Journal of Paediatrics and Neonatal Disorders
Volume 3 | Issue 2
ISSN: 2456-5482

Case Report Open Access

Movement Assessment Battery for Children-2 (MABC-2): A Cross-Cultural Comparison for Surinamese Children at 5 Years of Age

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Citation: Fleurkens-Peeters MJAJ, Janssen AJWM, Akkermans RP, Zijlmans WCWR, Nijhuis-van der Sanden MWG (2018) Movement Assessment Battery for Children-2 (MABC-2): A Cross-Cultural Comparison for Surinamese Children at 5 Years of Age. J Paediatr Neonatal Dis 3(2): 204

Received Date: July 30, 2018 **Accepted Date:** August 28, 2018 **Published Date:** August 30, 2018

Abstract

Background: The Movement Assessment Battery for Children (MABC) is used globally to identify and describe impairments in motor development in children; however, norms for Surinamese children are lacking. We thus conducted a cross-cultural comparison for Surinamese children 5 years–5 years and 6 months using the Dutch/Flemish (NL) and United Kingdom (UK) norms of the MABC, second edition (MABC-2).

Methods: We used the MABC-2 in typically developing children from nine kindergarten schools in the capital, Paramaribo, and surrounding rural areas. We calculated total test standard scores (TTS), component standard scores (CSS), and item standard scores (ISS) to conform to the NL and UK reference manual and compared the outcomes (one-sample t-tests). For both norms separately, we assessed the percentages of children classified with "normal," "at risk," or "impaired" motor development against the expected percentages (chi-square goodness of fit test).

Results: We assessed 105 children (63 boys, 60%), mean age 63 months and 8 days, and found no significant differences in TTS and CSS. ISS differed significantly on two items, One-Leg Balance and Jumping on Mats in the NL norms (mean difference: –2.16 to 0.76) and four items, the same two and Posting Coins and Walking Heels Raised, compared to UK (mean difference: –1.50 to 1.19) norms. The percentages of Surinamese children that scored "at risk" or "having movement difficulties" were significantly higher than expected using NL and UK norms, respectively 25.7/9.5% and 26.7/10.5%.

Conclusion: For this age range, children in Suriname scored differently on fewer items on the NL norms compared to the UK norms, not leading to differences in TTS and CSS, but leading to different classifications. Thus, the NL scores seem more suitable. Further research is needed in the whole age band before deciding if item references need to be adapted. This research group data can be used as a comparison group in peers of the same age.

Keywords: Motor Assessment; Movement ABC-2; Reference Values; Children; Suriname

List of abbreviations: MABC: Movement Assessment Battery for Children; MABC-2: Movement Assessment Battery for Children, second edition; MABC-2-NL: Movement Assessment Battery for Children, second edition, Dutch version; NL: Dutch/Flemish (norms); UK: United Kingdom (norms); TTS: Total test scores; CSS: Component standard scores; ISS: Item standard scores; SS: Standard score; M: Mean; SD: Standard deviation

Introduction

The Movement Assessment Battery for Children (MABC) is used globally to identify and describe impairments in motor development in children and evaluate the effects of treatment [1,2]. The first edition of the MABC [3] was developed and standardized in the United States. Studies in several countries (e.g., Israel [4], Belgium [5], South Africa [6], Hong Kong [7], Japan

[8], and Sweden [9]) suggested that cultural differences in performance on the test items existed, and that reference norms needed small adjustments.

In 2007, a revised test was developed using a United Kingdom (UK) normative sample named the MABC-2 [2]. Recent studies on cross-cultural validation of the MABC-2 performed in Brazil [10] and Greece [11] showed that the UK norms were valid for those countries. For China [12] and the Czech Republic [13], some adjustments were necessary, but no new norms were made. In the Netherlands and Flanders, norms were adjusted, resulting in the Dutch version (NL) [14]. Therefore, the MABC-2 has UK and NL norms. The test items and instructions remained the same for the UK and NL versions.

