

Articulatory Acquisition in Typically Developing Malayalam Speaking Children: 2-3 Years

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Abstract

The purpose of the present study was to obtain norms for the Malayalam Articulation Test (MAT; Maya, 1990) in the age range of 2-3 years and to determine those phonemes which are acquired by 75% and 90% of the children. MAT was administered to 120 (60 males and 60 females) children in the age range of 2 - 3 years subdivided into four age groups (2 - 2.3 years, 2.3 - 2.6 years, 2.6 - 2.9 years & 2.9 - 3 years) and the responses were transcribed using IPA. The statistical analysis of the data indicated that there was a significant difference across the age but not across gender. As age increased, the scores also increased indicating improved articulatory abilities due to neuromuscular maturation. All the vowels tested were mastered by 2.6 years of age. The phonemes as /ɳ/, /n/, /b/, /m/, /p/, /-nt/, /-t/, /-nth/, /-cj/, /-nd/ and /ʃ/ reached 90% criteria in all the three positions by 2.3 years itself /k/, /g/, palatal nasal /ɲ/, /g/, /v/, /-ty/, /ɳ/, /t/, /d/, /j/, /ʃ/, /-nk/, /r/ and /t/ reached 90% criteria by 3 years. None of the clusters reached even the 75% criteria by this age. Bilabials, labiodentals, dentals and velars were acquired earlier than alveolar, palatal, retroflex and glottal sounds. Unaspirated sounds were acquired earlier compared to aspirated sounds. Earlier acquisition of sounds in the present study is attributed to differences in lifestyle and to greater exposure to speech and language environment.

Key words: articulatory acquisition, malayalam, initial/ medial/ final position

Speech sound development refers primarily to gradual mastery of speech sound form within a given language. The order of acquisition of sounds and age norms pertains to the area of phonology. Many investigators have studied the acquisition of phonology describing the patterns that takes place in children at different age levels. The availability of normative data is essential to clinical assessment in child phonology. The data should include different groups of children acquiring the same target language because the norms are sensitive to sociolinguistic factors such as gender, socioeconomic status and language backgrounds.

The acquisition of phonemes in the speech of young English-speaking children has received considerable attention by speech language pathologists since 1930's (Wellman, Case, Mengert, & Bradbury, 1931; Poole, 1934; Templin, 1957; Sander, 1972; Prather, Hedrick & Kern, 1975; Arlt & Goodban, 1976; Fudala & Reynolds, 1986; Dyson, 1988; Mowrer & Burger, 1991; Robb & Bleile 1994).

Smit, Hand, Freilinger, Bernthal and Bird (1990) provided some normative data on the acquisition of speech sounds in children residing in Iowa and Nebraska. The study included 1049 children in the age range of 3 - 9 years of age. They considered 90% level

of acquisition for the mastery of sounds. The results indicated that girls appeared to acquire sounds earlier than boys, although this effect reached statistical significance only at age of 6 years and below. The consonants /m/, /n/, /h/, /p/, /f/, /w/ and /b/ were mastered by 3 years of age, the phonemes /l/, /tʃ/, /k/, /g/, /j/, /d/ and /t/ were acquired by 7 years of age and the phonemes /ŋ/ and /s/ were acquired by 7 to 9 years.

Mowrer and Burger (1991) stated that glides /j/ and /w/ are generally mastered before 3 years of age. Bauman-Waengler (1994) reported that the early sounds that are developing are nasals, stops, glides and liquids. Later sounds that are developing are fricatives and affricates.

Robb and Bleile (1994) studied the speech sample over a 12 month period of seven children, aged 8-14 months at the beginning of the study and 19 - 26 months at the end of the study. The findings showed that the number of consonants in their inventories increased over time, the number of consonants used in initial position was greater than in the final positions, stops and nasals emerged earlier than fricatives and bilabial, alveolar, glottal place of articulation predominated and produced were earlier than velars.

The literature on vowel development suggests that the acquisition is earlier than consonants (Templin, 1957). Fudala and Reynolds (1986) in their normative

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data reported that by the age of 1.6 to 1.11 years, vowels and diphthongs such as /ə/, /ʌ/, /ɛ/, /æ/, /ɔ/, /ʊ/, /a/, /ɪ/, /i/, /u/, /ou/, /ai/, /ei/, and /au/ reached 90% criterion. However the mid central vowel /ɜ/ and /ə/ did not reach the mastery criterion of 90% until the 5.6 to 5.11 years of age. The rhotic diphthong also reached the mastery criterion at the 5.6 to 5.11 years with the exception of /ɛr/, which reached 90% acquisition level at the 4.6 to 4.11 years.

