Validation of the Malawi Developmental Assessment Tool for children in the Dominican Republic

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Abstract

Background: This study initiated the validation process of a translated and adapted version of the Malawi Developmental Assessment Tool (MDAT) for children in the Dominican Republic (DR). Like Malawi before the development of the MDAT, the DR did not have early childhood development (ECD) tools explicitly designed for low-resource areas that are also valid assessments of child development. We chose MDAT because it underwent a rigorous validation process and retained measurements of test items that were culturally adaptable from the Denver Developmental Screening Test II. We aimed to test the internal consistency and inter-rater

reliability of the psychometric properties of the MDAT in children under the age of two years living in low-income neighborhoods in Santo Domingo in 2017.

Methods and Findings: Forty-two children from 2 to 24 months of age (mean = 11.26, SD = 6.37, boys = 22, girls = 20) and their corresponding caregiver participated in the study. We conducted a cross-sectional, pre-experimental study. The primary outcome measure was an index of ECD, as assessed by the Dominican adaptation of the MDAT. The tool evaluates children in four domains: social, fine motor, language, and gross motor. To determine internal consistency, we obtained Cronbach's alpha for each sub-scale. The results ranged from 0.89 to 0.94, indicating good consistency. Second, to test the interrater reliability, we conducted a Kendall's Taub test of independence for both the general scale and each sub-scale. Significant $r\tau$ scores ranged from .923 to .966, indicating appropriate interrater reliability. Third, we correlated the age variable with each subscale to determine if the development scale followed a progression of abilities that are expected to increase with maturation. The age variable correlated positively with all the subscales (social $r=.887$, $p < .001$; fine motor $r = .799$, $p < .001$; language $r = .834$, $p < .001$; gross motor $r = .805$, $p < .001$), indicating that the older the child, the better scores in the development measurements, as expected. There were no adverse events. This study, however, has multiple limitations. We did not gather information about socioeconomic position, which is an important variable when assessing child development; however, all participants lived in a low-income neighborhood. Given that this is the first ECD tool specific to the Dominican Republic, norm-referenced scores for the Dominican population do not yet exist. This study sample size is insufficient to make inferences about the national population.

Conclusions: This study represents the first attempt to obtain a valid tool to screen for development milestones in children living in poverty in the DR. More research is needed to

47 refine the instrument. The availability of the tool will enable impact evaluations of ECD
48 intervention programs and the development of evidence-based public policies in the DR.
49
50 **Keywords:** Early childhood development; poverty; early childhood development screening
51 tools; Dominican Republic.
52
53 **Introduction**
54 Developmental assessment or screening tools provide a standardized method of assessing
55 a child's neurological and musculoskeletal growth through the observation of the child's
56 performance of age and culturally-specific activities (1). The child is observed performing a set
57 of tasks associated with specific interrelated domains and evaluated based on direct structured
58 observations of the expected behavior, caregiver reports, or unstructured observation from
59 evaluators (2). As the assessment progresses, the child engages in activities of increasing
60 difficulty (2).
61 There are numerous benefits associated with the availability and use of developmental
62 screening tools. At the individual level, these screening tools help determine if a child is on track
63 in his or her development, identify interventions to compensate for any eventual delay, and
64 implement early interventions that help improve their health and educational outcomes (3). At
65 the program level, developmental screening tools are used as baseline and outcome variables in
66 impact evaluations to help determine a program's effectiveness (4). At the public policy level,
67 the use of screening tools helps guide the development of evidence-based health and education
68 policies (5).
69 Several tools have been created to measure early childhood development (ECD) in a
70 range of domains, standardized with large representative samples in places that have health data

readily available, piloted, and validated. These data-backed assessments of the tools' ability to assist health professionals in the measurement of ECD make them appropriate resources for assessing different aspects of child development in those locations (6). Despite the availability of these tools and their translation into a variety of languages, they may not necessarily be adequate to measure ECD in cultural and socioeconomic contexts for which the instruments were not specifically created. For example, a study in Chile adapted the Bayley-III developmental tool and validated it with a sample of children from higher socioeconomic position families, which was "representative of the private medical center where the study was conducted" (7). This shows that while the adapted screening tool was valid for that specific context, it was not necessarily applicable to lower socioeconomic position participants regardless of their shared geographic location and language. For this reason, it is essential to ensure that development tools are designed with the input of participating communities and validated with a sample representative of the specific population in which it will be used.

