Te Reo
the Journal of the Linguistic
Society of New Zealand

Volume 69
Issue 1

Research Article

2026
Pages 52–73

May, 2026

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This paper is a peer-reviewed contribution from https://www.nzlingsoc.org/journal/current-issue/

Editor: Victoria Chen

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Abstract

Bangla is the language spoken by millions of children in Bangladesh, as well as parts of India. However, little is known regarding lexical development in Bangla-speaking children due to a lack of linguistically and culturally suitable assessment tools. We report here on the development and initial piloting of a Bangla version of the MacArthur-Bates Communicative Development Inventories (MB-CDI), a parental report, to be used with Bangla-speaking children aged 12 to 36 months. We discuss the process of adapting the MB-CDI through to an initial pilot with parents of 23 children in Bangladesh. Feasibility and preliminary psychometric properties were examined using descriptive statistics, internal consistency analyses (Cronbach's alpha), and age-related comparisons. The pilot findings indicated that the Bangla MB-CDI was feasible to administer in the Bangladeshi context and demonstrated high internal consistency ($\alpha = 0.90$). Preliminary analyses also suggested age-related increases in vocabulary scores, consistent with expected developmental trends. The pilot also yielded useful feedback on ways to improve assessment protocols and item selection. With minor revision, the tool appears appropriate to use in a larger study to properly validate it for wider use with Bangla-speaking children.

Keywords

Bangla, assessment, MB-CDI, language, checklist, vocabulary development

1 Introduction

Language acquisition in children is a very significant part of their early development. It is a complex process, and both skills and needs for language and communication in children increase with age (Owens, 2016). It is important to gather information about the trajectory of language development as well as the degree of variability among typically developing children, so that a deeper understanding of this process can be achieved. Research have demonstrated

the significance of language development for later success in literacy, academic achievement, and social interactions (Simonsen et al., 2014; Moeller, 2000; Vohr et al., 2008).

A critical part of early language development involves word learning or acquisition of vocabulary. Vocabulary development has been shown to be a good indicator of children's language development in general, i.e., it reflects development in other domains of language as well. Vocabulary has also been found to be an indicator of cognitive development in children (Anderson & Freebody, 1981; Wechsler, 1949) and to relate to later achievements in reading tasks (Beck et al., 1987; Graves, 1986; Miller, 1988; Ricketts et al., 2007). Strong word knowledge allows children to decipher written words more quickly (Perfetti, 2010). Also, children with larger vocabularies can quickly comprehend the text's meaning, which is crucial for a child's reading (Hindman & Wasik, 2013). The ability to communicate effectively with their classmates (Menting et al., 2011) and understand science and mathematics (LeFevre et al., 2010) are both facilitated by children's vocabulary skills. As a result, vocabulary development is important for children's school readiness.

Typically developing children demonstrate their first signs of word understanding (receptive vocabulary) prior to their first birthday. Fenson et al. (1994) reported in a study with 1800 typically developing children's (8–30 months) acquiring English that they had an average receptive vocabulary size of 36 words at the age of 8 months, 67 at the age of 10 months and 191 at 16 months. By their second birthday a child is generally held to understand 200-300 words, and this figure grows to 900-1000 words by the age of three (Owens, 2016). However, these averages can disguise the fact that children's early receptive vocabulary development is highly variable as evidenced in Fenson et al. (1994) where variation is found between the mean and median values at each age point. Variability in receptive vocabulary would suggest that some children start fast but continue to grow slowly while others start sluggishly and later speed up (Bates et al., 1995).

Studies have found that receptive vocabulary is not only acquired earlier but at a faster rate than expressive vocabulary. Benedict (1979) found that children's first word understanding occurred on average at 9 months and reached the 50-word level at 13 months, whereas expressive vocabulary started on average later at 12 months and 50 words were reached at 18 months. Menyuk et al. (1995) in their larger study confirms this finding.

In terms of expressive vocabulary children start out producing single words before being able to produce sentences. Other research puts the first word produced between 10-15 months of age (Fenson et al., 1994; Huttenlocher & Smiley, 1987). On average 10 words occur at 12 months, 64 at 16 months and 312 at 24 months. The 50-word mark that usually coincides with the emergence of grammatical morphemes and combining words (Brown, 1973) occurs at around 18 months (Nelson, 1973).

Although many findings on early vocabulary development come from studies of English-learning children, it cannot be assumed that children acquiring other languages necessarily follow the same developmental trajectory. Research across a range of languages has shown that vocabulary growth patterns are broadly similar to those observed in English (e.g., Faroese: Rasmussen & Bleses, 2018; French: Bassano et al., 2005; Danish: Bleses et al., 2008; Mandarin Chinese: Hao et al., 2008; Spanish: Jackson-Maldonado et al., 1993). However, this pattern is not universal. For example, Caselli et al. (1999) found Italian-learning children showed slower overall vocabulary growth despite similarities in the onset and developmental patterns of different word types. To date, research has focussed primarily on European languages and there is limited evidence available for Bangla.

2 Background

2.1 Bangladesh

Bangladesh is a geographically small country in South Asia with over 175 million people (Worldometer, 2025). The population is young; nearly one-third (28.6%), over 50 million, are under 16 years of age (Bangladesh Bureau of Statistics, 2022). The population is largely rural; approximately 57.4% of the population live in rural areas and about 80% of people depend on agriculture for their livelihood. A majority (91.08%) are Muslim, a further 7.96% are Hindu, and Buddhist and Christian each make up <1% (Bangladesh Bureau of Statistics, 2022).

2.2 The Bangla language

Bangladesh is a strongly monolingual country. Bangla is the language spoken by over 175 million people in Bangladesh and also nearly 100 million in the Indian states of West Bengal, Tripura and southern Assam (Wikipedia, 2022), the region that was known as Bengal prior to partition. Bangla (previously Bengali) is an Indo-Aryan language derived from Sanskrit. It is the 6th most spoken language in the world by number of native speakers (Bhattacharya, 2000). The written form is the Bengali Assamese script, a syllabic script similar to Sanskrit.