Extensive studies on articulatory acquisition have been carried out in the Indian context also (Kumudavalli, 1973; Tasneem, 1977 and Prathima & Sreedevi, 2009 in Kannada; Usha, 1986 in Tamil; Padmaja, 1988 in Telugu; Arun Banik, 1988 in Bengali and Maya, 1990 in Malayalam). They concluded that the acquisition followed same pattern as in English but generally it was found that most of the sounds were acquired earlier in the Indian studies compared to the western context.

Padmaja (1988) studied the acquisition of sounds in 160 Telugu speaking children in the age range of 2½ - 4½ years and found that all vowels and most of the consonants except /r/, /s/, /ʃ/, /t/, /d/ and aspirated stops are acquired by 2½ years. /s/, /r/ and aspirated consonants are acquired by 3.3 years and /t/, /ʃ/ and some clusters by 3½ years.

Maya (1990) studied 240 Malayalam speaking children in the age range of 3-7 years. She reported that they acquired /s/, /r/, /l/, /f/, /tʃ/, /j/ and unaspirated stops at an earlier age of 3-3.6 years, while aspirated stops were acquired as late as 6-6.6 years. The criterion of acquisition considered was 75%.

Prathima and Sreedevi (2009) studied 120 Kannada speaking children in the age range of 3-4 years and reported that all the vowels, diphthongs and most of the consonants were mastered by 90% of the children by 3-3.6 years except /r/ and /h/ in initial and medial positions. By 4 years of age, /r/ was acquired in medial but not in initial positions by 90% of children and /h/ was not acquired even by 75% of the children. Among the clusters only /ski/ met the 90% criteria by 4 years.

More recently it has been the observation of speech-language pathologists that the children of this generation are acquiring speech sounds at an earlier age than their earlier counter parts. In view of this fact, the previous norms were obtained 20 years back in Malayalam by Maya (1990). Hence there is an immediate need to test much younger children for

determining the exact age of acquisition and to update the previously obtained norms for both clinical and research purposes. Thus this study aimed at obtaining norms for the mastery of articulatory skills in typically developing Malayalam speaking children in the age range of 2-3 years.

The specific objectives of the study were (a) to administer the Malayalam Articulation Test (Maya, 1990) and to establish the ages at which 75% and 90% of the children produce the phonemes of Malayalam correctly (b) to compare the articulatory skills across age and gender (c) to compare the difference in the articulatory acquisition of phonemes in initial, medial and final positions of the words (d) to compare the data obtained with that of the earlier reported studies in both English and other Indian languages.

Method

Subjects: 120 typically developing Malayalam speaking children in the range of 2 - 3 years were selected randomly from different localities of Wayanad district in Kerala. The children were subdivided into four groups with an age interval of three months (2 - 2.3 years, 2.3 - 2.6 years, 2.6 - 2.9 years & 2.9 - 3 years). Each group comprised of a total of 30 children including 15 girls and 15 boys. The subjects reared in an ambient environment of Malayalam and belonging to middle socio economic status was selected. The subjects were exposed to some amount of English language also in the kindergarten set up. The children who did not have any speech, language, hearing, cognitive or any other motor difficulties were considered. They were selected based on the parental interview and the informal screening for speech, language, hearing, cognitive or any other developmental difficulties.

Test material: The diagnostic test of articulation "The articulation test battery in Malayalam" by Maya (1990) was used as the test material. The Articulation Test consists of 82 target words for testing 10 vowels, 38 consonants and eight consonant clusters. The vowel sounds were tested only in the initial position. Most of the consonants were tested in the initial and medial positions, two consonants in medial and final positions (/l/ and /ŋ/) and three consonants (/r/, /R/ and /m/) were tested in all the positions. The consonant clusters were tested in initial and medial positions (two clusters in initial and six in medial positions). The material consisted of 82 colored photographs of the real objects which were highly representative of the target stimuli. Each target picture was designed to elicit the target sound as a single phoneme or cluster in each position.

Procedure: Each subject was tested individually in a quiet room. Once the rapport was established, the examiner presented the target pictures one after another. The target picture was presented one at a time to the subjects on a laptop computer (Compaq - C 770 TU) screen. Subjects were encouraged to name the pictures spontaneously. If any of the subjects failed to identify a target picture, additional cues were presented by the examiner. In spite of additional cues, if the child failed to name the target picture, the child was asked to repeat the target word after the examiner. The response elicited was audio recorded using Cenix digital recorder VR - P - 217 at high quality mode with an external mini microphone placed approximately 10 inches away from the subject's mouth.

