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Articulation Screener Scale Normative Data Study According to Phonological Developmental Characteristics of Turkish Children

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CLINICAL STUDY

ARTICULATION SCREENER SCALE NORMATIVE DATA STUDY ACCORDING TO PHONOLOGICAL DEVELOPMENTAL CHARACTERISTICS OF TURKISH CHILDREN

Meryem MUTLU[1], PhD; Ayse Sanem SAHLI[2], PhD; Erol BELGİN[3], PhD;

[1]*University of Health Sciences, Kayseri City Training and Research Hospital, Audiology and Speech Pathology Department, Kayseri, Turkey* [2]*Hacettepe University, Vocational School of Health Services, Hearing and Speech Training Center, Ankara, Turkey* [3]*Ankara Medipol University, Faculty of Health Sciences, Department of Audiology, Ankara, Turkey*

SUMMARY

Objective: Early diagnosis of phonological delay and articulation disorders is very important in childhood. The aim of this study is to obtain normative data of the Articulation Screener Scale (ASS) according to the phonological developmental characteristics of Turkish children between the ages of 2 and 8.

Method: The study was conducted with a total of 330 healthy children who attend to preschool and primary school, who have normal language and speech development. Auditory perception and expressive language development of children were assessed with the Preschol Language Scale-5. The articulation skills of children with normal language development were assessed by ASS, and normalization studies were performed with the obtained data.

Results: As a result of the study, the process of phonemic acquisition of children between the age of 2 and 8 were determined. When the total score of the ASS was compared considering each age range of the children from both genders, no statistically significant difference was detected (p>0.05). However, a statistically significant difference in favor of girls was detected between boys and girls (p=0.009).

Conclusions: In this study, a reference resource was created to evaluate the articulation skills of Turkish children and normative data of a scale that could have been used for screening the children with articulation disorders in our country was obtained.

Keywords: Articulation; phonological development; Articulation Screener Scale; child; Turkish

TÜRK ÇOCUKLARININ FONOLOJİK GELİŞİM ÖZELLİKLERİNE GÖRE ARTİKÜLASYON TARAMA ÖLÇEĞİ NORMATİF VERİ ÇALIŞMASI

ÖZET

Amaç: Çocukluk çağında fonolojik gecikme ve artikülasyon bozukluklarının erken teşhisi çok önemlidir. Bu çalışmanın amacı, 2-8 yaş arası Türk çocuklarının sesbilgisel gelişim özelliklerine göre Artikülasyon Tarama Ölçeği (ATÖ)"nin normatif verilerini elde etmektir.

Yöntem: Araştırmaya, okul öncesi ve ilkokula devam eden, dil ve konuşma gelişimi normal olan toplam 330 sağlıklı çocuk dahil edilmiştir. Çocukların işitsel algıları ve ifade edici dil gelişimleri Okul Öncesi Dil Ölçeği-5 ile değerlendirilmiştir. Normal dil gelişimi olan çocukların artikülasyon becerileri ATÖ ile değerlendirilmiş ve elde edilen veriler ile normalizasyon çalışması tamamlanmıştır.

Bulgular: Çalışma sonucunda 2-8 yaş arası çocukların fonem kazanım süreçleri belirlenmiştir. Her iki cinsiyetteki çocukların yaş aralıklarına göre ATÖ toplam puanları karşılaştırıldığında istatistiksel olarak anlamlı fark saptanmamıştır (p>0,05). Erkekler ve kızlar arasında kızların lehine istatistiksel olarak anlamlı bir fark tespit edilmiştir (p=0,009).

Sonuç: Bu çalışmada, Türk çocuklarının artikülasyon becerilerini değerlendirmek için bir referans kaynağı oluşturulmuş ve ülkemizde artikülasyon bozukluğu olan çocukların taranmasında kullanılabilecek bir ölçeğin normatif verileri elde edilmiştir.

Anahtar Sözcükler: Artikülasyon; Fonolojik gelişim; Artikülasyon Tarama Ölçeği; Çocuk; Türkçe

INTRODUCTION

Speech and language skills are among the most important ways for people to express themselves, their emotions and thoughts. In the event if a problem is detected in either of the two developmental areas, it should be treated as soon as possible and its source should be investigated to see whether it is organic or psychological based[1-3]. With the progression of age, the child begins to use sounds, syllables and words, and learns the basic requirements of the spoken language. These basic requirements include comprehension, putting the words in right and meaningful order, learning how to use the language, and pronouncing the sounds correctly. Children who cannot achieve this development experience communication disorder.