Bangla is most closely related to other Indian subcontinent languages such as Hindi, Gujarati and Urdu. It has Subject-Object-Verb order and rich inflectional marking on nouns and verbs. Some of the differences to English are that yes/no questions are marked by prosody only, there is no copula verb, nouns have case endings and verbs are inflected for tense, aspect, and person (Sultana et al., 2019; Sultana et al., 2016). Around two-thirds of the vocabulary is of Bangla origin, and around one third is "borrowings" from Sanskrit, Persian and Arabic, and European sources such as Portuguese, Dutch, and English (Stokes, 2012; Wikipedia, 2022).

2.3 Language development in Bangla; current knowledge and practice

There is very little published data on language development in Bangla. In terms of grammatical development Sultana and colleagues have published a number of studies focused on children's development of verb morphology (Sultana, 2021; Sultana et al., 2019; Sultana et al., 2016) and Stokes (2012) considered syntactic development of bilingual Bangla-English speaking children in England. There are some studies on vocabulary development (Hasna, 2016; Dirbana, 2015; Hamadani et al., 2010), however only Hamadani et al. (2010) is published, the others being unpublished student projects. Hamadani et al. (2010) collected information on lexical development using a Bangla adaptation of the MacArthur-Bates Communicative Development Inventories (MB-CDIs).

2.4 The MacArthur-Bates Communicative Development Inventories (MB-CDI)

The MB-CDI as a tool was developed as an efficient way to collect information on children's early language development because collecting information on the words children produce and understand through observation is time consuming and studies have found them to be reliable, inexpensive and effective in assessing children's language abilities (Feldman et al., 2005; Fenson et al., 2000; Fenson et al., 2007; Law & Roy, 2008). The MB-CDIs were developed in English by Fenson et al. (1993) in the USA to assess infant and toddler communication development and includes gestural development, the production and comprehension of early lexicons, language use and the development of syntax. The original American MB-CDI (Fenson et al., 1993, 2007) has forms for children from three different age groups; the *CDI:*

Words and Gestures for children aged 8-16 months, the *CDI: Words and Sentences* for children 16-30 months, and the *CDI-III* for children 30-37 months.

These tools have a number of practical advantages. They do not require a professional to administer and are very effective in collecting data from a wide range of communicative environments and are particularly useful where children have difficulties in face-to-face interaction and do not actively participate in structured sessions (Crais, 2011; Fenson et al., 2007). In addition to being an instrument to assess an individual child's language development the MB-CDI has also been used to collect data from large samples to establish population-based norms. They have been widely reported in research (Mancilla-Martinez et al., 2016; Hurtado et al., 2008) and are commonly used in clinical assessment (Charman et al., 2003; Heilmann et al., 2005; Kim et al., 2014).

The MB-CDI also have some shortcomings like many other data collection methods. It relies on parent reports, which may be influenced by variability in parental awareness, literacy, and subjective interpretation of children's language abilities. In addition, the MB-CDI focuses primarily on early vocabulary and grammar and does not provide in-depth information on pragmatic, narrative, or discourse-level language skills (Tardif et al., 1999).

The MB-CDI are notable for having been adapted for more than 60 languages and dialects (Dale & Penfold, 2011). The MB-CDI website lists nearly 100 versions, including several varieties of Arabic, English, and Spanish, along with a wide variety of non-European languages such as Hindi and Jamaican Creole, and several sign languages (CDI Advisory Board, 2015a). The USA English version has been used as the basis for British English (Hamilton et al., 2000), New Zealand English (Reese & Read, 2000), and Spanish (Jackson-Maldonado et al., 1993). In addition to the three versions for different age ranges the original USA English instrument exists in both long and short versions where short versions have items taken from the longer ones. The *CDI: Words and Gestures* short version has 89 items while the *CDI: Words and Sentences* version has 100 items. These two short versions form the basis to the version in Hamadani et al. (2010)'s adaptation.

Non-English adaptations of the MB-CDI typically involve rigorous processes including translation, cultural and lexical adaptation, community consultation, and pilot validation. For example, the Australian Aboriginal MB-CDI was developed through close collaboration with Indigenous communities, incorporating culturally relevant vocabulary and reflecting multilingual language contexts (Khamchuang et al., 2022). In the New Zealand context, the Growing Up in New Zealand study has adapted MB-CDI measures for Samoan, Tongan, Mandarin, and Cantonese-speaking children, ensuring cultural appropriateness and sensitivity to bilingual development (Reese et al., 2015; Zhang et al., 2024). These efforts highlight the importance of culturally responsive and contextually grounded approaches to ensure valid assessment of early language development across diverse populations.

2.5 Hamadani et al. (2010)

The first Bangla MB-CDI was developed and adapted by Hamadani et al. (2010) and her colleagues. This study consists of 60 items (words), and no gestural items were included. Lexical items in this version are drawn from 15 lexical categories (e.g., animals, vehicles, toys, food and drink, etc.). The purpose of the study was to see if the adapted instrument could be validated as a screening tool for general use, in this case for nutrition surveys. Although it was used to assess 2,418 12–18 months old children in Bangladesh and was found to be reliable with acceptable concurrent and predictive validity and sensitive to environmental and child characteristics, it was not used to provide detailed lexical developmental data as such and was

developed and tested with children from rural areas only. Their particular purpose combined with the site of publication (a nutrition journal) meant that there has been little awareness of this research and no follow up or further use of the instrument in child language development.