Scoring: The data obtained from all the 120 subjects were transcribed using broad and narrow IPA transcription. All the responses of each subject were analyzed sound-by-sound on a response sheet. Correct responses (CR), substitutions (S), omissions (O), distortions (D), additions (A) or any other type of articulatory deviation (Ao) were recorded on the response sheet. A score of '1' was given to each correct response; a score of '¾' for distortion error; a score of '½' for substitution error and score of '0' for omission error were assigned. The maximum score was 82, i.e. when all the test phonemes were correctly produced. Finally the total score for each subject was calculated. The score sheet is provided in the Appendix.

Inter-judge Reliability: To examine inter-judge reliability, 10% of the total samples were selected randomly from each of the four groups and it was transcribed and analyzed by two experienced speech-language pathologists who were native speakers of Malayalam. The transcribed samples of the two judges were compared and the mean percentage of consonant agreement was calculated.

Data analysis: From the scores obtained for the articulatory production, the mean, standard deviation and range of scores were calculated for each age group and separately for boys and girls in initial, medial positions and final positions. The data obtained were subjected to suitable statistical analysis. Phonemes which were produced correctly by 75% and 90% of the subjects in each age group in the initial, medial and final positions were separately identified. An analysis of the phonemes substituted or distorted in production is discussed in detail.

Results and Discussion

Two-way ANOVA was carried out to analyze the significant difference in articulatory scores between the age groups as well as across gender. Their results indicated that in general there was no significant difference between gender but there was a significant difference across age groups. The results are presented and discussed under the following sections.

I Age vs. Articulatory acquisition: Two-way ANOVA was carried out to find the significant difference between different age groups and the result indicated that the articulatory development was steady from 2 to 2.6 years of age. There seemed to be a sudden increase in the development of articulatory skills in the period of 2.6 to 2.9 years following which there was no significant change in the developmental scores till 3 years of age. All the vowels and some of the consonants were acquired by 75 % of the children by 2.3 years of age itself. The exceptional consonants were /g/, /ʈ/, /ɳ/, /ŋ/, /l/, /ʌ/, /v/, /pʰ/, /s/, /ʃ/, /r/, /ʒ/, /R/, /tʰ/, /dʰ/, /ʒ/, /tʰ/, /h/ and /kʰ/. Table 1 and Figure 1 depict the articulatory scores across the age groups over the years.

Table 1. Mean articulation scores & standard deviation in different age groups

Gender	Groups	Age in years	N	Mean (Std. Deviation)
Boys	Group I	2-2.3	15	63.07 (1.87)
	Group II	2.3-2.6	15	64.40 (2.74)
	Group III	2.6-2.9	15	68.55 (2.77)
	Group IV	2.9-3	15	69.40 (5.21)
	Mean Total Scores		60	66.35(4.26)
Girls	Group I	2-2.3	15	63.30 (2.23)
	Group II	2.3-2.6	15	64.42 (3.19)
	Group III	2.6-2.9	15	68.72 (3.18)
	Group IV	2.9-3	15	69.55 (1.94)
	Mean total score		60	66.49(3.77)
Combined Scores	Group I	2-2.3	30	63.18 (2.02)
	Group II	2.3-2.6	30	64.40 (2.92)
	Group III	2.6-2.9	30	68.63 (2.93)
	Group IV	2.9-3	30	69.47(3.86)

The findings of the earlier Western classical studies (Wellman et al., 1931; Poole, 1934; Templin, 1957; Mecham, 1962; Arlt & Goodban, 1976) and some of the Indian studies (Tasneem, 1977; Usha, 1986; Padmaja, 1988; Arun Banik, 1988; Maya, 1990 and Prathima & Sreedevi, 2009) indicated that

phoneme development is correlated with age and some sounds are acquired earlier than others.

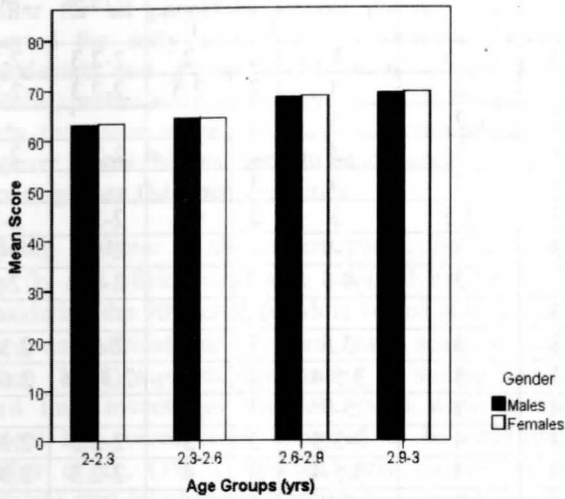


Figure 1. Mean articulation scores in different age groups in males and females.

The results of the present study are in consonance with the above studies. It is evident that with neuromuscular maturity, all motor skills increased as the age advanced and so also the articulation skills.