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Communication disorders are among the most common problems in childhood. It is known that children suffering from problems with language generation and language use also struggle in their academic life and encounter risks in social life and have emotional problems[4,5].

The natural processes in the formation of human voice are closely related to their learning ability. Vowels have the major role in formation of speech sounds. In general, all children become capable of pronouncing these sounds between the ages of 3 and 3.5. This development may be prolonged up to 5 years and it is not considered as an important problem. Some studies indicate that consonant generation in children continues up to the age of 8 and speech problems observed in children over 8 years old pose a significant risk. Articulation is the use of tongue, jaw, teeth, lips and air coming from vocal cords to create sounds, syllables, and words. If a person is unable to use sounds, syllables or words correctly, and if listener has to listen carefully to understand what the person is saying, the disorder is called articulation disorder[6-9]. Articulation disorder is defined as speech impairment due to neurological, organic, or functional reasons which disable the control of the movement of articulator organs. Disorders of the sound generation in children are the most common type of speech disorders. Speech disorders sound may result from hearing loss, oral malformations, motor sensory disorders, intellectual retardation, emotional disorders and mislearning. These problems are observed during preschool and/or school period and their prevalence is higher in men than in women[10]. The main problem of children with articular dysfunction is the difficulty to correctly generate sound during speech. This problem can be seen in the form of substitution of the sound with the impairment, distortions in the sound, omission of a sound in the word or addition of a new sound to the word. If the disorder still continues in children who have passed the expected developmental age (phonological development) of the sounds, this can be defined as articulation disorder and speech therapy may be beneficial. What is important at this point is that after the completion of the phonological developmental process, articulation therapy should start without delay and therapy should be performed by a speech-language pathologist. Therefore, Articulation Screening Programs are very important in preschool period[11-13].

Speech Sounds in Turkish

Turkish alphabet consists of 21 consonants and 8 vowels. /b/,/c/,/d/,/g/,/j/,/l/,/m/,/n/,/r/,/v/,/y/ and /z/ are voiced consonants and /ç/,/f/,/h/,/k/,/p/,/s/,/ş/ and /t/ are unvoiced consonants. The vowels are /a/,/e/,/o/,/ö/,/u/,/ü/,/ı/ and /i/. Each of speech sounds are acquired in different ages. Children learn speech sounds by listening to people around them and it starts in very early period of life. The correct articulation of sounds is acquired in an order. Some sounds such as /p/, /m/ and /b/ are acquired in early ages like 3; while other sounds are acquired later. Children with normal development generally cannot show full proficiency in the generation of /s/, /r/ and /l/ sounds until school age. Although young children often make mistakes in their speech, sound and articulation disorders occur at an early age. Sounds may shift or may be added or omitted from a word. For example they may say "dop" instead of "top" by omitting /t/ and adding /d/ sound[14,15]. In our study, the aim was to obtain normative data of the Articulation Screener Scale (ASS) which is an additional scale of Preschool Language Scale-5 (PLS-5) according to the phonological developmental characteristics of Turkish children between 2 and 8 years with normal language and speech development. The obtained data may be used as reference for evaluation of the articulation skills of children. Moreover, more insight about the age of Turkish children to acquire phonemes may be achieved by obtaining normative values.

MATERIAL and METHODS
Participants

The study was conducted with a total of 330 healthy children attending to nursery, preschool and primary school, with normal language and speech development, and with no additional disorder and/or disease. Before the study commenced, schools and nurseries in which the study would be conducted were determined with the permission of the Provincial Directorate of National Education. The applications have been carried out under the supervision of the class teachers in classroom environment on appropriate days and hours, in a

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way not to interfere with education of children, upon receiving permission and approval of principals" of institutions. Of 330 children with normal language development and without a disease or disorder; 154 (46.7%) were girls and 176 (53.3%) were boys. While determining age ranges that the scale would be applied on, children who participated in the study were divided into 11 groups according to age: Group 1: 2 years 6 months-2 years 11 months, Group 2: 3 years-3 years 5 months, Group 3: 3 years 6 months-3 years 11 months, Group 4: 4 years-4 years 5 months, Group 5: 4 years 6 months-4 years 11 months, Group 6:5 years-5 years 5 months, Group 7: 5 years 6 months-5 years 11 months, Group 8: 6 years-6years 5 months, Group 9: 6 years 6 months-6 years 11 months, Group 10: 7 years-7 years 5 months, Group 11: 7 years 6 months-7 years 11 months. There is a 6 months age gap between each group. In the study, 30 children were selected from each age group (N: 330), girls and boys in each age group were distributed carefully.