In Suriname and in the former Dutch Antilles, the MABC-2 with NL norms is used because the Dutch language is spoken there. However, in other Caribbean (Anglo-Saxon) countries, as well as in Suriname's neighboring country, Brazil, the UK norms are used.

In 2014, we initiated a prospective cohort study in Suriname to evaluate the motor development of preterm infants born with a gestational age of less than 32 weeks and/or a birth weight less than 1500 grams. Preterm infants have greater risk of developmental delays than children born at term [15,16]. Little is known about the prevalence and severity of motor delays in preterm infants born in Suriname. Because, internationally, a number of studies evaluated motor development at the age of 5 years using the MABC [17-20], in this study, we wanted to determine potential delay at the age of 5 years 0 months up to 5 years 6 months using the MABC-2. However, so far, it remains unclear whether the NL or UK norms are more valid for testing Surinamese children or if new norms should be established.

In the NL and UK normative samples, children of different ethnic groups are included. In those groups are, among others, children of Black Caribbean and Asian descent, but these groups differ from the Surinamese groups. Many factors can influence motor performance, such as climate, physical growth, gender, nutrition, experience in motor skills, socioeconomic status, and childrearing practices, for example, wakeful hours, positioning, and parental expectations and habits [21]. Therefore, even though Surinamese children are part of the population in the Netherlands and people from the Caribbean live in the United Kingdom, the environmental factors are different, making a cross-cultural comparison meaningful.

Suriname is a middle-income country with a population of 542,000, with more than six different ethnic groups, rural and city areas, and a tropical climate. As of this writing, we lack the resources and manpower to develop new norms specific for the Surinamese population and have to choose between the current UK and NL norms. We are not aware of other norms.

The validity of the MABC-2 has been extensively studied by, among others, Valentini *et al*., 2014 [10]; Hua *et al*., 2013 [12]; and Psotta *et al*., 2012 [13], and the results were acceptable. Our study examined the cross-cultural validity of NL and UK norms of this test. Conforming to Niemeijer *et al*., 2015 [22], in Belgium, we tested if the cut-off-points for classification were valid and used a t-test to compare the differences in means. The overall aim of this study was to assess the validity of the NL and UK norms of the MABC-2 for children between 5 years 0 months and 5 years 6 months in Suriname, taking gender and ethnicity into account.

Methods

This was a cross-sectional study. The Commission of Human Subjects Research of the Ministry of Health of Suriname approved the study (Number VG026-15), and we performed it in accordance with the Helsinki agreement. Only children for whom we could obtain written informed consent from parents or legal guardians were included.

Participants

All children aged between 5 years and 0 months and 5 years and 6 months in the visited kindergarten classes of primary schools were considered for this study. Exclusion criteria were children with congenital deformities or syndromes or children not able to perform the test. We selected nine schools in consultation with the Office for Primary Education, a coordinating institute for public primary education in Suriname, which provided written permission for this study. To obtain a representative group of different socioeconomic statuses and ethnicities, we studied three schools from rural areas and six from various neighborhoods in the capital, Paramaribo.

We explained the aim of this study and its procedures to the school principals and teachers, and the teachers explained the purpose of the study verbally to the parents on parents' day. Moreover, the teachers handed letters with written information about the study and consent forms to the parents. Parents filled out a questionnaire about the highest maternal and paternal education, as well as the ethnicity of their child. Ethnicity was thus self-reported.