Children's development depends on multiple factors, including childrearing practices that are culture-specific. Therefore, using development tools without validating them in the cultural and socioeconomic context where they will be used can lead to an under- or over-estimation of ECD (8). Some experiences exist across the world of contextualized ECD screening tools for specific populations in India, Pakistan, and Zambia (9), Malawi (10), Sri Lanka (11), Cambodia (12), and Aboriginal Australia (13). These tools were designed and validated with as many culture-free items as deemed possible, but also with items that account for specific population characteristics of environments that are frequently not represented by the most commonly used developmental screening tools.

In addition to having a more culturally relevant measurement to assess ECD, it is necessary for these screening tools to be accessible for projects, programs, and research at the

national level. The accessibility guarantees the constant use of the instrument and the standardization of ECD measurement across projects. Therefore, commercial ECD screening tools used to measure development or to screen for developmental delay in children are expensive and are used mostly in clinical settings (14). Tools that can help health professionals in these areas identify at-risk children for developmental delays and assess if they are developing according to their age need to be available at low or no cost to the provider to maximize their use (6).

The purpose of our study was to test an ECD tool that could be used in the Dominican Republic (DR) at the community level in a resource-poor setting and no cost. The DR faces multiple challenges in educational attainment, as reflected by international educational reports, which show that Dominican students have the lowest scores from a subset of fifteen Latin American countries in reading, writing, and math in third and sixth grade (15). An early literacy national study conducted in 2015 showed that second graders had still not acquired basic literacy skills (16), partly due to low oral comprehension—a skill that the education system implicitly assumes the child has acquired before entering formal educational settings (17). On the other hand, no ECD testing tools have been developed specifically for the Dominican context, as the only ones that are used are available in private clinics, such as the Developmental Profile 3 (18) and the Denver Developmental Screening Test II (DDST-II) (19).

In our study, we aimed to test the internal consistency and inter-rater reliability of the psychometric properties of the Malawi Development Assessment Tool (MDAT) (10) in a group of children under the age of two years in the Dominican Republic. The MDAT is an ECD screening tool that focuses on a continuum of skills from four different domains—gross motor, fine motor, language, and social, with the purpose of identifying children with severe disabilities. Like Malawi before the development of the MDAT, the Dominican Republic does not have ECD

tools designed specifically for low-resource areas in the country that are also valid assessments of child development. After reviewing a variety of ECD screening tools, we chose the MDAT because it was developed for children ages 0 to 5 years, underwent a rigorous validation process informed by Malawian health workers and pediatricians, and retained measurements of test items that were culturally adaptable (6, 10) from the Denver Developmental Screening Test II (DDST-II) (19)—which is one of the most used instruments to assess child development in a short amount of time and that can be used by "anyone who works well with children and meticulously follows directions for administration" (6). These qualities are ideal for use in low-resource environments where many children must be assessed quickly and highly-trained health care workers are not available.

Methods and materials

Participants

Forty-two children from 2 to 24 months of age (mean = 11.26, SD = 6.37, boys = 22, girls = 20) and their corresponding caregiver—their mother in all the cases—participated in the study. We recruited study participants in Los Guandules and Guachupita, two neighborhoods of high economic deprivation in the Santo Domingo metropolitan area, the capital city of the DR. Inclusion criteria for the study were being a child from 0 to 24 months of age with a parent or guardian aged 18 years or older who understood Spanish—regardless of whether their first language was Spanish or Haitian Kreyol. Since our goal was to determine the validity of a tool that measures typical ECD, we excluded children with diagnosed developmental disabilities.

Volunteers from the Pastoral Materno Infantil (PMI), a Jesuit organization that promotes maternal and child health among low-income families throughout the Dominican Republic through trained community mobilizers who live in the community, recruited participants via