2.6 The present study

In general, knowledge about Bangla-speaking children's language development is constrained by the lack of culturally and linguistically appropriate tools to collect data. Like many other Majority World countries[1], those interested in collecting data on language development have generally turned to translating tools from another language without recognizing how different languages might be, and without norms being established for that translated tool. This is particularly significant given that the norms for the original tools are usually established in western, educated, industrialized, rich and democratic (i.e., Minority World countries[2]) countries and therefore would not be applicable in Majority World countries (Henrich et al., 2010). In addition to linguistic differences there are cultural and socio-economic differences between the two worlds which impact on the appropriateness of a translated assessment (Boivin, 1991; Carter et al., 2005). The present study aims to address these shortcomings by developing a culturally and linguistically appropriate version of the MB-CDI that can be used with Bangla speaking children in Bangladesh. This version uses Hamadani et al. (2010)'s version as a starting point and is a long version in line with the categories used in the original English version. In the current study we discuss how items for the tool were selected and describe the procedure for piloting the tool with mothers of typically developing Bangla-speaking children. We collected feedback from participants in regard to assessment content and procedure and tested the tool for both linguistically and culturally appropriateness in terms of content validity, feasibility, and internal consistency (Cronbach's $\alpha \geq .70$). Children's performance was statistically analyzed against variables of age, gender and location (urban vs. rural).

3 Materials and Methods

3.1 The development of the instrument

The website for the MB-CDI includes instructions and advice for developing adaptations of the tool in different languages. We followed the MB-CDI adaptation guidelines, prioritizing culturally appropriate item selection over literal translation while retaining the broader semantic groupings and testing of both receptive and expressive vocabulary. The authors had permission from the MB-CDI board to create an adapted inventory in Bangla.

The initial Bangla instrument was developed by the research team through a systematic review of words used in existing adaptations. The first author was born and raised in Bangladesh and is of Bengali ethnicity and culture and is also a trained and experienced paediatric speech language therapist. The adaptation process drew on professional expertise in paediatric speech and language therapy and knowledge of Bangla language use to ensure cultural and linguistic appropriateness. These words are accessible through Wordbank (<http://wordbank.stanford.edu>), a structured database of developmental vocabulary data

[1] The term "Majority World Countries" is used in preference to 'developing' or 'third world' countries (Shallwani, 2019)

[2] The term "Minority World Countries" is used in preference to 'developed', 'western' or 'first world' countries (Shallwani, 2019)

(Frank et al., 2017). The Hamadani et al. (2010) item list was expanded through a review of the American English original (Fenson et al., 1993, 2007), the UK English (Hamilton et al., 2000), and the New Zealand English adaptations (Reese & Read, 2000). Selecting the American, New Zealand and British English versions of the MB-CDI provides a sound basis for adapting the assessment to Bangla, taking into account some similarities in expressions and concepts, resource availability, and research validity.

The words needed to be those to which children from both rural and urban areas of Bangladesh would have been exposed and would be part of a child's vocabulary. There are three differences to the original English version. We developed a hybrid one similar to Hamdani et al. (2010)'s version that incorporates items from both the infant and the toddler forms. This approach was taken so that a tool could be developed to efficiently collect data to assess receptive and productive vocabulary development from a wider age range (12 to 36 months).

Separate sections on gesture and grammatical complexity were omitted due to the lack of evidenced information available for Bangla. A section on gestures did not seem to be feasible as preliminary field testing indicated that caregivers could not reliably give details on gestures. Grammatical information is reported in a small number of studies (Sultana, 2021; Sultana et al., 2019; Sultana et al., 2016), but there is still not sufficient information to establish which morphemes are acquired first. Our hybrid MB-CDI omitting gestures and grammatical sections is in line with Kalashnikova, Schwarz, and Burnham (2016) in their Australian English adaptation to study lexical development in Australian Aboriginal children.

A final difference is in the inclusion of measures of comprehension for children older than 18-20 months. In the original English MB-CDI vocabulary comprehension is not included for children older than 18 months on the assumption that parents can no longer keep track of the number of words their children understand. The rationale for including comprehension here is because so little is currently known about early language development in Bangla. It is possible that information may be missed if we adopt the assumptions from the original. If the instrument captures a comprehensive and diverse set of words and ideas relevant to children's linguistic development up to 36 months, it enhances the content validity of the measure, and if the items seem relevant and reasonable for various age groups, it adds to the face validity. There is also a general point that language development is a dynamic process and gathering data on comprehension skills beyond 20 months contributes to research on language milestones, developmental trajectories, and factors influencing language development more broadly. Lastly, there is some precedent in the literature for this decision. (see Abdelwahab and colleagues (2021) for Arabic, and Thal et al. (1999) investigating the correlation between gesture and comprehension at the age of 24 and 32 months).

3.2 Cultural and linguistic adaptations

This initial inventory had 613 lexical items in 21 lexical categories (see Table 1). This is comparable to the 672 items in 22 categories in the British version (Hamilton et al., 2000), and 680 items and 22 categories in the American version (Fenson et al., 2007). The categories differed slightly in detail to the English language versions (see section below). For example, we included 'Common expressions' as a separate category in line with Hamadani's original short adaptation, for example: এখানে আসো (*come here*), সাবধানে (*be careful*). The 'Games and routines' and 'Helping verbs' categories were excluded from the Bangla version. There were not sufficient games to constitute a separate category, so the few common games were

incorporated into other categories, e.g., 'Toys/Playthings'. Helping verbs were excluded as these are not commonly used in Bangla.

The lexical items chosen reflect the cultural context for Bangla-speaking children. Words like '*rickshaw', 'tempu'* and *'CNG*' (three-wheeler vehicles) are very common in Bangladesh and thus were added, whereas '*sled'* and *'tricycle'* from the original version are not common and were not included. The 'Food and drink' category figures largely in all children's early vocabularies and for this version words like '*biriyani', 'kebab', 'halim',* and '*singara'* appear. Common animals in Bangladesh include *'cow', 'mosquitoes',* and '*dog'*. The full list of categories and sample items within them are listed in Table 1.