Applications

- **Phase I:** In this phase, children's general profiles have been examined using the "Child and Family Assessment Information Form" prepared by researchers. This form consists of questions that inquire development, including socio-demographic characteristics, hearing, speech and language development, and additional disorders/diseases of the child and family. Whether the children could participate in the study was decided according to the evaluation results of these forms and the information obtained from the families. Children who have been identified to have any disorder of hearing, language and speech and/or with an additional illness or disability were excluded from the study.

-Phase II: The children who have been decided to participate in the study have been evaluated with the Turkish Preschool Language Scale-5 for auditory perception and expressive language development.

-Phase III: After the language development evaluation, Articulation Screener Scale (ASS), an additional scale of Preschool Language Scale-5, was applied to children who have normal auditory perception and expressive language development considering their ages and

both articulation skills and phonological development were evaluated. The duration of the test depends on child's age, language skills and compliance with test.

Criteria sought in children to participate in the study:

-Being between the ages of 2 years 6 months and 7 years 11 months,

-Attending to an educational institution (preschool and primary school) regularly,

-Having a normal story without a risk factor, such as premature birth, low birth weight,

-Being a native speaker of Turkish and not being a bilingual,

-Not having a known or diagnosed neurological, psychological or developmental problem or hearing disability,

-Having a normal receptive and expressive language development.

Children those who do not match these criteria were excluded from the study.

Data collection tools

Preschool Language Scale-Fifth Edition (PLS-5)

Pre-school Language Scale-5 is a language evaluation test is widely used all around the world to identify children with auditory perception and expressive language delay or impairment. The test was developed for children between 0 and 7 years 11 months old. The Preschool Language Scale-5 is a language evaluation test prepared and put into use by Zimmerman, Steiner and Pond in 2011[16]. Turkish adaptation and validity-reliability check of the test were performed and it was determined to be a valid and reliable test for evaluating the language and speech abilities of Turkish children[17]. The duration of test composed of Picture Manuel, Record Form and Manipulative (specific objects and toys) varies, depending on age, ability and cooperation level of child during the test. PLS-5 consists of 2 standard and 3 additional scales[18].

Articulation Screener Scale (ASS)

ASS, one of the additional scales of PLS-5, was developed for children between 2 years 6 months and 7 years 11 months. It consists of 16 pictures. A child is told to look at the picture and asked. "What is this?" and he/she is given a score according to being able to generate the target sound[16,18]. After translating 16 words in ASS

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into Turkish, they have been adapted considering the children's language development characteristics, target sounds and cultural structure. For the ASS, a list of words have been compiled that would target both appropriate sound units and constitute an easily identifiable visual stimuli for children between 2 years and 7 years 11 months and children were evaluated for being able to generate consonants except for /ğ/ and /j/ letters in Turkish. The ASS, which has been adapted to Turkish, was applied to a total of 330 children between 2 years and 7 years 11 months that participated in the study. The testers gave a plus (+) for each target correctly generated and a minus (-) for each target that could not be correctly generated. In the original study, it was indicated that children younger than 2 years 6 months were not able to reliably complete the ASS during standardization data. For this reason, cut-off points for each age group between 2 years 6 months and 7 years 11 months were defined. In order to create cut-off points, the distribution of raw scores was analyzed for each group and defined as follows:

-Points within the standard deviation of 1.5 (7th percentile range and above) are considered to be within normal capability range.

-The scores between 1.5 and 2 standard deviations below the average (below the 2nd percentile range) are considered to rank significantly below the points earned by the peers. Detailed scoring information for the ASS is presented in the Administration and Scoring Manual and on the Record Form[16-18].

This study was based on the typical performances shown in Table 1 and children below the total raw scores have been excluded from the study.

