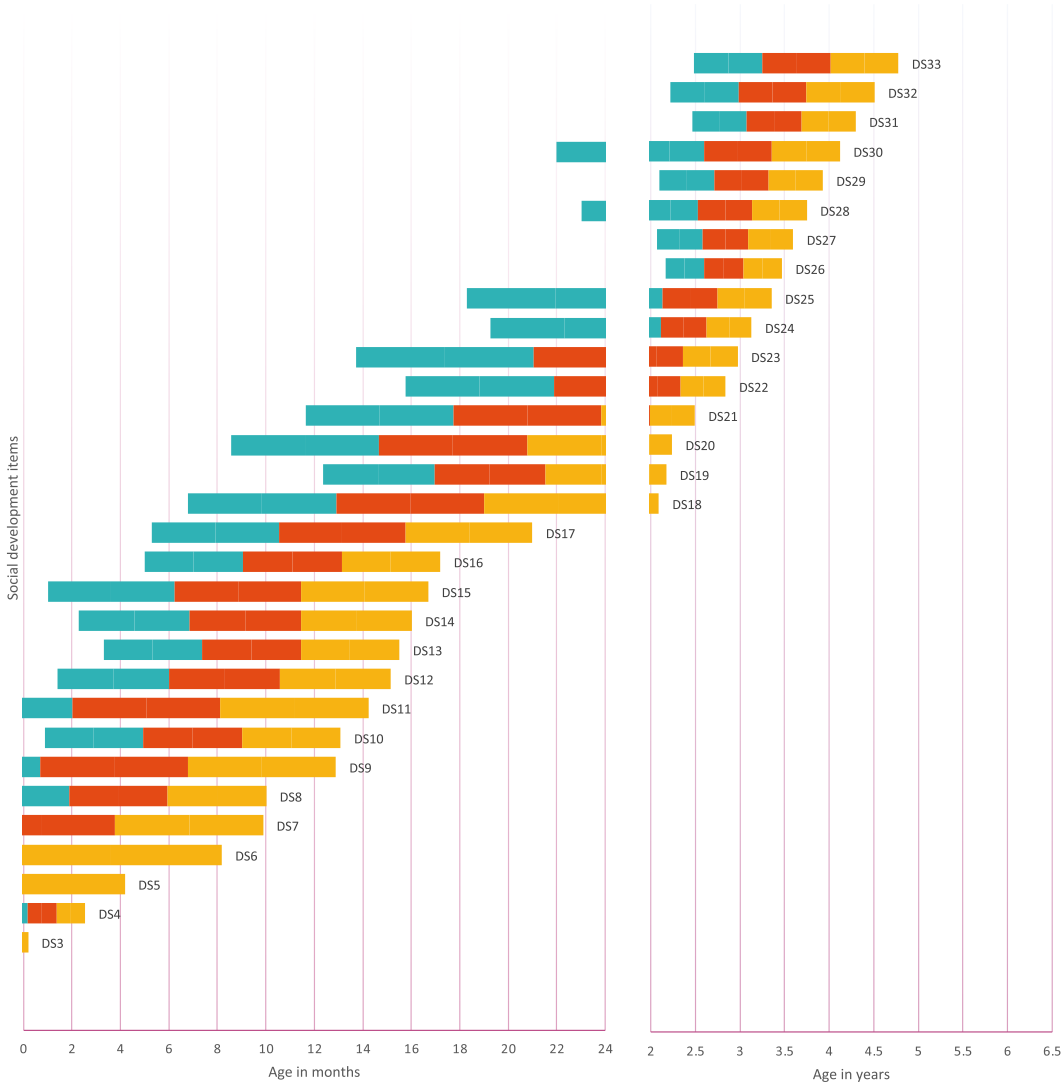

Figure 4. Age reference values for socioemotional development items. ***Notes:*** **DS1** Calm down with family members or caregivers; **DS2** Smile spontaneously; **DS3** Smile in response to a person; **DS4** Recognize the voice of the main caregiver; **DS5** Make eye contact; **DS6** Touch the examiner's hands; **DS7** They are aware of their hands (body); **DS8** Try to hold a cup when being fed; **DS9** Respond to a conversation; **DS10** Raise their arms or indicate that they want to be carried; **DS11** Laugh out loud; **DS12** Explore their face when they are in front of the mirror; **DS13** Show interest or intention to feed themselves; **DS14** Look for continuing the game; **DS15** Explore the environment; **DS16** Participate in games; **DS17** Wave or verbally greet; **DS18** Express their satisfaction when they achieve something; **DS19** Take a glass without spilling; **DS20** Imitate adult actions; **DS21** Recognize their belongings; **DS22** Express interest in playing with other children; **DS23** Symbolic game; **DS24** Refer to themselves as "I"; **DS25** Say the names of the people with whom they live; **DS26** They urinate or defecate independently without dirtying their clothes; **DS27** Indicate in some way that they need to urinate or defecate; **DS28** Identify basic emotions in images; **DS29** Come up with games; **DS30** Share their belongings; **DS31** Recognize basic emotions in themselves and express them verbally; **DS32** Recognize and express basic emotions in others; **DS33** Participate in games respecting rules and turns. The turquoise range signifies a probability of success between .25 and .50, the red range indicates a probability of success between .50 and .75, and the yellow range denotes a probability of success between .75 and .90. The y axis represents the distribution of the probability of success as explained by the color ranges.

Discussion

This paper collects evidence for the validity of SIMEDID, an electronic early childhood development screening tool adapted to the Dominican context conducted by INAIPI's personnel through an electronic application. Regarding the first aim, we found that the instrument has adequate psychometric properties: the instrument's subscales showed high internal

consistency scores, evidencing excellent reliability. Furthermore, total scores for each sub-scale increased progressively across age, which evidenced alignment with standards already provided by an expert panel (Alonso *et al.,* 2022) and criterion validity with a previous version of this instrument on a small sample size (Sánchez-Vincitore *et al.,* 2019).

Regarding the second aim, we found that age predicted item success in most items, which supports similar results in children from Malawi Gladstone *et al.* (2008, 2010). However, age did not predict four initial items from the gross motor and language development subscales. We attribute these null findings to the fact that our study did not include an acceptable sample size for the age group for which these items were relevant. This is because INAIPI's services to very young children were scarce at the time of this study, which will be considered for future studies. To comply with the third aim, age-standardized norms for each item were established, obtaining correspondences between ages and different probabilities of success for each item, which will allow comparing the achievement of participants with what is expected at their age.

