



Cambodian Developmental Milestone Assessment Tool (cDMAT): Performance reference charts and reliability check of a tool to assess early childhood development in Cambodian children

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ABSTRACT

Background: Childhood development milestones are essential skills that define how children participate in their environment socially, physically, and intellectually. A culturally-sensible and environmentally-appropriate tool is needed to assess their performance and detect disabilities at an early stage.

Method: This observational study aimed to create reference charts of performances among healthy rural and semi-rural Cambodian children aged 0–83 months for each milestone using the Denver II-based Cambodian Development Milestone Assessment Tool (cDMAT). Inter-observer reliability testing yielded Kappa scores.

Results and conclusion: 1330 children included in the analyses represented an average population sample with similar gender balance, expected poverty distribution and the illiteracy rate among their mothers (81% with no or attended < 7th-grade education). While gender, poverty and the mother's education level were not found to be confounding factors, the child's school enrolment status was ($p < 0.005$). The performance reference charts document the PASS ratios from which age onwards < 25%, 25–75%, 75–90%, 90–99% and 99–100% of the children in each monthly cohort can perform a particular milestone. The mean inter-observer reliability ranged from substantial (Kappa 0.61 for delay) to excellent (Kappa 0.84 for immediate) in all domains. The performance reference charts of a culturally-sensible and environmentally-appropriate cDMAT can be used in Cambodia with special attention given to the child's school enrolment as it was found to be a confounding factor affecting child development. Creating a small-scale pilot program linking the cDMAT to early intervention would help raise awareness and create local expertise on early childhood development.

1. Introduction

The WHO World Report on Disability estimates that 93 million children between age 0–14 years old experience moderate or severe disability worldwide [1]. According to the WHO, disability is the 'umbrella term for impairments, activity limitations and participation restrictions' that impact the interaction between individuals and their environmental and personal factors [1]. In Cambodia, between 9.6 and 10.5% of children aged 2–9 years old have a disability [2]. For these children, early detection and intervention can help to improve their lives and reduce the severity of their limitations [3].

Childhood development milestones are essential skills that define how children participate socially, physically, and intellectually. Due to varying cultural, language and environmental factors, performance reference charts used for assessing children may differ across countries and ethnic populations. Nevertheless, there are different ways to measure a child's

functionality to detect disability, one of which is using a developmental milestone assessment tool [4]. Children should be able to perform essential tasks that are progressively more complicated and develop a set of skills as they grow up. These developmental milestones mark their age-appropriate abilities that most children in their similar age group can perform. Social/personal (SO), fine motor (FM), language/cognition (LA) and gross motor (GM) milestones need to be assessed frequently for early detection of potential developmental delays. In turn, early detection allows for timely intervention, such as stimulation exercises and medical interventions [3]. Early detection of delays relies on the availability of performance reference charts that are based on a reliable screening tool.

To facilitate early identification of disability, we need an assessment tool that is culturally, linguistically, and environmentally appropriate, which this study aimed to do. For low-income countries, including Cambodia, the lack of cultural and language-specific tools for identifying and characterizing disability can be problematic [5]. Various

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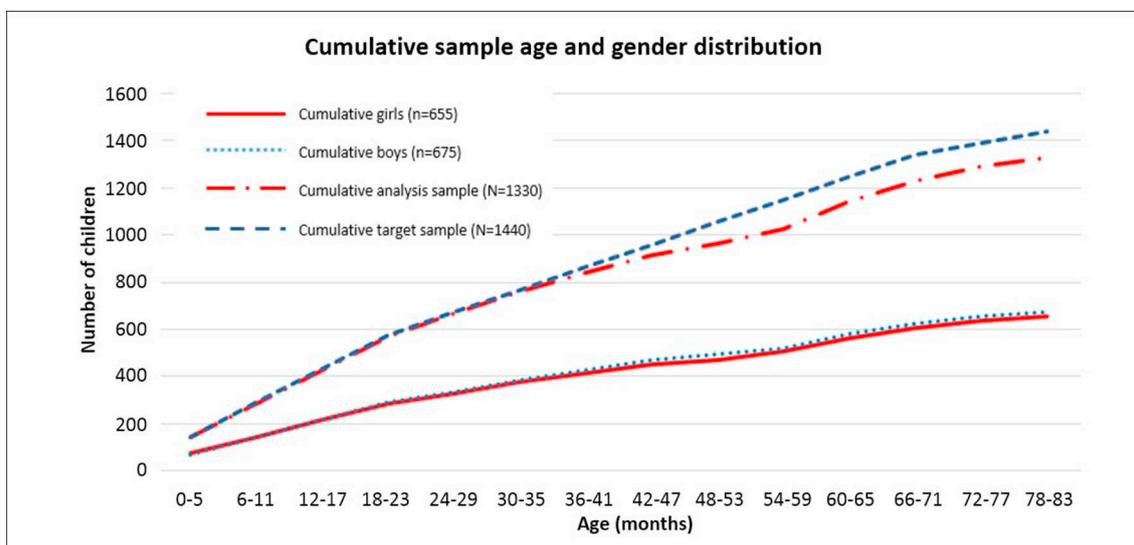


Fig. 1. Cumulative sample age and gender distribution.

Table 1
Age and gender composition.