Table 1. Semantic categories in Bangla MB-CDI with sample items

	Category	Sample Bangla items (translated into English)
1.	Animal sounds and other sounds	বা বা (baa baa), টি টি (ti ti), মিয়াও (meow)
2.	Animals (Real or Toy)	গরু (cow), কুকুর (dog), হাতি (elephant)
3.	Vehicles (Real or Toy)	বাস (bus), রিকশা (rickshaw), ট্রেন (train)
4.	Toys/Playthings	বল (ball), বাবল (bubble), পুতুল (doll)
5.	Food and drink	ভাত (rice), কলা (banana), দুধ (milk)
6.	Clothing	শার্ট (shirt), পায়জামা or প্যান্ট (pants), জুতা (shoes)
7.	Body parts	মাথা (head), চুল (hair), চোখ (eye)
8.	Small household items	ঝুড়ি (basket), ব্যাগ or থলে (bag), ব্রাশ (brush)
9.	Furniture and rooms	বিছানা (bed), চেয়ার (chair), পায়খানা (toilet)
10.	Outside things	গাছ (tree), চাঁদ (moon), দোকান (shop)
11.	Places to go	মাঠ (playground), চিড়িয়াখানা (zoo), খাবার দোকান (restaurant)
12.	People	বাবা or আব্বু (father), চাচা (uncle), বোন (sister)
13.	Action words/Verbs	খাই (eat), খেলা (play), ঘুম (sleep)
14.	Descriptive words/Adjectives	ভালো (good), বড় (big), খুশি (happy)
15.	Words about time	সকাল (morning), রাত (night), আজ or আজকে (today)
16.	Pronouns	আমি (I), আমার (mine), তুমি or তুই or আপনি (you)
17.	Question words	কি (what), কখন (when), কেন (why)
18.	Prepositions and locations	উপরে (on), মধ্যে or ভিতরে (in), পরে (after)
19.	Quantifiers and articles	টি or টা or খানা or খানি (a), অনেক or অনেকগুলো (a lot), বেশি or আরও (more)
20.	Connecting words	এবং or ও (and), কিন্তু (but), তারপর or পরে (then)
21.	Common expressions	এদিকে or এখানে আসো (come here), সাবধানে (be careful), মাম or পানি খাবো (drink water)

The category 'People' included more relationship terms than the English ones. Many Bangladeshi children are raised in a joint family system under the influence of grandparents, uncles, aunts, and cousins and as a result Bangla has a complex system of kinship terms. Respect and regard for elders is a significant aspect of Bangladeshi society, and special titles exist for almost all the maternal and paternal relationships (e.g., '*nana*' maternal grandfather, '*dada*' paternal grandfather, '*khala*' maternal aunt, '*chacha*' paternal uncle). Conversely, a number of words that appear across categories in the English versions like '*sled'* (vehicles),

‘*penguin’* (animals), ‘*snowsuit’* (clothing) were omitted as they are not relevant to Bangladeshi culture. Some direct borrowings from English were kept as those words are now used in Bangla, for example: ‘*bus*’, ‘*zebra*’, ‘*ball*’, ‘*mobile*’, ‘*noodles’*.

The numbers of items within a category varied across versions. ‘Food and drink’ contained 97 items in Bangla compared to 68 in American English. ‘Action words’ contained 70 items in Bangla compared to 103 in American English. The overrepresentation of food/drink items and underrepresentation of action words in the Bangla MB-CDI reflect the cultural-linguistic context. In Bangladesh, early caregiver-child interactions are strongly centered around feeding routines, during which food-related nouns are repeatedly named and pragmatically salient. Bangla also has a culturally rich and lexically specific food vocabulary. In contrast, Bangla verbs are morphologically complex and often expressed through light-verb constructions or conveyed pragmatically through context, which may delay the emergence of a diverse verb lexicon in early development. Additionally, caregivers tend to more reliably identify and report concrete nouns than action words in checklist-based instruments. Other category numbers were similar; ‘Small household items’ were 49 in Bangla and 50 in American English, although they did not refer to the same items.

3.3 Expert feedback

The initial Bangla version was sent to six experts, recruited through the first author’s professional networks as a speech language therapist and a faculty member at a University in Bangladesh. These experts were asked for their feedback on the tool and any suggestions for improvements. They were two linguists, one child psychologist, one lecturer from a public university, one early childhood researcher from a government child research institution, and one speech and language therapist working with children in a speech and language therapy centre. All had between 5 and 20 years of experience of Bangla-speaking children’s language development. These experts were asked to add, delete, or use synonyms for each category and make any relevant comments.

Although the intention was to ultimately edit the initial version down to fewer items, many of the recommendations from the consulting group were to add words. For example, ‘*mongoose*’, ‘*bug*’ for the ‘Animal’ category; ‘*puzzle*’, ‘*carom*’, ‘*gun*’ for ‘Toys’; ‘*popcorn*’, ‘*jilapi*’, ‘*sausage*’ for ‘Food and drink’. Similarly, they recommended adding religious synonyms to kinship terms (People category), such as ‘*fufu*’ (used by Muslims) or ‘*pisi*’ (use by Hindus) for parental aunt, ‘*chacha*’ (Muslims) or ‘*jetha*’ (Hindus) for parental uncle, and ‘*khala*’ (Muslims) or ‘*mashi*’ (Hindus) for maternal aunt. A total of 89 items were suggested, along with two deletions and 35 synonyms. There were also a few additional comments (for all responses, see supplementary material 1). Not all of the words suggested by the experts were included e.g., ‘*maxi*’, ‘*blouse*’, ‘*petticoat*’ or ‘*saya*’ (‘Clothing’ category) and ‘*rickshaw puller*’, ‘*servant*’ (‘People’ category) as these words in the judgement of the first author were more appropriate for older children. Similarly, they suggested a few synonyms, like ‘*pa*’ or ‘*theng*’ for ‘leg’, ‘*ma*’ or ‘*ammu*’ or ‘*mum*’ for ‘mother’ and some of these were included. Furthermore, two experts suggested a number of adverbs such as দ্রুত or তাড়াতাড়ি (*quickly*), এখন (*now*), খুব (*very*) as a different category. These types of words are common and used frequently in everyday conversation in Bangla.