Adapting this instrument to the Dominican context guarantees that cultural aspects of childrearing do not overshadow developmental scores (Suchdev *et al.,* 2017) and that development is not under or overestimated. Having the instrument in an electronic platform solves two main challenges. First, personnel training is kept to the minimum since the platform guides the evaluator throughout the evaluation, presenting the items that only pertain to the child according to their age, with suggested videos and additional testing resources. Second, having SIMEDID connected to INAIPI servers and incorporating the data on national services provided by INAIPI creates a continuous stream that otherwise would be costly and logistically convolute data. This data stream will allow the development of new research agendas that include correlational modeling, intervention studies, and longitudinal studies to understand better the factors associated with childhood development in the Dominican Republic in a timely and cost-efficient way.

The study findings demonstrate that SIMEDID passes three elements of a checklist of critical methodological elements to consider when appraising a childhood development assessment tool: (1) the instrument measures domains affected by the risk factor or intervention; (2) reliability and validity of the instrument in the population of interest; (3) sensitivity of the instrument to identify changes; (4) logistics and methodology is suitable for evaluating the outcome; and (5) consideration of control group (Sabanathan *et al.,* 2015). SIMEDID passes the first two elements from this checklist, as it measures specific domains of early childhood development previously identified as risk factors in the Dominican Republic, such as the sociodemographic and psychosocial factors that predict childhood development (Sánchez-Vincitore and Castro, 2022) and low levels of oral language comprehension in school-aged children that should be addressed during early childhood development before children enter primary school (Sánchez-Vincitore *et al.,* 2020, 2022) among other risk factors. In addition, it passes the fourth element, given that the logistic and methodology was specifically designed to assess the outcome in the Dominican context. Future studies will address the third and fifth items when SIMEDID is used as a monitoring tool on a population basis.

This study has some limitations that should be considered before its interpretation. Children from the sample for which these age standards were obtained received services at INAIPI. Socio-economic vulnerability is one of the main criteria for receiving such services. This means that the sample may not accurately reflect all children in the Dominican Republic since it comprises only those involved in INAIPI programs within the metropolitan region. During the study period, 77,000 children enrolled in INAIPI from the metropolitan region accounted for 1.23 percent of the total population of children ages 0 to 5. The limited sample size was influenced by the challenges posed by the COVID-19 pandemic, including restrictions and prevention measures. Future studies should consider the whole socio-economic position spectrum to obtain national norms. The data generated in the Dominican context using SIMEDID has limited comparability to data from other countries.