Age group (months)	Girls, n	Boys, n	Total, n
0-5	71	70	141
6-11	71	74	145
12-17	71	72	143
18-23	69	73	142
24-29	47	47	94
30-35	46	46	92
36-41	39	43	82
42-47	34	42	76
48-53	23	27	50
54-59	34	27	61
60-65	56	60	116
66-71	44	45	89
72-77	30	30	60
78-83	20	19	39
Total	655	675	1330

studies in different populations have shown that direct application of predominantly western tools and their performance reference charts can be inappropriate and invalid [6–13]; for instance, the Khmer language has no plural form of a word. The notion that Cambodia needs its own population-specific developmental screening tool had been explored in studies conducted at a children hospital in Siem Reap province [14]. In these studies, the author observed that 25% and 31.5% of children at the Angkor Hospital for Children in Siem Reap failed to achieve one or more age-appropriate developmental milestones, respectively. These results prompted the author to caution that any referral for ‘further evaluation, parental education/support, early childcare and early intervention’ needs to be based on studies of more culturally-accurate milestones, particularly in low- and middle-income countries, like Cambodia [14]. In response, Ngoun and colleagues created and piloted a culturally-adapted assessment tool for Cambodian children that has since been renamed to the Cambodian Developmental Milestone Assessment Tool (cDMAT) [3]. The overall purpose of the cDMAT observational study was to create performance reference charts for a country-specific developmental milestones assessment tool.

2. Methods

2.1. Study process

The presented prospective, observational study was designed to create reference bar graphs (charts) of performances among healthy Cambodian

Table 2
Basic characteristics.

Characteristic	N	%
Total children analysed	1330	100
Geographic origin (districts)		
Stoung	657	49.4
Chi Kreng	344	25.9
Sout Nikom	293	22.0
Siem Reap	36	2.7
Poverty status		
Not poor	1142	85.9
Poor	188	14.1
Mother education		
Attended no school	311	23.4
Attended grade 1–6	777	58.4
Attended grade 6+	242	18.2
Child education (school age 48–83 months, % of total 415)		
No school enrolment	81	19.5
Pre-school enrolment	220	53.0
Primary school enrolment	114	27.5

children for each of the cDMAT milestones (140 milestones) [3]. Pre-study activities included protocol and screening manual preparation, describing steps on how to assess the milestones to facilitate consistent data collection. A two-day training-of-trainers workshop was conducted prior to the start of recruitment. The trainers refers to the supervisors who supervised the assessors. The assessors were 12 nurses from local health centers and 12 pre-school teachers in rural and semi-urban districts who had been engaged previously in training on disability screening and inclusive education techniques. Inter-observer reliability tested how different assessors/observers rate the children's performances during the same assessment (immediate reliability) and second assessment by another group of assessors (delayed reliability). Focus group meetings were held to discuss the findings and to obtain the consensus on how to improve the cDMAT. Participants at the focus group meetings were national and international pediatricians, physiotherapists, social workers, psychologist, speech therapist, and health care workers – all with local expertise in child development.

2.2. Participants

Signed consent from parents was obtained before the commencement of the assessment. The study intended to recruit 1440 children from four