The raw scores that determine the typical performance of peers of the same age for each age group are shown in Table 1. Each child in the study was tested for being able to generate target sounds, and plus (+) points were given if the target voice was correctly generated and minus (-) point was given if another sound instead of the target sound was generated or no sound was generated. The total score of the application result is maximum 23. In the ASS, the /k/ and /l/ phonemes have been evaluated 2 times, and the /b/ phoneme has been evaluated 3 times depending on their position in the word.

Other consonant phonemes have been evaluated once. Positions of the consonants that were evaluated more than once are: b1 ; consonant phoneme /b/ as the initial of the word, b2; consonant phoneme /b/ between two vowels, b3; consonant phoneme /b/ in the middle of word combined with consonant /r/,k1; consonant phoneme /k/ in the middle of the word between two vowels, k2; consonant phoneme /k/ as the terminal of the word, l1; consonant phoneme /l/ in the middle of the word, l2; consonant phoneme /k/ as the initial of the word. Total raw scores for each child have been calculated and children who have compatible raw scores compared to their peers have been included in the study. /j/ and /ğ/ consonant phonemes were not evaluated in our study because they were not included in the original test.

Statistical Evaluations

SPPS 15.0 Package program has been used in the analysis of the data. Student t test has been used in comparing two independent samples and unidirectional variant analysis (Post-Hoc test: Tukey) has been used in comparing more than two independent samples. $p < 0.05$ value was considered as statistically significant. Relationships between categorical variables were evaluated by chi-square analysis.

RESULTS

As seen in Table 2, a total of 330 children were included in the study; 46.7% were male and 53.3% were female. The proportion of children in each age group is 9.1%. Each age group consists of 11 groups according to the chronological age of the children with a gap of 6 months. 45.5% of the children participating in the study were attending to nursery, 22.4% preschool and 32.1% primary education (Table 2). When the educational background of the parents of the children participating in the study was examined; 13.6% of the mothers are primary school graduate, 7.0% are secondary school graduates, 29.4% are high school graduates and 50.0% are university or a higher education graduates, and 8.2% of fathers are primary school graduates, 5.2% are secondary school graduates, 29.4% are high school graduates and 57.3% are university or a higher education graduates. 51.2% of mothers are working and 48.8% are not working. When professions of fathers were examined; 16.7% are civil servants,

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20.0% are workers, 14.5% are self-employed, 0.6% are retired, 1.2% are unemployed and 47.0% are others. When the financial income of families of the children have been examined, 1.8% earn lower than minimum wage, 14.6% earn minimum wage, 12.2% earn two times as minimum wage, 39.3% earn 3-4 times as minimum wage, 29.9% earn 5 times or more of minimum wage, and 2.1% are in other income group.

When the children are examined considering the number of children in the family; 25.8% live in a single child family, 50.9% live in a two children family, 18.8% live in a three children family and 3.9% live in a four children family. When the order of birth of the children participating in the study in their family has been examined, 53.9% are the first-born, 32.4% are the second-born, 11.5% are the third-born and 0.6% are the fourth-born children. 95.2% of the children participated in the study are looked after by their mother, 1.5% by a babysitter, 0.9% by paternal grandmother, 1.8% by maternal grandmother and 0.6% by grandparents. In this study, the values in the table are given as the standard deviation (X?±SD) and minimum-maximum values together with the arithmetic average. As seen in Table 3, the total raw score of the ASS of the children participating in the study is not significantly different according to gender at each age range (p> 0.05), but without consideration of age groups, a statistically significant difference is found among boys and girls (p=0.009).

If the alphabetical upper symbols are different, the multiple comparison result means that the difference is meaningful. As seen in Table 4, there is a statistically significant difference (p=0.002) between income levels of families of children participating in the study and the total scores of ASS. According to the multiple comparison test, those who earn 5 times or more as minimum wage and those who earn two times and 3-4 times as minimum wage have a statistically significantly lower score in the total score of the ASS (p<0.05). When the total ASS scores of the children participating in the study whose mothers work are compared, the total articulation scale scores of the children having a working mother are statistically significantly lower (p=0.001). There is no

statistically significant difference between the educations level of mothers categories and the articulation scale scores of the children participating in the study (p>0.05). Also, there is no statistically significant difference between the education level of fathers categories and the articulation scale scores of the children participating in the study (p>0.05).

Table 5 shows the percentage of correct generation of phonemes in the ASS by 330 children (boys and girls) between 2 years 6 months and 7 years 11 months participating in the study. According to the chi-square analysis, there is no statistically significant difference between male and female children's correct generation of consonant phonemes (p>0.05).