Another important limitation is that the experience of creating this platform in the Dominican Republic was cost-effective due to the already existing infrastructure within INAIPI, which should be considered when transferring it to other countries. The institution is the national administrator of early childhood services, which gives them access to the population of interest and trained personnel already working with children. In addition, INAIPI has the Division of Early Childhood Development Measurement, with dedicated personnel to designing, creating, supervising, and training the personnel in childhood development measurement. Also, INAIPI has a dedicated Information and Communications Technology Department, which developed the online platform and made it synchronized with SIGEPI, the national database for managing data from early childhood services. Further studies should conduct a cost-per-user analysis to evaluate its efficiency.

Finally, the study did not account for other relevant factors in childhood development, such as low birth weight and other health factors or disabilities. However, future data collection activities, which will involve a larger sample of children

from INAIPI, will consider variables such as birth weight, prematurity, and other health factors to determine cutoff points that better identify children at risk for developmental delays and to further understand the sensitivity of SIMEDID.

Additionally, we could not validate the initial items of SIMEDID given that INAIPI does not provide services to infants younger than 45 days, given that mothers are on maternity leave during that period. However, the research team is meeting other governmental institutions that work with infants that young to expand the age range of the study.

We have yet to demonstrate the tool's ability to sensitively identify changes, as this is the first large-scale data collection using this instrument. However, since SIMEDID is already part of the monitoring strategy, with constant data collection, it would be relatively simple to demonstrate its sensitivity to changes.

Even with these limitations, these results will allow the pertinent institutions of the Dominican Republic to implement and report more accurate early childhood development indicators. They will also contribute to creating a robust monitoring system with a high-quality data collection process that allows evidence-based and timely decision-making. Furthermore, such a system will contribute to generating longitudinal data that can establish the association between childhood development and sociodemographic and psychosocial variables and determine the impact of initiatives and interventions (Richter *et al.,* 2017), which is not sufficiently evaluated in most countries (Daelmans *et al.,* 2017).

In the future, SIMEDID will identify children at risk for developmental delays using data from a standardization study which will incorporate the item presentation order determined by the current validation study. Ensuring the appropriate order will narrow standard deviations, enabling the determination of developmental cut-off points at -1 and -2 standard deviations for different levels of developmental delay risk.

Although SIMEDID was created to be integrated into the services provided by INAIPI, and the instrument so far has only been administered to INAIPI beneficiaries, efforts to make a paper version of SIMEDID are on the way under the name of TADID (Tamizaje de Desarrollo Infantil Dominicano). This will allow other institutions, clinicians, schools, and pediatricians to use this validated tool at no cost.

Conclusion

This study provides compelling evidence for the validity and utility of SIMEDID, an electronic early childhood development screening tool adapted to the Dominican context. Demonstrating robust psychometric properties and high internal consistency, SIMEDID aligns with expert panel standards and exhibits criterion validity. Age-standardized norms enhance its precision, allowing nuanced assessments of developmental progress. The cultural adaptation addresses potential biases in childrearing practices. Future considerations include broader accessibility through the TADID paper version and the tool's potential contribution to generating longitudinal data for evidence-based decision-making. Overall, SIMEDID emerges as a promising and versatile screening tool with implications for both program design and individual monitoring of childhood development in the Dominican Republic.

In conclusion, this study provides evidence for the validity of SIMEDID, an electronic early childhood development screening tool adapted to the Dominican context, with adequate psychometric properties and age-standardized norms for each item. Adapting this instrument to the Dominican context ensures that cultural aspects of childrearing do not overshadow developmental scores. While SIMEDID is a screening tool and not intended for diagnosis, it offers valuable insights for caregivers and stakeholders, both at a group level for program design and decision-making, as well as at the individual level to monitor each child's progress.

Data availability

Underlying data

Open Science Framework: Database for Validation of the Dominican System for Measuring Early Childhood Development. https://doi.org/10.17605/OSF.IO/KW3B8 (Sánchez-Vincitore *et al.,* 2023b).

The project contains the following underlying data:

- Codebook SIMEDID.docx (names and values of each variable).
- Database – Validation study – SIMEDID.csv (database).

Extended data

Open Science Framework: Extended data - Validation of the Dominican system for measuring early childhood development. https://doi.org/10.17605/OSF.IO/SWN8C (Sánchez-Vincitore *et al.,* 2023a).

This project contains the following extended data:

- SIMEDID – Presentation order V2.xlsx. (Order of item presentation before and after data collection. Spanish and English translations)
- Extended data - COSMIN checklist.pdf

Acknowledgements

The authors sincerely thank Besaida Manola Santana and Penélope Melo Ballesteros for their exemplary leadership throughout the project. We also extend our heartfelt appreciation to the dedicated team of data collectors whose hard work and commitment to quality ensured the success of this study.