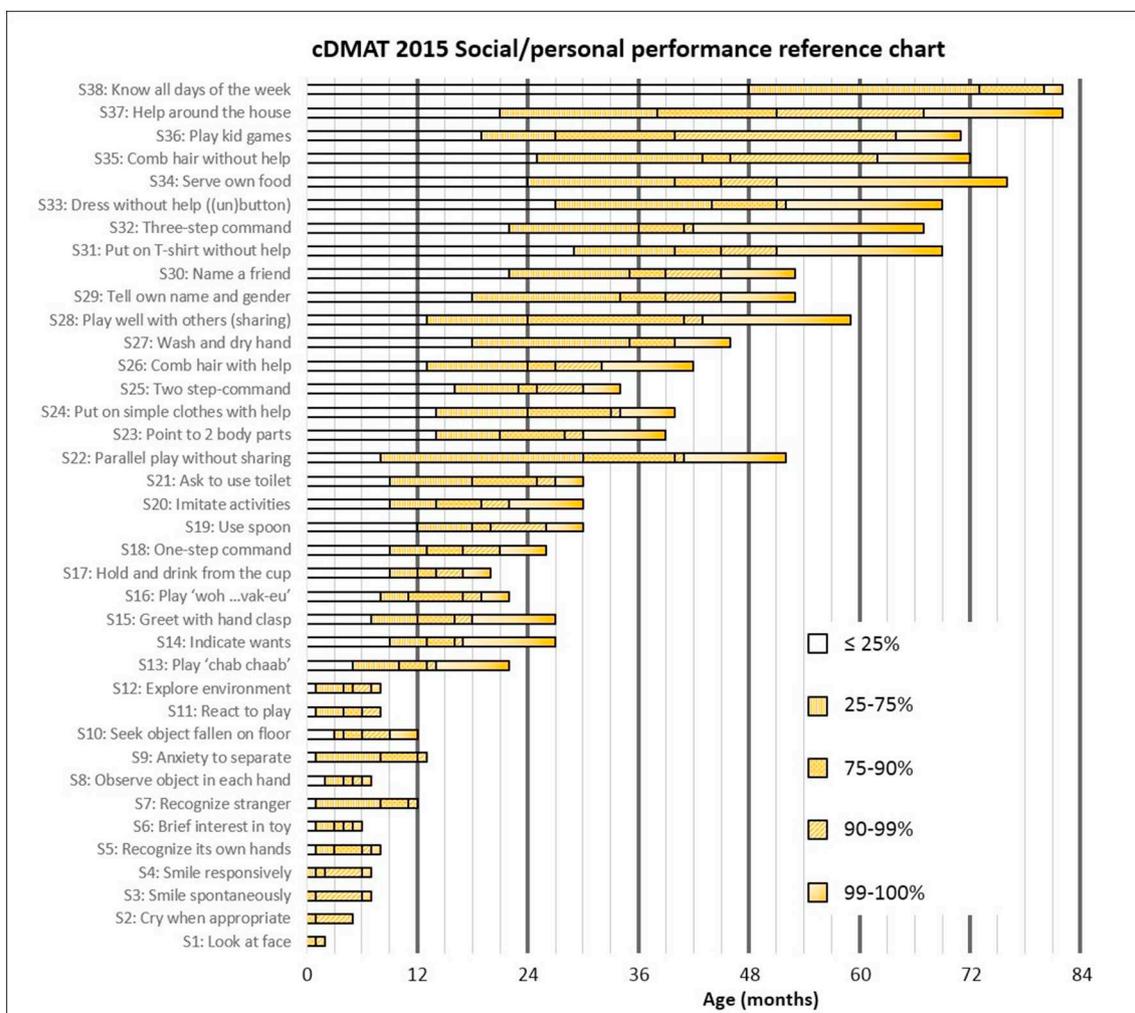


Fig. 2. Performance reference charts showing social/personal domain of PASS performances.
 Footnote: The white box shows the range of performances passed by ≤ 25% of the children. The vertical color pattern box shows the range of performances passed by 25–75% of the children. The dotted pattern box shows the range of performances passed by 75–90% of the children. The skewed line pattern box shows the range of performances passed by 90–99% of the children. The gradient pattern box shows the range of performances passed by 99–100% of the children.

districts (Sout Nikom, Chi Kreng, Siem Reap, and Stung) in two provinces (Siem Reap and Kampong Thom), pending on the availability of a pre-school within their commune. The sample size was based on a study conducted in Malawi with a similar aim – to create performance reference charts for a country-specific assessment tool [13]. A quota sampling technique was used to determine the number of children to be surveyed, following the design of the Malawi study [13]. The targeted numbers of children for 34 different monthly age groups were: 24 one-monthly age cohorts with 24 children each aged below two years (0–23 months completed age), 8 six-monthly age cohorts with 96 children each aged between 2 and < 6 years, and 2 six-monthly age cohorts with 48 children each aged between 6 and < 7 years. The study intended to recruit an equal number of boys and girls. Only children who met the following additional criteria were included: healthy (without chronic illness, not taking medication), well nourished with WHO -2Z-score or above [15], without disability, and from native Khmer speaking families. A maximum of two children from one family and only one of the twin children were included. Each assessment team (assessors) used the age and gender criteria to reach the planned sample frame.

2.3. Assessment

All assessors were given the protocol and screening manual (Khmer and English versions), cDMAT milestone registration forms containing

the 140 milestones and demographic information, and a toolkit containing props to be used during the assessment. Four supervisors oversaw and participated in the data collection process.

The assessments were conducted at the children's homes because they would be less distracted in a familiar environment and therefore performed their skills to their real abilities. They were assessed starting from a very early milestone for their age according to the following domain order: SO, FM, LA and GM milestones. This order was selected to ease the assessment by allowing time for the child to familiarize and interact with the assessor. For the assessment of each domain, a child had to pass at least four milestones consecutively at the start of the assessment, either by demonstration or by caregiver reporting. Once the child had failed four milestones consecutively, the assessment would end [16].

For the inter-observer reliability testing, each of the 140 milestones were assessed using the same quality assurance measures by four teams of assessors, each with four to six observers (nurse/pre-school and teacher/trainer) in 22 children during the same exercise of stimulating the child to perform by one team member (immediate reliability). Inter-observer delayed reliability was set to re-assess for the same children independently on the same day during another assessment by another team.