We assessed a total of 105 children (63 boys [60%] and 42 girls [40%]) in April 2015 (two schools), January 2016 (five schools), and February 2016 (two schools). The mean age was 63 months and 8 days (60m+11d–65m+26d). Table 1 presents the demographic characteristics of the children. No children were excluded.

n = 105	Number (%)
Gender	
Boys	63 (60)
Girls	42 (40)
Highest maternal education	
None or primary school (4–12 years)	14 (13)
Junior secondary school (12–16 years)	39 (38)
Senior secondary school (16–18 years)	16 (15)
College or university	21 (20)
Missing	15 (14)
Highest paternal education	
None or primary school (4–12 years)	10 (10)
Junior secondary school (12–16 years)	28 (27)
Senior secondary school (16–18 years)	23 (22)
College or university	11 (10)
Missing	33 (31)
Number of children per location of school	
Rural area	52 (50)
Paramaribo	53 (50)
Ethnicity	
Amerindian	3 (3)
Creole	15 (14)
Hindustani	20 (19)
Javanese	13 (12)
Maroon	18 (17)
Mixed	30 (29)
Missing	6 (6)

Table 1: Demographic characteristics of the included children

Motor assessment

In each age band of the MABC-2, we tested three domains: Manual Dexterity (three test items), Aiming & Catching (two test items), and Balance (three test items). We converted the raw data into standard scores per item (ISS), per domain into component standard scores (CSS), and into total test standard scores (TTS) to conform to the NL or UK manual. All standard scores had a mean (M) of 10 and a standard deviation (SD) of 3. There was no difference in how we administered the test between the NL and UK versions; only the norms differed. If the TTS was ≤ 5, we categorized the child as having a "movement difficulty." TTS scores 6 and 7 were related to the category "at risk," and standard scores >7 were related to the "normal" range [2].

Procedures

We performed the MABC-2 in a dedicated room, if available; in the school corridor; or in the schoolyard. Seven students (five master physical therapy students and two bachelor movement technician students) performed the assessment after intensive training. Because all the students spoke Dutch, we used the manual of the MABC-2-NL [14] age band 1 in this study. During the training, students first read the MABC-2-NL manual and observed the instruction movie that was part of the MABC-2-NL test box, published by Pearson, edited by Bouwien C. M. Smit-Engelsman. Afterward, a pediatric physical therapist (MF) with expertise in education and test taking trained the students. In the next step, each student assessed three healthy children of the Rehabilitation Center staff and obtained feedback from the trainer. Once the training was successfully completed, we carried out testing of the first three children at each school under supervision of the pediatric physical therapist, who provided feedback and adjustments if appropriate. In conformance with the manual, we tested the children with one tester or in a circuit with a single tester at each test station (one station for each test item).

Data analyses

We used descriptive statistics to present all the outcome data and converted the raw data of the Surinamese children into NL and UK standard scores (Figure 1). We utilized a one-sample t-test to test the difference between the performance of the children in Suriname and the M of 10, using the NL as well as the UK norms per ISS, CSS, and TTS. The set of standard scores (SS) closest to $M = 10$ was expected to be most suitable for the Surinamese children. In addition, we also tested if the cutoff points SS ≤ 5,

for classification of children with "movement difficulties," and SS ≤ 7, for children "at risk," were valid compared to the expected normal distribution using a chi-square goodness of fit test.