This recommendation was, after careful consideration, not added as the MB-CDI is a lexical or semantic tool rather than a syntactical one. The original MB-CDI does have some syntactical categories, such as “Pronouns”, “Prepositions” and “Articles”. However, it is possible to argue that each of these still makes sense in a semantic tool. Pronouns are a deictic

category of address that do not behave quite like any other semantic items and relate clearly to language development in themselves, articles do not have a semantic category, and prepositions can be about place (location) or time. Furthermore, we found that each of the items for the 'Adverbs' category could be shifted to existing categories. For example, '*quickly*', could be shifted to "Descriptive words". Similarly, '*today*' and '*here*' fit well in the "Words about time" and "Prepositions and locations" categories respectively.

The additional comments from the experts concerned the organization and structure of the tool. One of the consultants suggested ordering words by age of emergence so that '*cow*', '*cat*', '*tiger*' occur first in the 'Animal' category and '*head*', '*nose*', '*eyes*' in 'Body parts'. He also suggested adding sub-categories such as 'domestic' versus 'wild' within 'Animals', and 'fruits', 'vegetables' and 'drinks' in 'Food and drink'. These structural suggestions related to the categorization that makes sense to adults, but they were not adopted as they have not been found to be needed in other versions of the MB-CDI.

3.4 Revised version of the Bangla MB-CDI after review

The final word list consisted of 652 items from 21 semantic categories (supplementary material 2). Table 2 lists the final categories and number of items in each category compared to the original.

Table 2. Number of categories and words/items in each category in Bangla

Category	Number of words/items	Original (US) English version
Animal sounds and other sounds	16	12
Animals (Real or Toy)	41	43
Vehicles (Real or Toy)	19	14
Toys/Playthings	24	18
Food and drink	97	68
Clothing	23	28
Body parts	34	27
Small household items	49	50
Furniture and rooms	30	33
Outside things	28	31
Places to go	24	22
People	30	29
Action words/Verbs	70	103
Descriptive words/Adjectives	64	63
Words about time	12	12
Pronouns	24	25
Question words	08	7
Prepositions and locations	23	26
Quantifiers and articles	13	17
Connecting words	05	6
Common expressions	18	0 (replaces Helping verbs=21)
Games and routines	0	25
Total=21	Total=652	Total=680

4 Results

4.1 Initial trial of the tool

The revised version of the tool was trialled with 23 families. The intention was to see if the tool was appropriate for the Bangladeshi population, whether parents understood what was required, and whether those administering the tool found it easy to use and if the instructions were adequate or needed modifications. The children in the families represented a spread of the ages so that development by age could potentially be evidenced in the children's scores. This would then help in verifying if the current tool could be used in a further larger study. Given the nature of Bangladesh, it was important that it was trialled in both rural and urban areas.

Table 3 shows the socio-demographic profile of the mothers and their children. The mothers were recruited from both urban (n = 12, 52.17%) and rural areas (n = 11, 47.82%) of Bangladesh. All the urban mothers were from the capital city Dhaka, and the mothers from rural areas were recruited from one village of 'Jhinaidah' district in the south-west of Bangladesh. Bangla was the primary language in all families, and all the parents spoke Bangla to their children at home. All the children were reported by the mothers as having no known conditions which may have affected their development, for example hearing loss or developmental disability. The genders of the children were fairly equally represented; the group was somewhat biased towards the older children within the age range (see Table 3). To capture changes in language complexity and size over a short time span, the children's age range was divided into six-month intervals following the Gatt et al. (2013) study on Maltese speaking children.

Mother's level of education, which is associated with children's vocabulary development (Friend et al., 2017; Hoff, 2003), ranged from no formal schooling to university level. One (4.34%) of the mothers had no formal schooling, seven (30.43%) attended high school, two (8.69%) had completed college and 13 (56.51%) were university graduates. This group therefore were more highly educated than the general female population of Bangladesh, for whom 16% have no formal schooling, 31% have primary education only, 40% have secondary education and 13% have tertiary education (Das et al., 2022). Most (86.95%) were housewives.

Table 3. Socio-demographic profile of the pilot group mothers and their children

Variables	Content	Frequency	Percentage%
Gender of child	Boys	10	43.47
	Girls	13	56.52
Age of child	12-17 months	3	13.04
	18-23 months	3	13.04
	24-29 months	9	39.13
	30-36 months	8	34.78
Location	Urban	12	52.17
	Rural	11	47.82
Sibling status	0	9	39.13
	1	12	52.17
	2	6	8.69
Mother's education level	No formal schooling	1	4.34
	Primary school	0	0
	High school	7	30.43
	College	2	8.69
	Bachelor degree	5	21.73
	Masters/PhD	8	34.78
Mother's occupation	Housewife	20	86.95
	Teacher	2	8.69
	Job (private/public)	1	4.34

A tool such as this could be filled out by parents in their own time. However, for the purpose of this trial, it was conducted as an interview. This allowed the assessors to observe how the tool performed, and the mothers to give feedback as part of the data. It was also culturally more appropriate, as in Bangladesh face to face interaction is much more likely to result in families being willing to participate. A similar face-to-face interview method was used in the New Zealand Growing Up CDI study (Reese et al., 2018). There may also be literacy issues in some parts of the country, making the task of filling out a written form inappropriate. The disadvantage is that the data collection is more time consuming and more expensive to conduct.

The interviews were conducted by four research assistants (RAs) who were final year students of speech and language therapy (SLT) program from the Department of Communication Disorders at the first author's university. These RAs were trained on the tool and the data collection procedures by the first author. After the training, they recruited participants from their own community networks through a snowballing method. This is a common practice in Bangladesh in terms of finding participants. People usually do not respond if any other selection process is used. A similar method for selecting participants was used in the MB-CDI adaptation study in two Kenyan languages (Alcock et al., 2015). Mothers provided consent for their participation, and it was conveyed to them that they were free to withdraw from the process at any time during data collection. All the interviews were conducted at the participant's house and lasted between 30 and 60 minutes. They were audio-recorded with the consent of the mothers and conducted in Bangla in a conversational format to ensure that mothers were comfortable with the process of completing the parental report.