II Gender vs. Articulatory articulation: Two-way ANOVA was carried out to find the significant difference across male and female children. The results revealed that there was no significant difference across gender in all the four groups. These results agreed with many of the earlier Western studies (Roe & Millisen, 1942) and Indian studies (Tasneem, 1977; Padmaja, 1988; Maya, 1990 and Prathima & Sreedevi, 2009) who found statistically no significant difference between boys and girls with respect to the correct production of consonant sounds. In the present study, the difference between boys and girls was not significant and this may be because of the equal opportunity in the speech environment for both boys and girls in the present day scenario especially in the urban population. So both male and female children are following the same developmental trend for articulatory acquisition.

III Order of acquisition of sounds

Vowel acquisition: All the vowels /a/, /a:/, /i/, /i:/, /e/, /e:/, /o/ and /o:/ were acquired by 100% of the children by the age of 2.3 years itself except /u/ and /u:/ where only 75% of the children mastered the production by 2.3 years of age. By 2.6 years of age 90% of the children produced /u/ and /u:/ correctly and 100% scores were obtained by 2.9 years of age.

Consonant acquisition: 11 consonants such as /ŋ/, /n/, /b/, /m/, /p/, /-nt/, /-t/, /-nth/, /-cj/, /-nd/ and /ʃ/ were acquired by 90% of the children in all the three positions by the age of 2.3 years itself. By the age of three years, 16 phonemes- /k/, /t/, palatal nasal /ɲ/, /g/, /v/, /-ty/, /l/, /t/, /d/, /t/, /d/, /j/, /tʃ/, /-nk/, /tʰ/ and /t/ were also acquired in all the three positions by 90% of the children. Tables 2 and 3 present the comparison of present results with Western and Indian studies.

When comparing the present study with the western studies (So & Dodd, 1995; Fudala & Reynolds, 2000), it was observed that all the sounds were acquired much earlier. However the order of acquisition of the consonants was the same. According to Fudala and Reynolds (2000), the age of acquisition of /s/ and /z/ appears to be quite late, supporting the late acquisition of /s/ in the present study (< 75% by 3 years).

On comparison of the present study with that of Maya's (1990) in Malayalam, all the consonants tested were acquired much earlier. Maya reported the late acquisition of /s/, /ʃ/, /ʒ/, /l/, /r/ and /R/ (4 - 5.6 years). However in the present investigation these sounds were achieved at a younger age though they did not meet the 75% criteria except /r/ in initial and medial and /R/ in final positions.

The aspirated sounds were acquired late compared to the unaspirated sounds. Among aspirated sounds, phoneme /tʰ/ was acquired early by 2.3 years of age itself (86.66%), followed by /tʃʰ/ and /dʰ/ in all the positions and /kʰ/ in medial position by 2.6 years and in initial position by 3 years of age. Phoneme /pʰ/ did not reach 90% criteria by 3 years. The present results agree with the results of So and Dodd (1995) and the results of Padmaja (1988) and Maya (1990) which reported the early acquisition of unaspirated plosives compared to their aspirated cognates.

Consonant clusters: In Malayalam Articulation Test (MAT), seven consonant clusters were tested which included /ndra/, /kra/, /tra/, /sta/, /stra/ that occur in medial positions, /pra/ in initial position and /ska/ that occur in both the initial and medial positions. Considering the acquisition pattern in consonant clusters, the results indicated that none of the clusters reached 75% criteria by 3 years of age. Only a single boy in the age range of 2.9 to 3 years produced /tra/, /sta/, and /ska/ in medial position.