The acquisition processes of consonant phonemes in Turkish according to age in our study (Table 6) shows that the phonemic skills improve as the age increases. Criteria of acquisition of sounds by children are determined according to the correct generation from 60% to 100%. As it may be seen in the table; /b/,/n/,/m/,/g/,/d/, and /y/ phonemes are acquired the earliest and /r/, /ç/,/ş/,/v/,/s/, and /l/ phonemes are acquired latest. There is no statistically significant difference generation of consonant phoneme /b/ considering its position in the word (as the initial of the word, between the two vowels and in the middle of the word combined with the consonant 'r') (p>0.05). There is no statistically significant difference generation of consonant phoneme /k/ considering its position in the word (in the middle of two vowels or as the terminal of letter of the word) (p>0.05). However, a statistically significant difference is found between the correct generation of consonant phoneme 'l' considering its position in the word (in middle of the word and as terminal letter of the word) in both boys and girls (p<0.05).

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Table 1. The raw scores that determine the typical performance of peers of the same age for each age group

	Articulation Screener Raw Scores		
Age	Performance Typical of Age-Level Peers	Further Evaluation Indicated	Further Evaluation Strongly Indicated
2:6–2:11	6 or more	5–1	0
3:0–3:5	10 or more	5–9	4 or less
3:6–3:11	13 or more	5–12	4 or less
4:0–4:5	14 or more	12–13	11 or less
4:6–4:11	15 or more	12–14	11 or less
5:0–5:5	16 or more	12–15	11 or less
5:6–5:11	17 or more	15–16	14 or less
6:0–6:5	17 or more	15–16	14 or less
6:6–6:11	18 or more	16–17	15 or less
7:0–7:5	20 or more	18–19	17 or less
7:6–7:11	21 or more	19–20	18 or less

Table 2. Distribution of children according to socio-demographic characteristics (gender, age and school)

Gender	N	Percent(%)
Female	154	46.7
Male	176	53.3
Age groups	**N**	**Percent (%)**
2.6-2.11 years	30	9.1
3.0-3.5 years	30	9.1
3.6-3.11 years	30	9.1
4.0-4.5 years	30	9.1
4.6-4.11 years	30	9.1
5.0-5.5 years	30	9.1
5.6-5.11 years	30	9.1
6.0-6.5 years	30	9.1
6.6-6.11 years	30	9.1
7.0-7.5 years	30	9.1
7.6-7.11 years	30	9.1
School	**N**	**Percent (%)**
Nursery	150	45.5
Preschool	74	22.4
Primary education.	106	32.1

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Table 3. Distribution of raw scores of articulation screening for children between 2 years and 6 months-7 years and 11 months

Age (year)	Boys		Girls		Total		p
	X̄±SD	Min-Max	X̄±SD	Min-Max	X̄±SD	Min-Max	
2.6-2.11	20.0±2.4 (N=15)	16-23	20.9±3.1 (N=15)	12-23	20.5±2.8 (N=30)	12-23	0.364
3.0-3.5	22.1±1.2 (N=15)	19-23	22.67±0.8 (N=15)	20-23	22.4±1.0 (N=30)	19-23	0.163
3.6-3.11	21.5±2.4 (N=15)	14-23	22.2±0.9 (N=15)	20-23	21.9±1.8 (N=30)	14-23	0.318
4.0-4.5	21.4±2.3 (N=16)	15-23	22.2±1.1 (N=14)	20-23	21.8±1.9 (N=30)	15-23	0.221
4.6-4.11	21.9±1.4 (N=17)	19-23	22.6±0.5 (N=13)	22-23	22.2±1.1 (N=30)	19-23	0.077
5.0-5.5	22.1±1.8 (N=11)	17-23	22.6±0.7 (N=19)	21-23	22.3±1.5 (N=30)	17-23	0.356
5.6-5.11	22.56±0.9 N=14	20-23	22.8±0.4 (N=16)	22-23	22.7±0.7 (N=30)	20-23	0.401
6.0-6.5	22.6±1.2 (N=13)	18-23	22.9±0.3 (N=17)	22-23	22.7±0.9 (N=30)	18-23	0.433
6.6-6.11	22.8±0.4 (N=14)	22-23	22.9±0.3 (N=16)	22-23	22.9±0.3 (N=30)	22-23	0.368
7.0-7.5	22.9±0.3 (N=15)	22-23	22.9±0.5 (N=15)	21-23	22.9±0.4 (N=30)	21-23	0.658
7.6-7.11	22.9±0.5 (N=15)	21-23	23.0±0.0 (N=15)	23-23	22.9±0.4 (N=30)	21-23	0.326
Total	22.1±1.7 (N=176)	14-23	22.5±1.2 (N=154)	12-23	22.3± 1.4 (N: 330)	12-23	0.009