In line with the standard MB-CDI guidelines (Fenson et al., 2000; Reese et al., 2018) the following instructions were provided to the mothers: "for words your child understands but does not yet say on his/her own, mark the first column (understands). For words that your child not only understands but also says on his/her own, mark the second column (understands and says). If your child uses a different pronunciation of a word or another word with the same meaning (e.g., *mum* for *pani-w*ater), mark it anyway. Please add any words in each category if your child understands or says but not listed here. Remember that this is a *catalogue* of all the words that are used by many different children. Don't worry if your child only knows a few of these right now".

In addition, mothers were instructed to report on their child's current language abilities, to indicate words the child understands and/or says spontaneously rather than words repeated through imitation, and to consider typical behavior across everyday contexts rather than isolated instances. Clarification was provided regarding the distinction between receptive and expressive vocabulary, including examples, to ensure consistent interpretation across respondents. Moreover, mothers were given the opportunity to ask questions before completing the inventory. Mothers were advised to mark an item only if they were confident that the word reflected consistent use or understanding across contexts. The RAs read aloud the words one by one to the mothers and noted both those 'understood' but not yet said as well as those 'understood and said' by a participant's child. They also made note of any words where the child used a synonym and any words not listed but that the mother indicated were understood or said by their child.

Comments on procedures around data collection were gathered from both mothers and RAs and used to consider any further modifications of the tool. Additionally, though this is a small sample, analyses were conducted to see if there were preliminary indications that the tool was likely to be able to discriminate by age, and whether any differences by gender and by rural/urban location were potentially present. For each child, a receptive and an expressive score were calculated, and differences in scores by age group, gender and by geographical area were analyzed using IBM SPSS statistics 26.

4.2 Determining tool feasibility

4.2.1 Procedures around data collection

In general, both mothers and RAs considered the word list useful in identifying Bangla-speaking children's early vocabulary skills. RAs reported that most mothers completed the tool without any difficulties in understanding the task. The mothers found the words appropriate, and they responded (as far as could be judged) accurately. However, some mothers needed clarification on what was required; the RAs often had to provide examples to differentiate between "understand" and "understand and say" words. Both the mothers and the RAs found the tool to be long and felt it might be best completed across two sessions. RAs felt that some of the mothers may have over-rated their child's vocabulary skills. Although there is no objective data to support this view, research has shown that although parents can be reliable reporters, they may also under-or over-report their children's language (Law & Roy, 2008). Further research would be needed to check on such issues in this population.

Although the tool is designed to be completed by parents in their own time, the RAs recommended conducting these interviews face to face as illiteracy may be an issue and some parents needed assistance in completing the tool. Furthermore, the RAs suggested adding a separate section to the checklist to note any 'local words/other words' children use.

4.2.2 Item choice

It was noted that a few mothers had difficulty with words like '*puzzle*' (পাজেল), '*French fry*' (ফ্রেঞ্চ ফ্রাই), mostly those from rural areas and/or low educational backgrounds. An issue was also raised concerning the category "Common expressions". This category was originally used in Hamadani et al. (2010) and treated expressions as single lexical items. However, such an interpretation may not be justified for young children, and we may need to reconsider this category given the feedback. A final issue concerned the duplication of words in different categories. There were 19 similar items used in various categories, for example, '*mobile*' was used both in "Toys/Playthings" and "Small household items", '*shop*' was allocated both in "Places to go" and "Outside things". This might lead to misleading results in terms of total vocabulary and in revising the tool these duplications need to be eradicated.

4.2.3 Total reliability

The internal reliability of the Bangla MB-CDI was evaluated using Cronbach's alpha to estimate inter-item correlations across receptive and expressive vocabulary items. The Bangla MB-CDI demonstrated excellent internal consistency, with a Cronbach's alpha of 0.90. Comparable levels of reliability have been reported for other language adaptations, including te reo Māori (Reese et al., 2018), ($\alpha = 0.98$), and the short form for English toddlers (Fenson et al., 2000). Overall, this finding indicates that the Bangla inventories exhibited high internal reliability within this pilot sample.

4.2.4 Vocabulary scores of the pilot group

The scores indicate an increase in both comprehension and production scores by age for the children in this sample (see Figure 1). The average reported comprehension and production scores were 262 and 13 respectively in the 12–17-month age group, and these increased to 468 for comprehension and 438 for production in the 30–36-month-olds. The slope of the graph shows that the children's comprehension increased fairly steadily across the age groups, whereas production had a spurt between the 18 month and the 2-year-old groups. As this result is consistent with findings from other studies (Rasmussen & Bleses, 2018; Hao et al., 2008), it provides preliminary evidence supporting the feasibility of using this tool for Bangla, with further validation in a larger study needed.