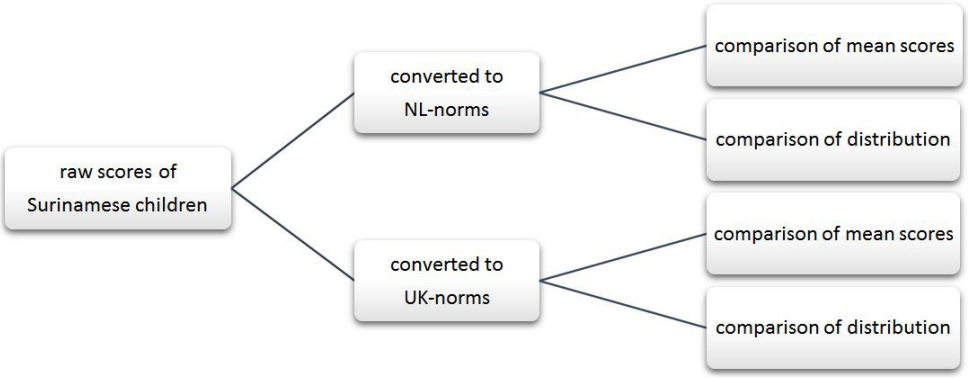

Figure 1: Flow chart data analysis

We used an independent sample t-test to test the difference between boys and girls and one-way ANOVA to assess the influence of ethnicity. For gender and ethnicity, we compared the raw data on the item level and the CSS and TTS for NL as well as UK norms. Because of the small numbers of some ethnic groups, we reduced the number of ethnic groups to three, grouping Creole and Maroon as African, Javanese and Hindustani as Asian, and Amerindians with the mixed group. We considered a *p*-value of <0.05 statistically significant based on two-tailed tests.

Results

Comparison of mean standard scores

The mean TTS and CSS scores were not significantly different from M = 10 for both norms (Table 2). Using the NL norms, two mean ISS scores differed significantly from *M* = 10, whereas, using the UK norms, this was the case for four ISS scores. The Surinamese children's mean ISS for "Posting Coins" was significantly lower than the UK norm of 10. In contrast, Surinamese children scored significantly higher on the item "One-Leg Balance" than the NL and UK norms of 10. For the ISS "Walking Heels Raised," they scored significantly higher than the UK norm of 10, and they scored significantly lower on the ISS "Jumping on Mats" for both the NL and UK norms of 10.

n = 105	Mean (*SD*)	Mean difference (*SD*)	One sample t-test, *p* value
Posting Coins			
NL	9.89 (2.86)	–.11 (–.14)	.683
UK	8.88 (2.98)	–1.12 (–.02)	.000*
Threading Beads			
NL	9.92 (2.76)	–.08 (–.24)	.778
UK	9.76 (3.49)	–.24 (.49)	.486
Drawing Trail			
NL	9.88 (1.35)	–.12 (–1.65)	.349
UK	9.47 (2.85)	–.53 (–.15)	.058
Manual Dexterity			
NL	9.91 (2.70)	–.09 (–.30)	.746
UK	9.67 (2.92)	–.33 (–.08)	.245
Catching Beanbag			
NL	10.22 (2.65)	.22 (–.35)	.399
UK	10.00 (2.28)	.00 (–.72)	1.000
Throwing Beanbag onto Mat			
NL	9.70 (3.25)	–.30 (.25)	.339
UK	9.50 (3.32)	–.50 (.32)	.130
Catching & Aiming			
NL	9.88 (2.76)	–.12 (.24)	.647
UK	10.15 (2.79)	.15 (.21)	.577

n = 105	Mean (*SD*)	Mean difference (*SD*)	One sample t-test, *p* value
One-Leg Balance			
NL	10.76 (2.75)	.76 (–.25)	.005*
UK	11.19 (2.48)	1.19 (–.52)	.000*
Walking Heels Raised			
NL	10.14 (2.11)	.14 (–.89)	.488
UK	10.61 (2.92)	.61 (–.08)	.035*
Jumping on Mats			
NL	7.84 (3.98)	–2.16 (.98)	.000*
UK	8.50 (4.13)	–1.50 (1.13)	.000*
Balance (Static & Dynamic)			
NL	9.70 (3.38)	–.30 (.38)	.358
UK	10.56 (3.69)	.56 (.69)	.121
Total Test Score			
NL	9.83 (3.25)	–.17 (.25)	.590
UK	9.95 (3.29)	–.05 (.29)	.882

* $p < 0.05$
Abbreviations: NL = Dutch/Flemish, UK = United Kingdom, SD = standard deviation, ISS = item standard score, CSS = component standard score, TTS = total test score
Table 2: MABC-2: ISS, CSS, and TSS for NL and UK norms in Surinamese children

Classification distribution

Table 3 shows the distribution of the classifications for the UK and NL norms. The percentages of Surinamese children with a TTS of ≤ 7 ("at risk") or ≤ 5 ("movement difficulty") were significantly higher than the expected percentages of 16% and 5%, respectively, using the NL (25.7% and 9.5%) as well as UK (26.7% and 10.5%) norms. Within the domain Balance, the percentage of children who had a CSS of ≤ 7 was higher than the expected 16% for NL (27.6%), as well as UK (22.9%) norms. The percentage of children who scored ≤ 7 for One-Leg Balance was higher for NL (19%) but lower for UK (9.5%). For Walking Heels Raised, it was, respectively, 11.4% and 17.1%, and for Jumping on Mats, it was 42.9% for both NL and UK norms.