2.4. Analysis

Data from both the observational study and reliability testing were

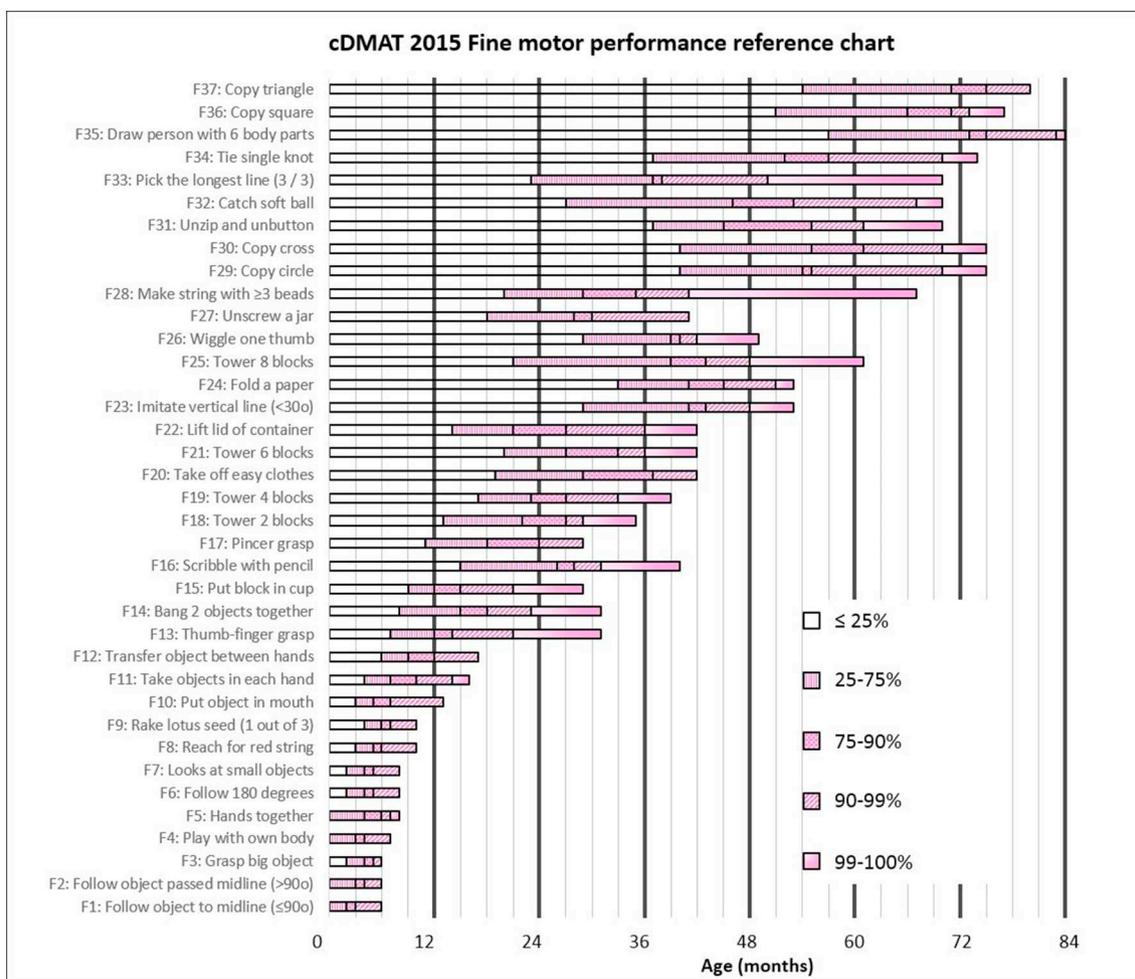


Fig. 3. Performance reference charts showing fine motor domain of PASS performances.

Footnote: The white box shows the range of performances passed by ≤ 25% of the children. The vertical color pattern box shows the range of performances passed by 25–75% of the children. The dotted pattern box shows the range of performances passed by 75–90% of the children. The skewed line pattern box shows the range of performances passed by 90–99% of the children. The gradient pattern box shows the range of performances passed by 99–100% of the children.

analysed in SPSS 18. The *t*-test was used for identifying significant difference for confounding factors (sex, school enrolment, family poverty, and mother’s education level) between mean ages for failing and for passing each milestone in the total cohort, in combination with the Levene’s test for assessing the probability for the equality of variances. For the reliability study, confidence intervals (CI) for the individual Kappa values were improved statistically by a bootstrapping process, where all the paired observations had been taken at random for 1000 times. The assessment methodology and PASS/FAIL criteria were refined for milestones with a weaker reliability score. The order of the milestones within the domain was later re-ranked to the performance in this study.

3. Results

3.1. Demographics and basic characteristics

1440 children were recruited, of which 110 (8%) were excluded from analysis because of errors in their age calculation during the data collection, resulting them to be too light or stunted for their age. Therefore, a sample of 1330 children was included in the analysis set with the mean age of 36.4 months. Although the reduction of the sample size did not create any gender inequality (51% boys, 49% girls) (Fig. 1, Table 1), it gradually increased in the sample size gap between the children aged 36 and 59 months, but compensated by the over-representation of children aged between 60 and 65 months. The age calculation also meant that

there were relatively few children close to their 7th birthday (78–83 months), which influenced the focus group’s decision to recommend removal of complex milestones from the final cDMAT.

Nearly half (49%) of the families resided in Stoung, 26% in Chi Kreng, 22% in Sout Nikom and 3% in Siem Reap districts. The majority (86%) of the families were considered ‘not poor’ following their official poverty status according to the government’s Identification of Poor Household’s Programme (IDPoor), which was based on a proxy-mean testing by assessing observable household characteristics and assets [17]. The poverty rate of the study population resembles that of the national rate.

More mothers attended grade 1–6 (58%) than grade 7 or higher (18%), and those with no schooling (23%). Among school-age children (48–83 months), 81% were enrolled in pre- or primary school (Table 2).

3.2. cDMAT results

Respecting the four consecutive PASS/FAIL rule, on average, 47 milestones per child and 10–13 milestones per domain were assessed. Each milestone was, on average, assessed four times as failed and nine times as passed. The duration of the assessment per child differed between 15 and 40 min, depending on the number of milestones assessed.