Table 2. Comparison of the result of the present study with western studies

Speech sounds	Well man et al., (1931) 75%*	Poole (1934) 100%*	Templin (1957) 75%*	Mecham (1962)	Sander (1972) 75%*	Prather (1975) 75%*	Arlt (1976)	Irwin & Wong (1983)	Smith et al. (1990) 75%*	Fudala & Reynolds (2000), 90%*		Present study (2010)	
										I	F	75 %	90%
/m/	3	3 ½	3	3.5	< 2	2	3	1.5	3	2	2	2-2.3	2-2.3
/n/	3	4 ½	3	3.5	2	2	3	2	3	2	2.5	2-2.3	2-2.3
/h/	3	3 ½	3	3.5	< 2	2	3	2	3	2	-	-	-
/p/	4	3 ½	3	3.5	< 2	2	3	3	3	2	3	2-2.3	2-2.3
/f/	3	5 ½	3	4.5	3	2-4	3	3	3	3	3	-	-
/b/	3	3 ½	4	3.5	< 2	2-8	3	1.5	3	2	3	2-2.3	2-2.3
/ŋ/	--	4 ½	3	3.5	2	2-8	3	3	7-9	-	4	2-2.3	2-2.3
/j/	4	4 ½	3 ½	4.5	3	2-4		3	4-5	5	-	2-2.3	2-2.3
/w/	3	3 ½	3	-	2	2-8	3			1.5			
/k/	4	4 ½	4	4.5	2	2-4	3	3	3.5	3	3	2-2.3	2.3-2.6
/g/	4	4 ½	4	4.5	2	2-4	3	3	3.5-4	3	3	2.3-2.6	2.6-2.9
/l/	4	6 ½	6	5.5	3	3-4	4	3	5-7	5	5.5	-	-
/d/	5	4 ½	4	4.5	2	2-4	3	4	3-3.5	3	3	2-2.3	2.3-2.6
/t/	5	4 ½	6	5.5	2	2-8	3	3	3.5-4	3	4	2-2.3	2.3-2.6
/s/	5	7 ½	4 ½	5.5	3	3	4	3	7-9	6	6	-	-
/r/	5	7 ½	4	5.5	3	3	5	3	8	6	-	2.6-2.9	-
/ʃ/	5	4 ½	4 ½	5.5	4	3-8	4	4	6-7	5	-	2-2.3	2-2.3
/v/	5	6 ½	6	5.5	4	4	3 ½	3.5	5.5	5	5	2.3-2.6	2.6-2.9
/z/	5	7 ½	7	7.5	4	4	4	3	7-9	6	6	-	-
/ʒ/	6	6 ½	7	7.5	6	4	4	3	-	-	-	-	-
/θ/		7 ½	6	5.5	5	4	5	4	6-8	5.5	-	2-2.3	2-2.3
/ʃ/		6 ½	4 ½	5.5	4	3-8	4 ½	3	5	5	1.5	-	-

‘*’ indicates criteria for the sound to be considered as acquired. ‘-’ indicates consonants not acquired, empty space indicate speech sound not tested

However during data collection it was observed that 60% of the children were substituting one of the consonants of the clusters by 2.9 years. Therefore it can be inferred that by 2.9 years children begin to produce clusters but they have substitution errors. The clusters with substitution errors seen in this study were /ʃta/ for /sta/ and /ʃka/ for /ska/, that is, a palatal fricative was used for a dental fricative. This finding is convincing because by 2.9-3 years, palatal /ʃ/ was achieved by 73.33% of the children whereas dental /s/ was achieved by only 53.33% of the subjects in the present study. Hence it can be inferred that in the process of acquisition of clusters, the early achieved palatal was used as a substitution. The results of the present study agree with most of the western studies (Templin, 1957 and Smit et al., 1990) and Indian studies (Tasneem, 1977; Arun Banik, 1988; Maya, 1990 and Prathima & Sreedevi, 2009) which say that the clusters were acquired later compared to consonants and vowels. Maya (1990) reported that the consonant clusters were emerging only at the age of 4.7 years and the acquisition continued till the age of seven years.

In contrast, the present finding was that clusters emerged by 2.9-3 years itself however with substitution errors.

Acquisition based on place, voicing and manner features

Place feature: When considering 90% criteria, the bilabials (/p/, /b/, /m/), dentals (/t/, /d/, /n/), labiodentals (/v/), and velars (/k/, /g/, /ŋ/) except their aspirated counterparts were acquired by 2.6 years. Alveolars (/t/, /s/, /l/, /r/, /R/), retroflex (/ɖ/, /ɳ/, /ɭ/, /ʂ/) and palatals (/ʃ/, /ʈ/, /j/, /ʃ/, /ɻ/, /ɻ/), were the late acquiring phonemes. Among alveolars, /t/ was acquired earlier (2.6 years), while other phonemes were not mastered by 90% of the children by 3 years. Palatal /ʃ/ and /j/ (2.3 years) were acquired earlier followed by /ʈ/ (3 years), whereas /ɻ/ and /ʃ/ did not reach 90% criteria by 3 years. Retroflex /ɻ/, /ɖ/ and /ɳ/ (2.9 years) were achieved earlier than retroflex /ʂ/ and none of these retroflex sounds reached 90% criteria even at the age of 3. Glottal /h/ was not acquired by 3 years even by 75% children.

When compared with Maya's (1990), it was observed that all the phonemes in the present study were acquired earlier. The order of acquisition was similar for all phonemes, except phoneme /h/. She reported the early acquisition of bilabials, dentals, labiodentals and glottal (3-3.6 years) followed by alveolar, palatal and retroflex phonemes. In the present study the same order of acquisition was observed, however glottal /h/ was found to be acquired at a much later stage than the other phonemes.