	SS ≤ 7	SS ≤ 5	Chi-square *p* =	16% poorest	5% poorest
Expected values	16%	5%		SS7	SS5
Manual Dexterity					
NL	17.1	7.6	.435	7	5
UK	20	9.5	.104	7	4
Catching and Aiming					
NL	16.2	7.6	.367	7	5
UK	16.2	7.6	.367	7	5
Balance (Static and Dynamic)					
NL	27.6	12.4	.001*	6	5
UK	22.9	7.6	.154	6	5
Total Test Score					
NL	25.7	9.5	.018*	6	5
UK	26.7	10.5	.006*	7	5

* $p < 0.05$
Abbreviations: NL = Dutch/Flemisch, UK = United Kingdom, SS = standard score, CSS = component standard score, TSS = total standard score
Table 3: Percentage of Surinamese children on NL and UK norm scoring ≤ 7 or ≤ 5 for CSS and TTS and SS for the 16% and 5% poorest performers (n = 105)

Gender and ethnicity

For the difference between boys and girls and between ethnic groups, we used the raw scores on the item level. For CSS and TTS, we converted to NL as well as UK norms (Table 4).

Girls were on average 6.27 seconds faster on the Threading Beats ($p = 0.027$) item. Boys threw almost one (0.92) beanbag more for the Throwing Beanbag onto Mat ($p = 0.033$) item. For One-Leg Balance, we used the maximum of 60 s instead of 30 s. There

was no difference in One-Leg Balance, Best Leg, but girls could stand 6.82 seconds longer on the other leg ($p = 0.007$). In the NL norms, girls also scored 1.06 points better on CSS Manual Dexterity ($p = 0.049$). There was no difference in performance between boys and girls in TTS in both NL and UK norms.

Children of the mixed and other group were on average 3.24 seconds faster than African children for the Posting Coins, Other Hand ($p = 0.047$) item. Using a one-way ANOVA, we found no differences between ethnic groups in TTS or CSS or on the other items.

	Boys ($n = 62$)	Girls ($n = 43$)	One-sample t-test p-value	African ($n = 33$)	Asian ($n = 33$)	Mixed/other ($n = 33$)	ANOVA p-value
RS Posting Coins, Best Hand (sec)*	19.97	19.33	0.256	20.39	19.3	19.27	0.193
RS Posting Coins, Other Hand (sec)*	22.44	22.12	0.76	23.94	21.88	20.7	0.047**
RS Threading Beads (sec)*	52.41	46.14	0.027**	51.18	49.24	49.21	0.825
RS Drawing Trail (errors)*	1.42	0.95	0.29	1.42	1.06	0.97	0.359
RS Catching Beanbag (catches)	7.11	6.95	0.706	7.73	7.15	6.64	0.102
RS Throwing Beanbag onto Mat (hits)	5.68	4.76	0.033**	5.64	5.06	5.21	0.525
RS One-Leg Balance, Best Leg (sec)	28.65	31.71	0.364	32.39	27.79	27.15	0.394
RS One-Leg Balance, Other Leg (sec)	15.06	21.88	0.007**	18.64	16.94	17.58	0.871
RS Walking Heels Raised (steps)	13.3	14.14	0.188	13.42	13.79	13.79	0.872
RS Jumping on Mats (jumps)	3.68	4.14	0.126	3.97	4.15	3.67	0.405
CSS Manual Dexterity NL	9.49	10.55	0.049**	9.24	10.3	10.24	0.212
CSS Manual Dexterity UK	9.27	10.26	0.089	8.85	10.21	10.06	0.116
CSS Catching & Aiming NL	10.25	9.31	0.086	10.42	9.91	9.55	0.43
CSS Catching & Aiming UK	10.59	9.5	0.05	10.88	9.76	10.06	0.238
CSS Balance NL	9.27	10.33	0.232	9.64	9.91	9.73	0.948
CSS Balance UK	10.08	11.29	0.101	10.36	10.82	10.64	0.883
TTS NL	9.62	10.14	0.421	9.91	10.03	9.76	0.946
TTS UK	9.71	10.31	0.367	9.85	10.24	10.03	0.892