143 convenience sampling by a phone call from the pool of PMI beneficiaries. Once the community
144 mobilizers had identified a group of participants interested in the study, they gathered them and
145 brought them to the evaluation setting. The Institutional Review Boards from the Universidad
146 Iberoamericana (UNIBE) in Santo Domingo and Tulane University approved the study. We
147 obtained oral and written consent from the child's caregiver before data collection.
148
149 ***Instruments***
150 *Sociodemographic interview:* The interview consisted of three parts to assess
151 participants' background and their home environment: (a) information related to the child,
152 including prenatal and perinatal history, access to stimulating materials such as books and toys,
153 and interaction with other people such as singing, speaking, and storytelling; (b) information
154 about the primary caregiver, including level of education and the relationship with the child; (c)
155 general nutritional indicators such as the source of household's water for cooking, cleaning, and
156 drinking.
157 *Malawi Development Assessment Tool – Dominican version:* At our request, the MDAT
158 team provided us with materials to assist in our adaptation with thorough documentation of the
159 process they underwent to create and validate the tool. We translated the MDAT into Spanish
160 from English by first directly translating the MDAT and then reviewing this version with
161 community volunteers from PMI. As part of the assessment of the translation, we adapted the
162 tasks of the original MDAT to the Dominican context by accounting for different availability of
163 materials and participants' familiarity with certain activities. We named this new version of the
164 test MDAT-DR. The appropriateness of the choice of words used and tasks involved in the
165 MDAT-DR were informed by discussions with staff and volunteers from PMI.

166 The MDAT- DR consists of four subtests that assess development in four different
167 domains: social, fine motor, language, and gross motor. Each subtest contains a list of 34 items
168 of behaviors that progress in complexity. Each item is scored with categorical answers 0, 1, or 2.
169 A score of 1 is given if the evaluator observed the behavior, a 2 if the caregiver reported that the
170 child performs the task, and 0 for behaviors that were neither observed by the evaluator nor
171 reported by the caregiver as having been performed. The child's age determined the starting point
172 of each domain. Each item was tested and scored as "pass observed," "pass reported," or "fail."
173 We administered the items sequentially,. When the child failed to complete six tasks in a row,
174 the evaluator moved on to the next subtest.
175
176 ***Procedure***
177 Data collection took place throughout eight days in February 2017 at Centro Bonó—
178 another Jesuit center in the same sector of Santo Domingo. A group of nine evaluators conducted
179 the assessments in three separate rooms; two evaluators assessed each child and each of them
180 provided their own set of scores. These evaluators were clinical psychology undergraduate
181 students from UNIBE who had already completed research and ECD measurement courses. The
182 local principal investigator (PI), a neuroscientist, provided them with a 4-hour training on the
183 study protocol, participant protection, and childhood development, and supervised them when
184 interacting with participants to ensure participant safety and study integrity.
185 First, the evaluators conducted the sociodemographic interview with each caregiver using
186 a structured multiple-choice questionnaire that took approximately 10 minutes. Upon completion
187 of the interview, the evaluators administered the MDAT-DR under the supervision of the local
188 PI. Once the evaluators completed data collection, the data entry team consisting of UNIBE
189 undergraduate psychology students inputted the data, which were reviewed by the local PI. We

converted the data to a binary scale, with "fail" coded as 0 and both "pass reported" and "pass observed" coded as 1. By numerically adding the "pass" responses, each child received a score from 0 to 34 on a continuum for each subscale. We analyzed the scores for internal consistency and inter-rater reliability.

Results

Sociodemographic information

The age of the 42 children who participated in the study ranged between 2 and 24 months, as shown in Table 1.

Table 1: Age and sex distribution of children participants, Santo Domingo, 2017

Age (in months)	Female	Male
2	0	2
3	3	1
4	0	1
5	1	1
6	1	1
7	1	1
8	3	3
9	1	2
12	1	2
14	1	0
15	1	0
16	2	3
17	1	2
18	1	0
19	0	2
20	1	0
22	1	0
24	1	1
Total	20	22

According to their caregivers, 23.8% of the children were born with low birth weight, and 16.7% were born prematurely. When asked who was regularly in charge of caring for their children, most reported that the main caregiver was the mother, followed by mother and father,

and the mother and grandmother (see Table 2). The results show that 23.8% of the children's mothers had elementary education level, 64.3% had secondary school education level, and 11.9% attended college. Forty-one caregivers spoke Spanish as a first language, and one caregiver spoke Haitian Kreyol as a first language. All of the households used bottled water to drink; to cook, 21 used tap water, 19 used bottled water, and 2 used water bought from a delivery truck; for cleaning and bathing, all the households used tap water, and one used water from the *camioncito* [a water delivery truck].