Figs. 2–5 illustrate the reference bar graphs for the PASS performances of the 1330 children for each of the 140 milestones (38 SO, 37 FM, 33 LA, 32 GM). These performance reference charts illustrate and document, by domain, the PASS ratios for each milestone from which age

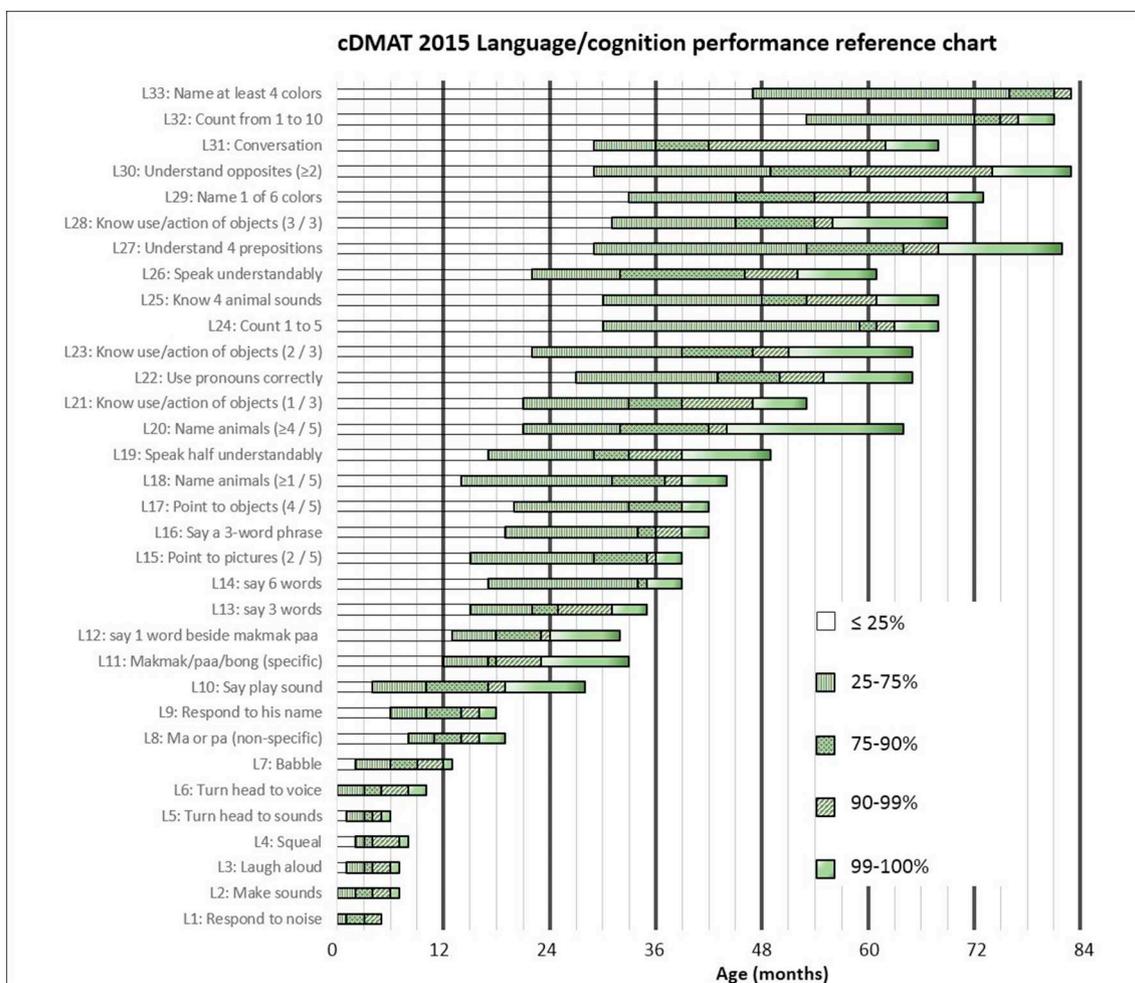


Fig. 4. Performance reference charts showing language/cognition domain of PASS performances.
 Footnote: The white box shows the range of performances passed by ≤25% of the children. The vertical color pattern box shows the range of performances passed by 25–75% of the children. The dotted pattern box shows the range of performances passed by 75–90% of the children. The skewed line pattern box shows the range of performances passed by 90–99% of the children. The gradient pattern box shows the range of performances passed by 99–100% of the children.

onwards at least 25% of the children in each monthly cohort can perform a particular milestone. This is indicated by the first black vertical dividing line between the white box on the left (0–25%) and the next box with vertical color pattern (25–75%). The box with the dotted pattern shows the ages between which 75–90% PASS of the children in each monthly cohort. The box with the skewed line pattern indicates between 90 and 99% until virtually all children PASS the milestone, excluding the very late failures (99%: < 1% of the cohort assessed for that milestone). The last box on the right with a gradient pattern shows those ages at which occasionally (< 1%) a child still might fail the milestone.

With significant differences (p -value < 0.005), children with a history of school enrolment (pre- and primary school) failed 21 and passed 14 milestones at a younger age averagely than those who were not enrolled in a school. This indicates that (pre-) school enrolment stimulates children to pass milestones at a younger age (Tables 3–4). Gender, mother’s education and poverty were not found to be significant confounding factors for child development (p -value < 0.005).

3.3. Reliability results

The inter-observer reliability was assessed in four assessment teams, examining 22 children: ten girls and ten boys were assessed twice on the same day, each time by a different team (each team with one assessor and five observers). One girl and one boy aged 1 month were assessed once because they needed to rest. Table 5 shows the inter-

observer reliability for passed/failed milestones assessment, based on pairs of two observers. In all domains, the immediate inter-observer agreement was excellent (mean Kappa 0.84 [95% CI 0.77–0.92]), and the delayed inter-observer agreement was substantial (mean Kappa 0.61 [95% CI 0.51–0.7]) [18].