*Raw scores, manual dexterity: lower score is better than higher scores

** $p < 0.05$

Abbreviations: RS = Raw scores, NL = Dutch/Flemish, UK = United Kingdom, CSS = component standard score, TSS = total standard score

Table 4 : Mean scores, divided by gender and ethnic group.

Discussion

The aim of this study was a cross-cultural comparison of NL and UK norms of the MABC-2 for children between 5 years and 0 months and 5 years and 6 months in Suriname, taking gender and ethnicity into account. Based on the mean scores, our results favor the NL norms. For the classifications of TTS "at risk" and "impaired" performance, more children scored below the "normal" range using NL as well as UK norms. Further research is needed over a larger age range before deciding if references or items need to be adapted.

The curriculum of all kindergarten classes in Suriname includes exercise classes. The children learn balance and coordination skills and to perform double tasks. Most children in our study were in their second year at school and had at least one year of movement education. They were used to performing movement tasks and understood the assignments during the assessment. Thus, the low performance for the "Jumping on Mats" item is hard to explain. We observed that children not only jumped too far (not on the mats but over them) but also that they stopped in between jumps. We were strict in our demonstration and our scoring: "continuous jumps" meant foot position was not adjusted, there was just one jump on each mat, and no short stop between jumps was allowed. We demonstrated the item and re-demonstrated if the practice performance was not adequate. Most children (57%)

performed this item well: they showed five continuous jumps. Others could not do it even after repeated trials (after the formal test). Because Surinamese children performed significantly better on the item "One-Leg Balance" and better (only significant with UK references) on the item "Walking Heels Raised," this is partially compensated for, resulting in no significant difference in the domain balance skills.

For the classification of TTS "at risk" and "impaired" performance, we see that significantly more children scored below the "normal" range. Looking at the item level, we think that the very low scores on "Jumping on Mats" are responsible for this. Norms or requirements for this item need to be adjusted in the future.

At the age of 5 years, body size and strength are similar in boys and girls. Therefore, differences in motor performance are most likely the result of differences in experience, not of biological factors. Maybe boys are expected to run and play with balls, whereas girls are supposed to play with dolls and draw pictures. The manual does not distinguish between boys and girls, but, in several studies [4,13,23,24], gender differences in the acquirement of motor skills are found. In accordance with these studies, we found that girls had a higher raw score for "Threading Beads." With the NL references, this also resulted in a significantly higher CSS for "Manual Dexterity." Boys scored significantly higher on the "Throwing Beanbag onto Mat" item. Although some studies reported no gender differences in the acquisition of balance skills [5,24,25], others found that girls were more advanced [23,26]. We found a significant difference only in One-Leg Balance, Other Leg. As in the reference groups, we found no differences in TTS.