Table 2: Frequency of primary caregiver in a sample of 42 children ages from 2 months to 2 years, Santo Domingo, 2017

Primary caregiver	
Mother	61.9%
Mother and father	16.7%
Mother and grandmother	11.9%
Grandmother	4.8%
Sister	2.4%
Mother and other	2.4%
Total	100%

Tables 3 and 4 depict the home background analysis, which includes access to stimulating materials and stimulating activities.

Table 3: Access to stimulating materials in children ages from 2 months to 2 years, Santo Domingo, 2017

Materials	**N**	**Min**	**Max**	**Mean**	**SD**
Books at home	41	0	2	0.3	0.656
Toys at home	37	1	20	6.3	4.235

Min = Minimum value; Max = Maximum value; M = Mean; SD = Standard deviation

221 Table 4: Access to stimulating activities in children ages from 2 months to 2 years, Santo
222 Domingo, 2017

Activities	N	%
% of children whose caregivers read stories	41	26.8%
% of children whose caregivers tell stories	41	48.8%
% of children whose caregivers sing to them	42	92.9%
% of children whose caregivers take them out for a walk	42	97.6%
% of children whose caregivers play with them	42	100.0%
% of children whose caregivers counts and name objects to them	42	85.7%

223

224 ***MDAT psychometric properties***

225 First, we analyzed the MDAT-DR's internal consistency to determine the degree to
226 which items within each sub-scale were correlated. We obtained Cronbach's alpha for each sub-
227 scale: social, gross motor, language, and fine motor. Table 5 contains general descriptive
228 statistics of each sub-scale, in addition to internal consistency data. Cronbach's alpha ranges
229 from 0.89 to 0.94, indicating a good consistency (20).

230

231 Table 5: Social, fine motor, language, and gross motor scales in children ages from 2 months to 2
232 years, Santo Domingo, 2017

Sub-scale	N	Min	Max	M	SD	α
Social	41	5	28	14.3	5.32	0.90
Fine motor	42	1	22	13.1	5.25	0.91
Language	42	3	23	10.0	4.20	0.88
Gross motor	41	1	27	15.3	6.27	0.94

Min = Minimum number; Max = Maximum number; M = Mean, SD = Standard Deviation; α = Cronbach's alpha

233

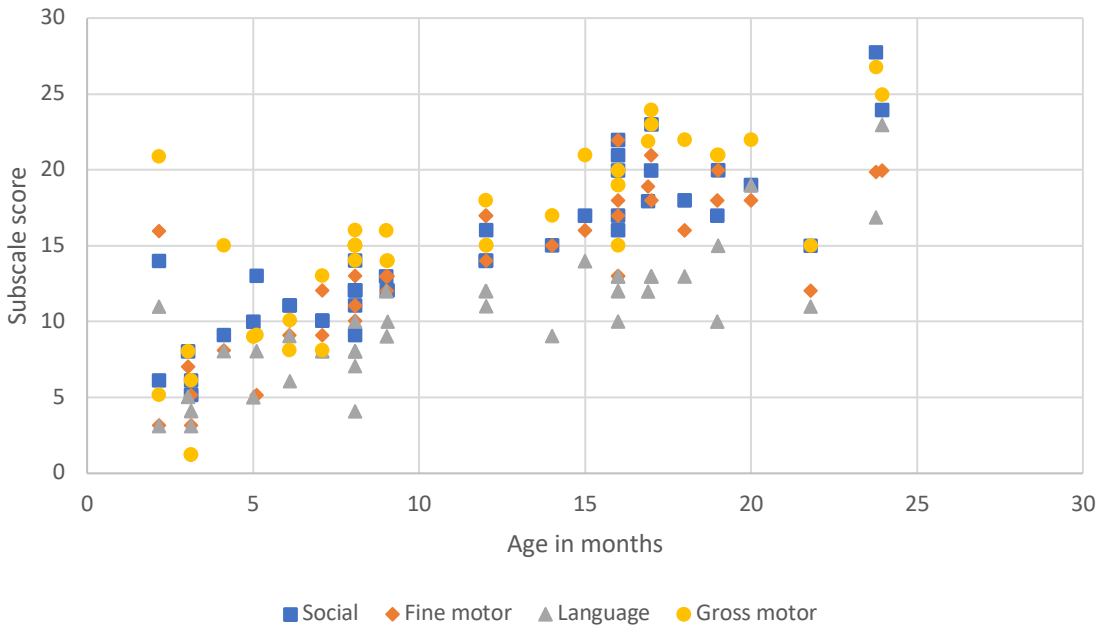
234 Second, to test the inter-rater reliability to ensure that multiple observers would obtain
235 similar scores, we conducted a Kendall's Taub test of independence for the general scale, as well
236 as for each sub-scale. Scores obtained by the first evaluator were not independent from scores