Voicing feature: In the present study, the unvoiced stop /k/ and affricate /tʃ/ were acquired by 2.6 years considering the 90% criteria, while voiced stop /g/ (2.9 years) and affricate /dʒ/ (3 years), were acquired later. Dyson (1988) supports this finding by stating that in word final inventories voiceless stops were always present but voiced stops appeared to be emerging. Prather et al., (1975) reported early acquisition of voiceless stop /p/ (2 years) compared to voiced stop /b/ (2-8 years). Smit et al., (1990) also supports the earlier acquisition of voiceless /k/ compared to voiced /g/.

Manner of articulation: Generally when considering the manner of acquisition it was observed that nasals, unaspirated stops, frictionless continuant were acquired

first compared to laterals, fricatives, affricates, flap and trill.

Plosives: Some of the plosives were acquired by the age of 2.3 years itself, where as few plosives did not reach 90% criteria even by 3 years. The sounds /p/, /b/ and /tʰ/ were the first acquired plosives by the age of 2.3 years, followed by /t/, /d/, /t̪/, /d̪/, /tʰ/ and /k/ by 2.6 years, /g/ by 2.9 years and /kʰ/ by 3 years of age. Aspirated /pʰ/ did not meet 75% of criteria even by 3 years. The present findings indicated an early acquisition of unaspirated phonemes (2.9 years) compared to aspirated phonemes. All the unaspirated plosives reached the 90% criteria by 2.9 years itself compared to 3.6 years reported by Maya (1990).

According to her, the aspirated retroflex /tʰ/ and dental /tʰ/ were acquired by 6.6 years, and /kʰ/ by 7 years. However she considered children above the age of 3 years.

Nasals: All the nasals achieved 90% criteria by 2 - 2.3 years itself. When comparing the present results with Western (Irwin & Wong, 1983; Fudala & Reynolds, 2000) and Indian studies (Padmaja, 1988 and Arun Banik, 1988) similar pattern of acquisition was seen, in which the nasals were acquired much earlier than other sounds. When compared with the results obtained by

Table 3. Comparison of the result of the present study with other Indian studies

Speech sounds	Tasneem, 1977 (Kannada) 75%*	Usha, 1986 (Tamil) 75%*	Padmaja, 1988 (Telugu) 75%*	Arun Banik, 1988 (Bengali) 90%*	Maya, 1990 (Malayalam) 75%*	Prathima & Sreedevi, 2009 (Kannada) 90%*	Present study (Malayalam) 2010	
							75% *	90 %*
M	3	3	2.6	2.5	3-3.6	3-3.6	2-2.3	2-2.3
N	3	3	2.6	2.5	3-3.6	3-3.6	2-2.3	2-2.3
D				2.5	3-3.6		2-2.3	2-2.3
P	3	3	2.6	2.5	3-3.6	3-3.6	2-2.3	2-2.3
F			2.9		3-3.6		-	-
H			2.6	3	3-3.6	-	-	-
K	3	3	2.6	2.7	3-3.6	3-3.6	2-2.3	2.3-2.6
B	3	3	2.6	2.5	3-3.6	3-3.6	2-2.3	2-2.3
D	3.6	3	2.6	3	3-3.6	3-3.6	2-2.3	2.3-2.3
G	3	3	2.6	3	3-3.6	3-3.6	2.3-2.6	2.6-2.9
R	4.6		3.9	4	3.7-4	-	2.6-2.9	-
S	3	3	3.3		3.6-4	3-3.6	-	-
ʃ	5.1	6	3.6	3	5-5.6	3.6-4	-	-
tʃ	3.7	3	2.6	3	3-3.6	3-3.6	2-2.3	2-2.3
t		3	2.6	3	3-3.6	3-3.6	2-2.3	2.3-2.6
v	-	3	2.6		3-3.6	3-3.6	2.3-2.6	2.6-2.9
l	3	3	2.6	3	3-3.6	3-3.6	-	-
j	3	3	2.5	3	3-3.6	3-3.6	2-2.3	2.3-2.6

“*” indicates criteria for the sound to be considered as acquired. “-” indicates consonants not acquired, empty space indicate speech sounds not tested

Maya (1990) all the nasals were acquired one year and three months earlier.

Fricatives: None of the fricatives tested (/s/, /ʃ/, /ʒ/ and /h/) met 75% criteria of acquisition by 3 years. These results are in consonance with the Western study by Wellman et al., 1931; Poole, 1934; Sander, 1972 and Fudala & Reynolds, 2000), which indicated the late acquisition of fricatives. Similarly the results are also in agreement with Maya's (1990) findings, that the fricatives /s/, /ʃ/, /ʒ/ and /h/ were acquired much later.