3.4. Focus group results

Focus group meetings were held to discuss the cDMAT results. At the final meeting, the focus group recommended removal of the following milestones for the future version of the cDMAT: two SO, four FM, four LA and one GM (Table 6). One of the reasons for the removal was that some children failed in performing eight of the complex milestones in the age brackets between 78 and 83 months (two SO, two FM and four LA). Since the study included only children up to the age of 83 months, it could not assess the milestone performance beyond that age. Another reason was the similarity of different milestones, which resulted in similar performance curves (four FM, two GM; Table 6). Removing these “redundant” milestones would also lessen the workload of cDMAT assessments. Based on the consensus of the focus group, 11 milestones were removed in the revised cDMAT version.

The hierarchy (order) of the milestones was adjusted to the local performance, ranking it by the sum of the monthly age at which 25, 75, 90 and 99% of the children can perform the milestones. The revised performance reference chart with the 11 milestones removed (Table 6)

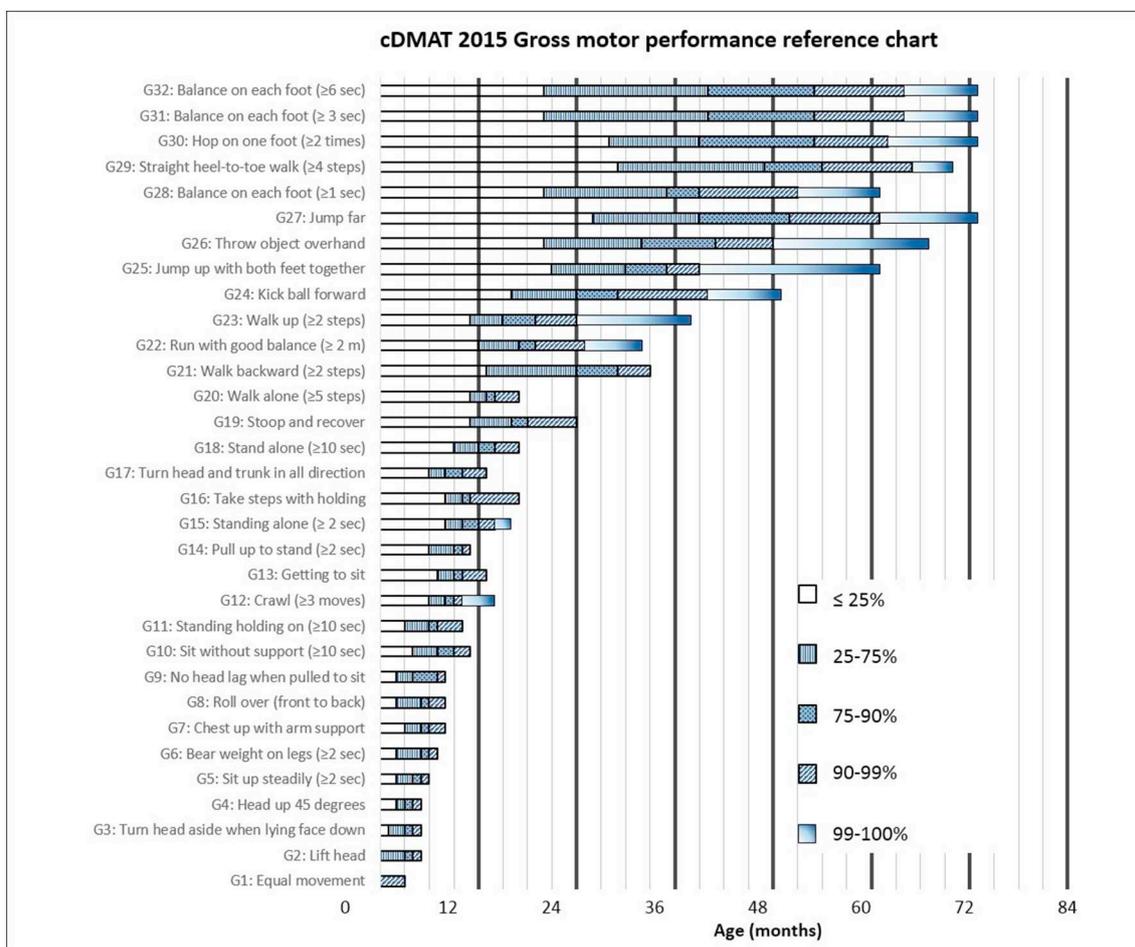


Fig. 5. Performance reference charts showing gross motor domain of PASS performances.

Footnote: The white box shows the range of performances passed by ≤ 25% of the children. The vertical color pattern box shows the range of performances passed by 25–75% of the children. The dotted pattern box shows the range of performances passed by 75–90% of the children. The skewed line pattern box shows the range of performances passed by 90–99% of the children. The gradient pattern box shows the range of performances passed by 99–100% of the children.

can be found in the Supplementary Material of this article (Figs. Supp A, Supp B, Supp C and Supp D).