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Open Peer Review

Current Peer Review Status: ✗ ?

Version 1

Reviewer Report 31 August 2023

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Mphelekedzeni Caroline Mulaudzi
[1] University of Witwater'srand, Johannesburg, South Africa
[2] Paediatrics and Child Health, Charlotte Maxeke Johannesburg Academic Hospital, Johannesburg, Gauteng, South Africa

I commend the researchers for doing research in the area of instruments for early child development in low/middle-income countries.

Literature review

The researchers should have shared more on their initial work of adapting MDAT to the Dominican instrument and how it differs.

Methodology and statistical analysis

There is no description of the sampling technique used and no information on how they determined the population was normal

As far as whether the correct statistical analysis was done to meet the aims of the study.

There is clear information and a report on reliability but not validity.

Results

Figures should be labeled appropriately with an explanation of the range of colors' meanings.

The Y axis of the item should not only mention the domain but also what analysis

Discussion

Interpretation of the result is poor. The researchers gave results of the Chronbach alpha and split-

half correlation but did not elaborate on the relevance

They did not comment on how the instrument should be used in the future, especially with items that had a standard deviation that was higher than 3 and even some items that had a standard deviation greater or equal to 6.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Child health and Early Childhood Development

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 11 April 2023

https://doi.org/10.5256/f1000research.141269.r166639

Melissa J. Gladstone
Department of Women and Children's Health, Institute of Life Course and Medical Sciences, University of Liverpool, Liverpool, UK

This article provides information about the recent validation of a system for measuring child development in Dominican Republic.

This is quite a large study which provides some initial information as to how a new tool for measuring child development in the Dominican Republic is working. This is extremely laudable and very important. Tools such as this are required to ensure that better developmental surveillance can be done across countries globally.

I do have some reservations that could be addressed but presently the article is not in a fit state to publish. I outline these below.

Methods:

It is not clear if the tool has been adapted from the mentioned MDAT tool and whether it is parent report or directly observed or a mixture of the two. It is not clear if it needs a kit to support assessment or not. It is also not clear if there are any pictures or materials that have been created to support assessment. It is also not entirely clear if it has been piloted prior to this use.

The authors describe how the tool was reviewed by an expert pane to provide information on construct validity but also to revise the items and their definitions. The authors provide examples of items they modified but it is not clear what the initial item was. It might be helpful to have a list of items and what was and was not changed. It also might be helpful to use the COSMIN framework to clarify the various validation procedures to ensure they were done as would be recommended and if not, this could be discussed more in the discussion part of the paper.

Do the items have to be passed in succession? Can they move from one area to another within the app?

Methods

The authors describe that a Normative sample of children were assessed. Can the authors be clearer about how this is known. It looks like the children who were assessed were those who attended Comprehensive Care Centers for Early Childhood but it is not clear how much or little these represent the general population of children in the Dominican Republic. The authors do not make it clear if any other demographics were taken into account e.g. born prematurely? Birth weight? Adversities and sociodemographic status (maternal education), health status and frequency of admissions to hospital, nutritional status etc?

The authors describe the use of Cronbach's alpha internal reliability and "split half parallel reliability" but it is not clear if any reliability was done at the time of training and whether any quality control was done between examiners?

What did the 6 hour session for training consist of? And could it be clearer who did this and what is needed for the future? Were there online sessions? In person sessions? Any materials that were created? Certification of assessors?

Furthermore, could the authors provide more information about whether children were assessed with a disability and if not, how did they decide to exclude them? Can the present tool go down further to assess a child who is not performing? How did the team decide if they had a child that they felt was below the norm?

Discussion

The authors describe that age did not predict certain items. Is this because these items are not acceptable or work in the setting or is it because there were not enough children to assess these items? It seems the latter.

The authors conclude that the study passes three elements which include that it is reliable and valid. The authors may want to check the COSMIN criteria to make decisions on what reliability and validity they are describing as having definitively concluded on through this study. It is not clear that the authors have definitively shown that the tool can sensitively identify changes? Could they make that clearer and that they have demonstrated its use in another population who are known to have a problem through doing a Gold Standard assessment of these children.

Could the authors provide a little more information on what they plan to do with the info from this study? At the moment, it seems like it goes into a data collection system but what and how will they create “cut offs” decided for referral? These next steps are very important and could be provided more clearly for the reader.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
No

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
No

Are the conclusions drawn adequately supported by the results?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Neurodevelopmental Paediatrics and International Child Health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.