Affricates: The results indicated that affricate /tʃ/ was acquired at the age of 2.3 years, followed by aspirated /tʃʰ/ by 2.6 years, whereas voiced affricate /dʒ/ was achieved only by 3 years. The present results indicated that the acquisition of affricates was much earlier compared to the western studies, as per Sander (1972) by 4 years, Prather et al., (1975) by 3-3.8 years and Fudala and Reynolds (1986) by 5.6 years. On comparison with Maya's (1990), the unaspirated affricates (/tʃ/, /dʒ/) were acquired 6 months earlier and aspirated affricates were acquired 4 years earlier in the present study.

Laterals: The results revealed that voiced retroflex lateral (/ɭ/) was acquired earlier (2.9 years) by 90% of the children, where as voiced alveolar lateral (/l/), voiced palatal lateral (/ɮ/) did not reach 90% criteria by 3 years. On comparison with Maya's (1990) findings, voiced retroflex lateral was acquired almost one year earlier in the present study.

Flaps: The Flap /ɾ/ was acquired by only 75% of the children by 3 years of age. In Maya's (1990) findings /ɾ/ was acquired only by 4 years of age.

Trill: The trill /R/ was not mastered even at the age of three years. Also the observation was that the percent of acquisition of trills was higher in the final positions (80%), followed by medial (53%) and then the initial position (26.6%) for both boys and girls. On comparison with Maya's (1990), /R/ in final position was acquired almost two years earlier in the present study.

Frictionless continuant (Semivowels): /j/ reached 90% criteria by 2.3 years itself, whereas /v/ reached only by 2.9 years. This finding is well supported by Mowrer and Burger's (1991) study, which indicated the early acquisition of glides before 3+ years itself.

On comparison with Maya's (1990), both the phonemes were acquired much earlier, /j/ by one year and /v/ by 6 months. Figure 2 indicates the manner of consonant acquisition by 90% of the children in the present study.

IV Speech sound acquisition versus word position:

In the present study the phonemes /l/, /R/ and /m/ were tested in all the three positions, where as retroflexes /ɭ/ and /ɮ/ only in medial and final positions, as it occurs only in these two positions. All other consonants were tested in both initial and medial positions. Results indicated that the phoneme /m/ was mastered in all the three positions by the age of 2.3 years itself. The phonemes /l/, /R/ and /ɮ/ were first acquired in final, followed by medial and initial positions by 90% of the children. However phoneme /ɭ/ was achieved first in medial position compared to final position. When considering the phonemes that were tested in initial and medial positions, the results found that /g/, /dʒ/, /ɳ/, /d/, /t/, /kʰ/, /ʃ/, /ʒ/ and /s/ were first acquired in medial position of words whereas /v/, /d/, /t/ and /j/ were acquired in the initial position. The present findings are similar to the study by Prathima and Sreedevi in Kannada and Stoel-Gammon's (1985) in English which indicated the phoneme /r/ appeared earlier in medial position than in the initial position of words.

Inter-judge reliability: Inter-judge reliability for phoneme transcription was assessed by comparing the percentage of phoneme agreement between the transcriptions of the investigator and those of the two judges on 10% of the samples randomly selected across the total 120 samples. The inter-judge agreement for phoneme transcription was 94%.

Based on the scoring obtained from the present study, typically developing Malayalam speaking children in the age range of 2-3 years should obtain mean scores as shown in Table 4. As no significant gender difference was observed, the articulation scores are combined for each age group.

Table 4. Mean articulation scores expected for typically developing children in the age range of 2-3 years

Age in years	Mean articulatory scores Maximum score - 82
2.0 - 2.3 years	66.18 ± 2.02
2.3 - 2.6 years	66.40 ± 2.92
2.6 - 2.9 years	68.63 ± 2.93
2.9 - 3.0 years	69.47 ± 3.86

Manner of articulation	Boys and Girls			
	2-2.3 years	2.3-2.6 years	2.6-2.9 years	2.9-3 years
Plosives				
/k/	————→	————→	————→	————→
/g/	————→	————→	————→	————→
/t/	————→	————→	————→	————→
/d/	————→	————→	————→	————→
/p/	————→	————→	————→	————→
/b/	————→	————→	————→	————→
/θ ^h /	————→	————→	————→	————→
/k ^h /	————→	————→	————→	————→
/t ^h /	————→	————→	————→	————→
/p ^h /	————→	————→	————→	————→
	-----▶	-----▶	-----▶	-----▶
Fricatives				
/s/	-----▶	-----▶	-----▶	-----▶
/ʃ/	-----▶	-----▶	-----▶	-----▶
/ʒ/	-----▶	-----▶	-----▶	-----▶
/h/	-----▶	-----▶	-----▶	-----▶
Affricates				
/tʃ/	-----▶	-----▶	-----▶	-----▶
/tʃ ^h /	-----▶	-----▶	-----▶	-----▶
/dʒ/	-----▶	-----▶	-----▶	-----▶
Nasals				
/m/	————→	————→	————→	————→
/n/	————→	————→	————→	————→
/ɳ/	————→	————→	————→	————→
Glides				
/j/	————→	————→	————→	————→
/v/	————→	————→	————→	————→
Trills				
/l/	-----▶	-----▶	-----▶	-----▶
/ɭ/	-----▶	-----▶	-----▶	-----▶
/ɮ/	-----▶	-----▶	-----▶	-----▶
Flaps				
/r/	-----▶	-----▶	-----▶	-----▶
Trill				
/R/	-----▶	-----▶	-----▶	-----▶
Frictionless continuant				
/v/	————→	————→	————→	————→
/j/	————→	————→	————→	————→