4. Discussion

There are several observations in the cDMAT results that are consistent with the assessment tool findings in other countries such as in Denver II [16] and Malawi [13] tools. In contrast to other domains, the relatively fast development of GM skills can be observed in all children who were assessed in the cDMAT study. The cDMAT also confirmed the gradual increase in the width of the age window (25–90%) the higher in the hierarchy the milestone gets within each domain. The cDMAT has seven milestones where the 90% age cohort is above 6 years old (one SO, two FM, and two LA milestones) compared the Denver II (one FM and one LA milestones) [16] and the Malawi findings (one SO, one FM, three LA and two GM milestones) [13]. This difference indicates that performance for individual milestones is country-specific, which confers with the Malawi findings [13].

While developmental assessment tools in other countries only report up to 90% PASS ratios [13,19], the cDMAT showed that for some milestones, there is a significant age window between 90 and 99% and/or between 99 and 100% (Figs. 2–5). In all domains, many 25, 75, 90, 99 and 100% performance scores were achieved later or earlier for some milestones than the milestones directly bordering them. Therefore, the cDMAT performance reference charts show, that the milestone hierarchy within the domain does not sufficiently reflect the sequence Cambodian children averagely obtain the different milestones within each domain.

The significant gap between 90 and 99% shows why it is important to include 99% in the performance reference charts. While it makes sense to be alerted when a child is among the last 10% of its healthy, well-nourished age-peers to fail a milestone, the number of referrals would easily overburden professional health and social service providers in Cambodia. We therefore, initially proposed to use the 99% PASS value as referral criteria for professional assessment and initiating stimulation games. Once there is enough capacity created at the community level for stimulation exercises, we could envisage advising referral and stimulation games as an early intervention when the child still fails when passed the age of the 90% month cohort performance.

The observational study only checked the rural and semi-urban performance of Khmer children. However, compared to the provincial averages in the Demographic Health Survey 2014 [20], the demographic characteristics of the study cohort were within the expected range for those living around the Tonle Sap lake (Sout Nikom, Chi Kreng, Siem Reap, and Stung). Child development also differs within a country, between urban and rural areas or among different ethnicities because of the exposure to different environmental factors. It is, therefore, obvious that reference charts need to be used with caution [21] as they do not substitute a professional assessment and are referral criteria only. The child functional performance depends on its environment, e.g. the child school enrolment may play a role in the milestones passed/failed performance as a confounding factor. The study highlighted the need to develop local reference charts and to consider the child's environment when diagnosing developmental delays [3,13].

Table 3
Younger mean age to FAIL the milestone among children with vs without school enrolment.

cDMAT milestone 2015	N	Mean age (month) for school enrolled children					
		With school	Without school	FAIL difference	95% confidence interval	T-test equality of means, P-value*	Equality of variances**
S38: Know all days of the week	215	60	64	3	1–5	0.0006	Rejected
F29: Copy circle	75	54	63	9	6–12	0.000000	Rejected
F30: Copy cross	66	53	63	10	7–14	0.000000	Rejected
F31: Unzip and unbutton	26	48	65	18	12–24	0.000004	Rejected
F32: Catch soft ball	37	52	64	12	8–17	0.000007	Rejected
F34: Tie single knot	49	54	64	10	6–13	0.000002	Rejected
F35: Draw person with 6 body parts	242	60	64	4	2–5	0.000016	Rejected
F36: Copy square	145	57	64	7	5–8	0.000000	Rejected
F37: Copy triangle	198	59	64	4	3–6	0.000000	Rejected
L22: Use pronouns correctly	18	45	63	18	7–28	0.0031	OK
L23: Know use of objects (2/3)	9	43	63	19	9–29	0.0032	Rejected
L24: Count 1 to 5	35	49	63	14	10–18	0.000000	OK
L25: Know 4 animal sounds	25	46	63	17	12–22	0.000000	Rejected
L27: Understand 4 prepositions	59	55	63	8	5–11	0.000014	Rejected
L29: Name 1 of 6 colors	54	55	63	9	5–12	0.000036	Rejected
L32: Count from 1 to 10	184	59	64	5	3–7	0.000000	Rejected
L33: Name at least 4 colors	218	62	64	3	1–5	0.0024	Rejected
G27: Jump far	26	47	64	16	9–24	0.0003	Rejected
G29: Straight heel-to-toe walk (≥ 4 steps)	36	50	64	14	9–19	0.000002	Rejected
G31: Balance on each foot (≥ 3 s)	27	51	64	12	4–21	0.0049	OK
G32: Balance on each foot (≥ 6 s)	30	51	64	13	6–19	0.0003	Rejected

Fxx = fine motor milestone; Gxx = gross motor milestone; Lxx = language and cognitive milestone; Sxx = social and personal milestone;

* Only milestones with t-test for equality of means with p-value ≤ 0.005 are shown.

** Levene's test (p-value < 0.05 means the equality of variances is rejected): the p-value is used for the t-test when equality of means has not been assumed.