Different societies have different expectations and requirements for skills in children. Ethnicity is not only based on physical and biological factors [27], but different ethnic groups also have different cultures and different styles of parenting and handling practices [28]. Suriname has more than six ethnic groups, and there may be differences in the way infants are handled by the parents and grandparents, but all children are treated the same in the nursery, and at school age, all children have to meet the same demands, regardless of ethnicity. Therefore, we expect that, within Suriname, at age five, there are no differences that are the result of variations in child-rearing practice. The literature is not clear on whether ethnicity plays a role in acquiring motor skills. Some suggest children of Black African origin are more advanced in gross motor skills [29], whereas children of Asian heritage perform slightly lower [29,30]. These differences are explained by cultural differences. When the children become older, the differences disappear. In our sample, the largest group was of mixed origin (30 children). The other groups consisted of no more than 20 children. We grouped them together in African, Asian, and mixed or other. Because our groups were small (33 children per group), only large effect sizes ($d = 0.8$) could be detected. We found differences on only one item, and there were no differences in CSS and TTS.

The strength of this study is the large number of children of the same age included. In the original UK reference population, there were 94 children between 5 and 6 years (double the age range), and in the NL reference population, there were 104 children between 5 years and 5 years and 6 months. We assessed 105 children, which is more than 2% of the total Surinamese population at this age, to guarantee the appropriate power in the comparison.

Limitations

The age range of 5 years 0 months–5 years 6 months is used because that was the age used in a prospective cohort study to evaluate the motor development of preterm infants born with a gestational age of less than 32 weeks and/or a birth weight less than 1500 grams. In the MABC-2-NL, the age range is also 5 years 0 months–5 years 6 months. In the UK sample, the range is 5 years 0 months–5 years 11 months. It is possible that the mean score of Surinamese children of 5 years 0 months–5 years 6 months is lower, using the UK norm for children 5 years 0 months–5 years 11 months, because the children are younger. Additionally, because of the small age range, it is not possible to make conclusions for the whole age band (3–6 years), let alone for the other age bands. Differences between NL and UK norms are larger in age bands 2 and 3 [22].

Sampling data in Suriname is difficult. By choosing schools in different neighborhoods, we expected to have a representative sample of the population. Within this area, we asked all the children of the selected schools, but we were not allowed to invite the parents directly. However, in some schools, all children participated, and in others they did not, and the characteristics of nonparticipating children were not registered. Because of the way the sample was drawn, 60% boys were included compared to 51% in the reference, but because we found no gender differences in TTS, nor in the four items that differ from the NL and UK references, we do not think this will influence the outcome.

The distribution of ethnic groups in Suriname is rapidly changing. For instance, in 2012, in the age group 30–34 years, 20% of the people were Maroon and 11% were mixed, whereas in the 5-year age group, 33% were Maroon and 21% mixed [31]. The distribution of ethnic groups in our study was not completely representative of the Surinamese population. Like in the 2012 census, we asked the parents to which ethnic group their child belonged. Our Maroon group was significant smaller, 18% instead of 33%. This can be explained because although only 10% of the population lives in the interior, 35% of the Maroon group lives there. Our mixed group was larger than expected. For the other groups, the distribution was as expected for children of 5 years.

Another limitation is that, although we went to schools in rural areas around the capital, Paramaribo, schools in the interior were not included. This was mainly because of logistical reasons (distance and language) but also because children from the interior

rarely use physical therapy services and therefore are almost never assessed with the MABC-2. Walhain *et al.* [32] compared the difference in health-related fitness and motor coordination between 7-year-old Maroon children living in Paramaribo and in the interior. They showed no difference in gross motor performance, measured with the Körperkoordination Test für Kinder (KTK), and fine motor performance, measured with the manual dexterity component of the MABC-2-NL, although there were some significant differences at the item level. When sufficient resources are available, we recommend testing all age bands (3–16 years) throughout the whole of Suriname, including a sufficient number of Maroon children.

Conclusion

For children 5 years 0 months up to 5 years and 6 months in Suriname, the NL norms of the MABC-2 were preferred above the UK norms. We found no difference in performance between boys and girls or between different ethnic groups when looking at CSS and TTS. These data can be used as a comparison group in peers of the same age, but caution is advised when adapting the data for clinical use because further research is needed for the whole age band for possible adjustments of item norms.

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