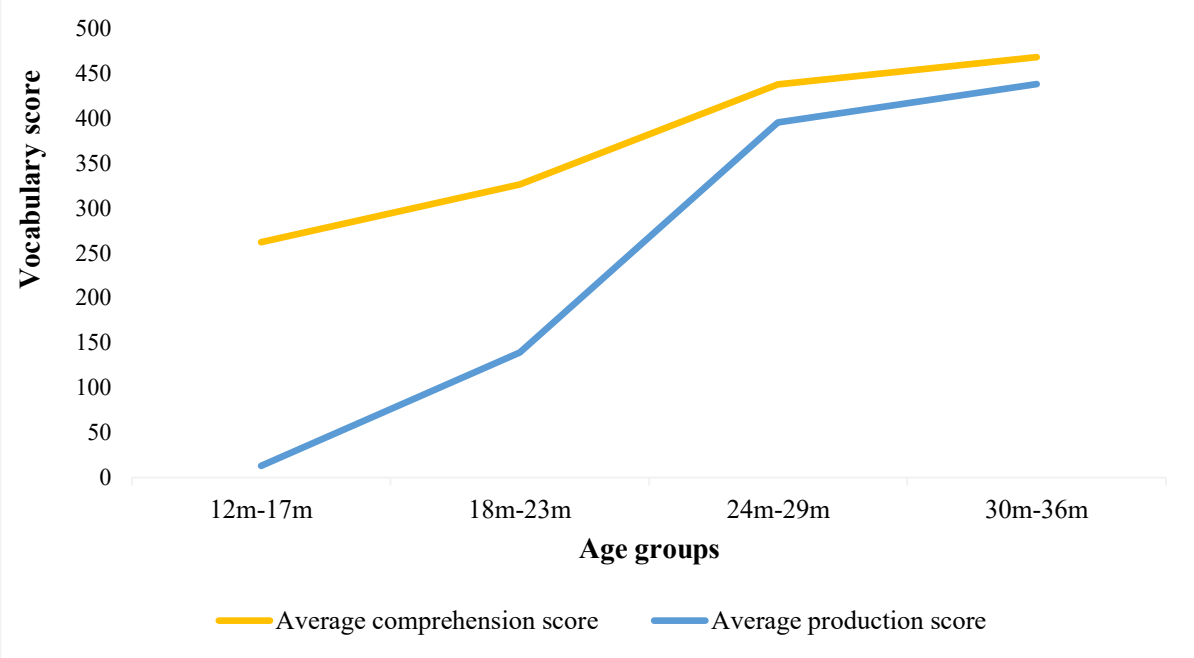

Figure 1. Vocabulary score of the children by age groups

Spearman correlation analyses were undertaken to assess the relationship between child's age and comprehension and production scores. A significant association was found between age and children's comprehension and production vocabulary scores, $r = 0.472$, $n = 23$, $p = .023$ for comprehension and $r = 0.664$, $n = 23$, $p \leq .001$ for production. These results are encouraging but should be interpreted as preliminary and require confirmation with a larger, more representative sample in a future validation study.

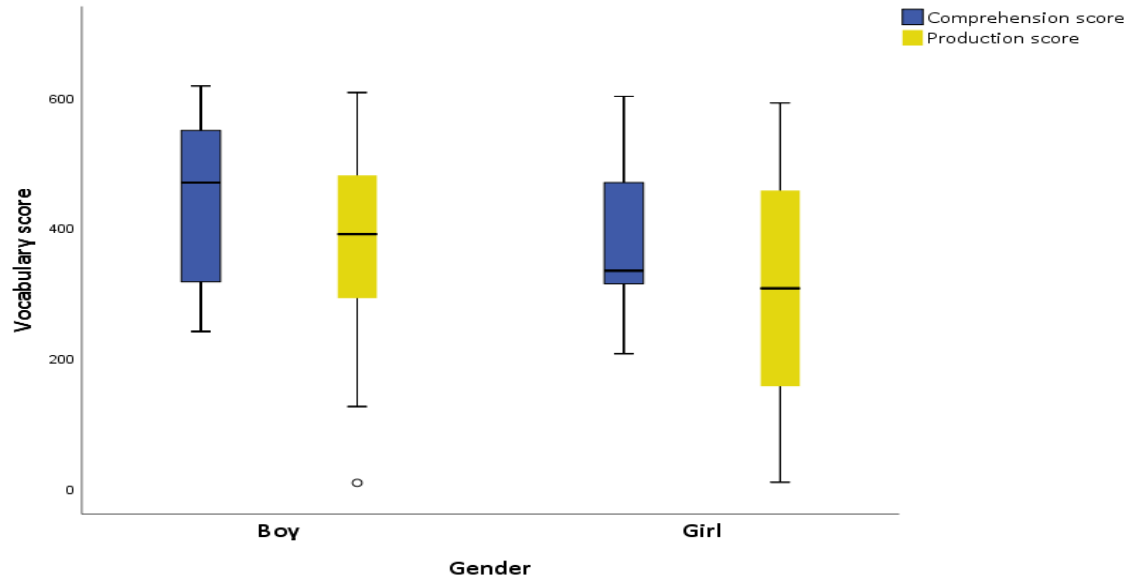

Figure 2. Vocabulary score of the children by gender

The literature has mostly reported that girls score higher in vocabulary than boys (Rasmussen & Bleses, 2018; Frota et al., 2016). A similar result was also found in the Hamadani et al. (2010) study. However, in this sample, differences by gender were not significant (Mann-Whitney $U = 48.00$, $p = .292$ and $U = 52.00$, $p = .420$ respectively), but raw scores for both comprehension and production were higher for boys (see figure 2). The median vocabulary score for boys was 469 (comprehension) and 390 (production) while those for girls were 334 and 307 respectively. However, there was considerable variability. These initial findings suggest a possible pattern, but the assessment of gender differences awaits validation in a larger, representative sample.