obtained by the second evaluator in any of the test (social $r_\tau = 0.953$, $p < 0.001$; fine motor $r_\tau = 0.923$, $p < 0.001$; language $r_\tau = 0.966$, $p < 0.001$; gross motor $r_\tau = 0.977$, $p < 0.001$; total $r_\tau = 0.954$, $p < 0.001$). Our interpretation of these results is that the scale has appropriate inter-rater reliability.

Correlations

We correlated the age variable with each subscale to determine if the development scale followed a progression of abilities that are expected to increase with maturation. The age variable correlated positively with all the subscales (social r=.887, $p < .001$; fine motor r = .799, $p < .001$; language r = .834, $p < .001$; gross motor r = .805, $p < .001$), indicating that the older the child, the better scores in the development measurements, as expected. See Figure 1 for a visual representation.

Figure 1: Age and developmental subscales correlation in 42 children ages from 2 months to 2 years, Santo Domingo, 2017



Discussion

The primary objective of this study was to determine the feasibility of using an adapted version of the MDAT in a community context in vulnerable areas of Santo Domingo, Dominican Republic. We evaluated children that were between 2 months and 2 years of age, since items in developmental scales in such early stages are less culture-dependent and, therefore, require minimal adaptations. We obtained measurements of internal consistency of the instrument, as well as inter-rater reliability, while informally assessing the logistics and methodology of the study.

The instrument showed appropriate psychometric properties, including good internal consistency and good inter-rater reliability. This high index on internal consistency indicates a low probability of measurement errors from the design and content of the test itself. Good inter-rater reliability index indicates instrument stability across observers. By reducing error variance, threats to internal validity are reduced. As expected in any developmental scale that follows a path in child development, we confirmed a progression of scores as children were older.

Regarding logistics, one of the main strengths of this study was the affiliation with the Pastoral Materno Infantil. We chose PMI because they have a history of engaging the community and providing services that enable them to access health services. By partnering with PMI, we respected the way in which the community engages the health system. The evaluation setting was a space that participants already knew and visited regularly, and the parents trusted the community mobilizers who invited them to participate in the study. It would be interesting to explore the possibility of training the community mobilizers in the application of the screening tool, increasing the benefit of this project to the community and making this a sustainable community-engaged project.

This study, however, has multiple limitations. While there was no language requirement for participation by either participants or their caregivers, we observed that the child of the one caregiver with more limited Spanish abilities did not perform as well as the other children. This is because some questions were directly asked to parents, and if the parent did not understand the questions being asked, the child's score could be affected negatively. Even though this was not common in this pilot study, for further studies in communities with immigrant populations, we recommend adding bilingual evaluators to the staff and additional translated materials to ensure appropriate representation of minority groups of languages.

The present study did not gather information about socioeconomic position, which is an important variable when assessing child development. The community coordinator and community mobilizers recruited participants from the same two neighborhoods, both of which include a large proportion of households under the local poverty line, but we did not take into account socioeconomic variability among the participants.

Because there are no available ECD tools specific to the Dominican Republic, there has been no developmental assessment on a national level. Therefore, we recommend the use of the MDAT-DR as an instrument to be used nation-wide to obtain norm-referenced scores for the Dominican population. The standardization of the scores would allow the use of the MDAT-DR for clinical and monitoring purposes at the community level. However, although developmental screening tools have the potential to infer about general development milestones, and probably detect children with significant impairments that require further testing, the use of screening tools may not be able to identify subtle developmental delays (2).

This study represents the first attempt to obtain a valid tool to screen for development milestones in children living in poverty in the Dominican Republic. More research is needed to refine the instrument, to have an available tool that is reliable and accessible to be used by health

workers, and that could be used in future studies on factors that affect or enhance early childhood development. The availability of the tool will enable impact evaluations of early child development intervention programs and the development of evidence-based public policies on early childhood development in the Dominican Republic.

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