Table 4
Younger mean age to PASS among children with school vs without school enrolment.

cDMAT milestone 2015	n	Mean age (month) for school enrolled children					
		With school	Without school	PASS difference	95% confidence interval	T-test equality of means P-value*	Equality of variances**
S27: Wash and dry hand	27	47	66	19	8–30	0.0014	OK
S28: Play well with others (sharing)	75	49	62	13	10–16	0.000000	OK
S29: Tell own name and gender	152	53	63	10	9–12	0.000000	Rejected
F25: Tower 8 blocks	102	52	63	11	9–13	0.000000	Rejected
L18: Name animals (1/6)	26	45	63	18	13–22	0.000000	Rejected
L19: Speak half understandably	25	46	63	16	9–24	0.0003	OK
L20: Name animals (4/6)	79	49	62	13	10–16	0.000000	OK
L21: Know use objects (1/3)	78	49	62	13	11–16	0.000000	OK
L22: Use pronouns correctly	63	50	62	12	10–14	0.000000	OK
L23: Know use of objects (2/3)	84	51	63	12	9–15	0.000000	OK
L24: Count 1 to 5	62	52	63	11	8–14	0.000000	Rejected
L25: Know 4 animal sounds	83	54	63	8	6–10	0.000000	Rejected
G23: Walk up (≥ 2 steps)	36	44	65	20	16–25	0.000000	Rejected
G24: Kick ball forward	37	45	65	20	15–24	0.000000	Rejected

Fxx = fine motor milestone; Gxx = gross motor milestone; Lxx = language and cognitive milestone; Sxx = social and personal milestone.

* Only milestones with t-test for equality of means with p-value ≤ 0.005 are shown.

** Levene's test (p-value < 0.05 means the equality of variances is rejected): the p-value is used for the t-test when equality of means has not been assumed.

Table 5
Inter-observer reliability for passed/failed milestones assessments.

cDMAT domains	Immediate reliability (Kappa)				Delayed reliability (Kappa)			
	Lower bootstrap	1000 bootstrap	Upper bootstrap	% conformity (P = P + F = F)	Lower bootstrap	1000 bootstrap	Upper bootstrap	% conformity (P = P + F = F)
Social/personal	0.81	0.85	0.94	97%	0.47	0.56	0.65	85%
Fine motor	0.79	0.87	0.93	96%	0.54	0.63	0.72	87%
Language/cognition	0.76	0.84	0.92	96%	0.51	0.60	0.69	87%
Gross motor	0.72	0.81	0.89	94%	0.52	0.62	0.72	86%
Overall	0.77	0.84	0.92	96%	0.51	0.61	0.70	86%

Kappa ≥ 0.8 excellent, 0.60–0.79 substantial, 0.4–0.59 moderate, < 0.4 weak; Conformity is the proportion of the times both observers rated the milestone as passed (P = P), plus the times both observers rated the milestone as failed (F = F), divided by the total number of paired observations.

Table 6
Suggested milestones and reasons for removal by focus group.

Milestones	Domain	Reason for removal
S37: Help around the house	Social/personal	Some children failed even among the eldest ones enrolled to perform these milestones correctly
S38: Know all days of the week	Social/personal	
F25: Tower 8 blocks	Fine motor	
F35: Draw person with 6 body parts	Fine motor	
L27: Understand 4 prepositions	Languages/cognition	
L30: Understand opposites (≥ 2)	Languages/cognition	
L32: Count 1 to 10	Languages/cognition	
L33: Name at least 4 colors	Languages/cognition	
F30: Copy cross	Fine motor	
F37: Copy triangle	Fine motor	
G32: Balance on each foot (≥ 6 s)	Gross motor	Similar performance to imitating vertical lines in F23
		Similar performance to copying square in F36
		Similar performance to balance with ≥ 3 s in G31

Detection and early intervention of children with developmental delays require a holistic system approach, including regular monitoring of child development following a standardized approach, physical examination, diagnostic testing, and provision of social support and specialist care. The cDMAT requires practice to remember the specific assessment methodologies as well as performance criteria for each of the milestones before it can become a reliable tool. It requires frequent application, and even then remains a time-consuming exercise. Therefore, further efforts have been made with the creation of the Community-Based Developmental Milestone Assessment Tool (CB-DMAT) as a referral tool to conduct a full medical assessment, including the cDMAT. The CB-DMAT is a four-milestone assessment tool based on the 99% cut-off point of the cDMAT results. It contains four specific skills (one per domain) that nearly all Khmer children of a certain age group are expected to be able to perform. The CB-DMAT has not been fully field-tested yet (please see the CB-DMAT in the Supplementary Materials (Fig. Supp E)).

This study recognizes some limitations. The study population had a high pre- and primary school enrolment (Tables 3–4) due to selection bias as pre-school teachers were part of the assessor teams and helped to identify the study population. Because school enrolment was found to be a confounding factor for milestone PASS/FAIL performance, the graphs for those specific milestones are likely to be too early for non-school attendees. Also, this study was not a population study, as only well-nourished, healthy, Khmer children without a disability were enrolled.

5. Conclusion

The performance reference charts of a culturally-sensible and environmentally-appropriate tool, the cDMAT, can be used for the development of improved developmental screening in Cambodia with special attention given to school enrolment as it was a confounding factor affecting child development. The effort to create a cDMAT will be practical for more effective monitoring of outcomes from any early intervention services instituted in Cambodia. Creating a small-scale pilot program linking the cDMAT to early intervention would help raise awareness and create local expertise on early childhood development.

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Authorship contribution statement

All authors contributed to the study planning, design, result interpretation and writing of the manuscript. Ngoun Chanpheaktra was the investigator. Piet De Mey performed statistical analysis. Klaus Baesel and Lina Saem Stoej were project and study coordinators. Rachana Khoeun Khann participated in the training of the assessors. All authors were part of the focus group.

Declaration of competing interest

None.

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