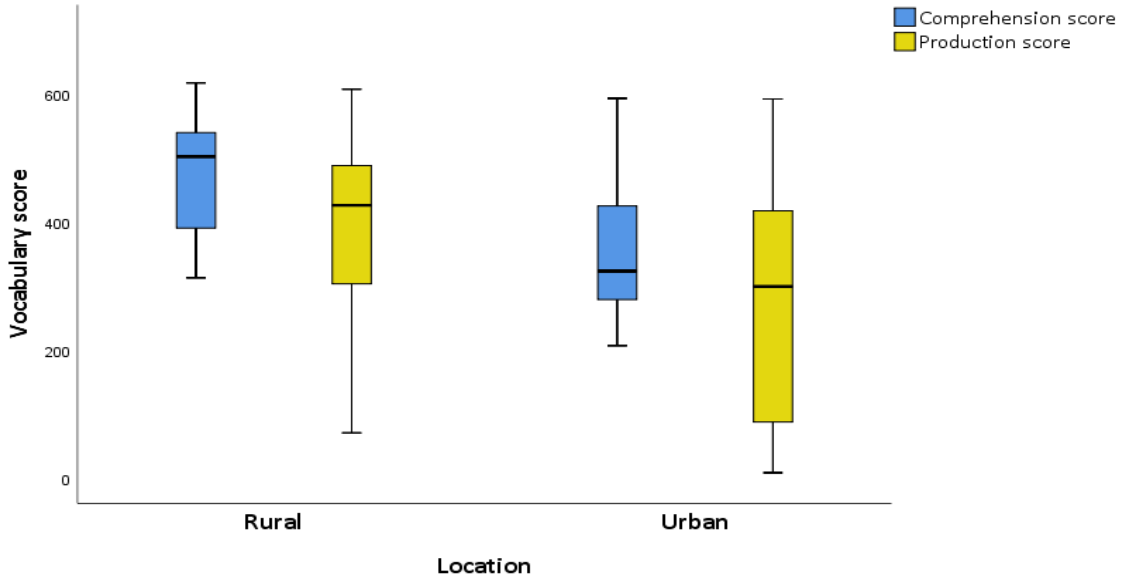

Figure 3. Vocabulary score of rural and urban children

Previous research has indicated that urban children tend to score higher in vocabulary assessments than rural children (Vogt et al., 2015). This is generally attributed to urban children having a wider set of experiences than their rural peers. In this small sample, there was a significant difference between rural and urban children for vocabulary comprehension (Mann-Whitney $U = 26.00$, $p = .014$), but not for vocabulary production ($U = 39.00$, $p = .097$). The difference was interestingly in the opposite direction; the median scores for rural children (502 for comprehension and 426 for production) were higher than those of urban children (323.5 and 299.5 respectively) [Figure 3]. The high degree of variability and small sample size means this result, while intriguing, needs to be confirmed or contradicted by a larger study.

Each item of this Bangla instrument was examined in regard to which were reported to as most commonly used. The five most used words were '*father*', '*mother*' (People), '*baa baa*', '*ma ma*', *'da da'* (Animal sounds and other sounds). The categories for the 20 most common words were 'People' (35%) and 'Animal sounds and other sounds' (25%). There were three items that no child understood or used, these were '*about*' (Prepositions and locations), '*cowboy*' (People), and '*borhani' (*a special drink common in Bangladesh) (Food and drink). Of the 20 least frequently produced words, 'Descriptive words' were the most featured (25%). Otherwise, there was a considerable spread of comprehension and production scores in many

categories (see supplementary material 3). Whether there are more patterns to be found within these categories would require further study with a larger and more representative sample.

5 Discussion

The MB-CDI has previously demonstrated the validity of using vocabulary to assess early language development (Dale & Penfold, 2011; Fenson et al., 2007). Majority world countries need efficient, valid, and reliable tools that are easy to use and not costly to develop or purchase, both to gain the background data needed to understand typical language development in their language and cultural contexts, and to identify delays and disorders in such development as early as possible.

The MB-CDI has been adapted into a range of languages, for example, Arabic, English, Spanish, Hindi (CDI Advisory Board, 2015b). However, apart from the short 60-word version (Hamadani et al., 2010) it has to date not been adapted into Bangla. This initial study on the feasibility of an adaptation of the MB-CDI for the Bangla language has been positive. The procedure for collecting data using this tool is time consuming, but it was not expensive nor arduous for the parents or the RAs and shows considerable promise as a tool for use in Bangladesh.

However, parents and RAs felt the tool was too long. This may be a possible barrier to use but weighed up against the amount of information it provides, and the possible increased reliability and validity that could result, it is worth retaining. Other versions of the MB-CDI are just as long, and there is ample evidence of them being used extensively. Although this is intended to be an independent parent report tool, RAs felt that the tool should be administered face to face as the mothers needed considerable support in completing the tool. Whether this is a barrier to the intended use of the tool may need further study.

The preliminary data indicates that this version of the tool may discriminate by age, as desired. The findings are similar to those for Faroese (Rasmussen & Bleses, 2018) and Mandarin Chinese (Hao et al., 2008). However, a larger study is needed.

The pilot results on gender and urban/rural location do not mirror those found elsewhere, see Frota et al. (2016) on the superior performance by girls and Vogt et al. (2015) on better performance from urban children. It is possible to speculate on reasons for the different results in this study, for example that patterns of family structure (generally, children in rural areas grown up in extended families and thus may possibly experience more rich language learning environment than urban children), or that parents may be more likely to overrate boys' language than girls. However, these results come from very small numbers, and a larger study will give more information, either support these findings or show that Bangla-speaking children are similar to children in other contexts.

6 Limitations and Directions for Future Research

This article reports on the development of a tool and includes data from a small sample from a specific city and village in Bangladesh. Building on the findings of this pilot, the next phase includes a revision of the tool in response to issues around duplications and lexical categories. This will be followed by validating the Bangla MB-CDI by establishing robust psychometric properties and representative norms. Planned analyses will include assessment of internal consistency and test-retest reliability, as well as evaluation of convergent and criterion validity with other established measures of early language development. Age-related growth patterns will be examined to ensure sensitivity across the 12–36-month range, and percentile norms will

be developed to facilitate practical interpretation of individual scores. Moreover, a head-to-head comparison between the current long version and Hamadani et al. (2010) 60-item Bangla CDI (or other brief versions), ideally using a longitudinal design, should be undertaken to evaluate their relative feasibility and psychometric equivalence, and to determine whether a shorter tool could serve as an efficient initial screening measure. A screening can then be followed by using the full version if more detailed assessment is required.

7 Conclusion

This pilot study has reported on the process of developing a culturally and linguistically suitable tool for assessing children's language development in Bangla. We hope that this serves as guide for other researchers hoping to develop a practical and cost-effective language tool for investigating early lexical development in majority world countries.

Acknowledgments

The authors would like to thank all the mothers who participated in this study and the research assistants who collected the data. The authors would also like to extend their special thanks to the six experts who provided their valuable feedback during developing the Bangla version of the MB-CDI. The authors would also like to extend their gratitude to Dr. Joan Leung for her support in statistical analysis. The first author would like to express his deepest appreciation to the University of Dhaka and the Government of Bangladesh.

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