Figure 2. Manner of consonants acquisition by 90% of children.

————→ Indicates sounds acquired by 90% of the children.
 -----▶ Indicates sounds not acquired by 90% of the children.

Conclusions

The purpose of the study was to obtain articulatory scores for Malayalam speaking children in the age range of 2-3 years using Malayalam articulation test (MAT). The results revealed that all the vowels tested were acquired by the age of 2.3 years itself except /u/ and /u:/. The children acquired bilabials, labiodentals, dentals and velars earlier compared to alveolars, palatal, retroflex and glottal sounds. Unaspirated sounds were acquired earlier compared to aspirated sounds. The early articulatory acquisition in the present study compared to some earlier studies may be attributed to differences in lifestyle and a change in norms, over years because of greater exposure to speech and language environment.

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APPENDIX (Score sheet)

Name:

Age/ sex:

Place:

Sl. No.	Phoneme	Position	Check word	CR*	S*	O*	D*	A*	Ao*	Score
1	a	initial	aṇṇa:n							
2	a:	initial	a:na							
3	i	initial	ila							
4	I:	initial	I:ḷa							
5	u	initial	uRi							
6	u:	initial	u: ṇṇa:l							
7	e	initial	eli							
8	e:	initial	e:ṇi							
9	o	initial	onnə							
10	o:	initial	o:la							
11	k	initial	kuda							
12		medial	ta:ko:l							
13	g	initial	gada							
14		medial	bagə							
15	ŋ	medial	ma: ṇa							
16	ʃ	initial	ʃi:ppə							
17		medial	Pu:ḷa							
18	ɕ	initial	ɕannal							
19		medial	gaɕam							
20	ɲ	initial	ṇandə							
21			ṇa:ṇṇu:l							
22	t	initial	tapə							
23	ɖ	initial	ɖo:kta:r							
24		medial	rodə							
25	ɳ	medial	kiṇar							
26		final	tu:ṇ							
27	t	initial	tata							
28		medial	mo: tiram							
29	d	initial	di:pam							
30		medial	maddalam							
31	n	initial	nakṣatram							
32	p	initial	Pu:və							
33		medial	uduppə							
34	b	initial	bassə							
35		medial	Riban							
36	m	initial	ma:la							
37		medial	am:a							
38		final	maram							
39	j	initial	Je:ḷu							
40		medial	mujal							
41	l	initial	lo:ri							
42		medial	alama:ra							
43		final	viral							

44	l	medial	va a							
45		final	va:							
46	v	initial	vi: də							
47		medial	ʃfevi							
48	h	medial	simham							
49	-nt	medial	pa: ntə							
50	-t	medial	pu: mpa: ta							
51	-nt	medial	pantə							
52	-nj	medial	sanji							
53	-nd	medial	tivandi							
54	nk	medial	panka							
55	s	initial	su: rjan							
56		medial	kas: era							
57	p ^h	medial	p ^h alam							
58	r	initial	ra: ʃa: və							
59		medial	ʃferuppə							
60	-ty	medial	intya							
61	ʃ	initial	ʃank ^h ə							
62		medial	me: ʃa							
63	l	medial	ko: l							
64	R	initial	Re: dio							
65		medial	uRumpə							
66		final	caR							
67	ndra	medial	ʃandran							
68	pra	initial	pravə							
69	kra	medial	ʃakram							
70	tra	medial	pa: tram							
71	ʃ	initial	ʃartə							
72		medial	braʃə							
73	sta	medial	pustakam							
74	ska	initial	sku: tar							
75			biskattə							
76	ʃ ^h	initial	ʃ ^h : ja							
77	t ^h	medial	ka t ^h akali							
78	t ^h	medial	mi t ^h a: ji							
79	stra	medial	vastram							
80	k ^h	initial	k ^h agam							
81		medial	muk ^h am							
82	kʃ	initial	nakʃatram							

*'CR'-Correct responses, 'S'-substitutions, 'O'-omissions, 'D'-distortions, 'A'-additions & 'Ao'-any other type of articulatory deviation