X: Mean, SD: Standard Deviation, Min: Minimum, Max: Maximum

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Table 4. Comparisons of children considering family income levels, working status of mothers and the education level of their mothers and fathers with results of ASS

Family income levels	X̄±SD	p
Lower than minimum wage (N:6)	23±0.0	
Minimum wage (N:48)	22.9±0.4	
Two times as minimum wage (N:40)	22.7±0.6	p=0.002
3-4 times as minimum wage (N:129)	22.2±1.5	
5 or more times as minimum wage (N:98)	21.9±2.0	
Other income (N:7)	22.7±0.5	
Working status of mothers		
Working (N:169)	22.0±1.8	
Not working (N:161)	22.6±1.1	p=0.001
Education level of mothers		
Primary school (N:45)	22.7±0.9	
Secondary school (N:23)	22.7±0.5	
High school (N:97)	22.3±1.5	p=0.057
University or a higher education graduate (N:165)	22.1±1.7	
Education level of fathers		
Primary school (N:27)	22.7±0.5	
Secondary school (N:17)	22.8±0.6	
High school (N:97)	22.3±1.5	p=0.147
University or a higher education graduate (N:189)	22.2±1.6	

X: Mean, SD: Standard Deviation

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Table 5. The status correct generation of phonemes in the ASS by 330 children (%)

Age	p	b₁	b₂	b₃	n	t	d	g	m	k₁	k₂	h	l₁	l₂	f	y	ç	c	ş	s	z	v	r
2.6-2.11 N:30	29 (96.6)	29 (96.6)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	27 (90.0)	30 (100)	22 (73.3)	30 (93.3)	18 (60.0)	26 (86.6)	28 (93.3)	27 (90.0)	29 (96.6)	25 (83.3)	28 (93.3)	26 (86.6)	21 (70.0)	18 (60.0)
3.0-3.5 N:30	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)	30 (100)	29 (96.6)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)	30 (100)	30 (100)	26 (86.6)	30 (100)	27 (90.0)	29 (96.6)	30 (100)	28 (93.3)	25 (83.3)
3.6-3.11 N:30	29 (96.6)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)	30 (100)	30 (96.6)	29 (96.6)	30 (100)	30 (100)	29 (96.6)	29 (96.6)	23 (76.6)	30 (100)	30 (100)	29 (96.6)	29 (96.6)	25 (83.3)	29 (96.6)	26 (86.6)	26 (86.6)	25 (83.3)
4.0-4.5 N:30	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	28 (93.3)	28 (93.3)	30 (100)	29 (96.6)	30 (100)	24 (80.0)	28 (93.3)	30 (100)	29 (96.6)	30 (100)	27 (90.0)	28 (93.3)	26 (86.6)	26 (86.6)	19 (63.3)
4.6-4.11 N:30	29 (96.6)	30 (100)	30 (100)	29 (96.6)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)	30 (100)	30 (100)	28 (93.3)	30 (100)	30 (100)	30 (100)	27 (90.0)	26 (92.3)	20 (66.6)
5.0-5.5 N:30	30 (100)	30 (100)	30 (100)	29 (96.6)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	28 (93.3)	28 (93.3)	29 (96.6)	30 (100)	28 (93.3)	30 (100)	27 (90.0)	30 (100)	29 (96.6)	28 (93.3)	25 (83.3)
5.6-5.11 N:30	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)	30 (100)	30 (100)	29 (96.6)	30 (100)	29 (96.6)	30 (100)	28 (93.3)	29 (96.6)	26 (86.6)
6.0-6.5 N:30	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)	29 (96.6)	30 (100)	30 (100)	29 (96.6)	29 (96.6)	30 (100)	29 (96.6)	29 (96.6)	30 (100)	30 (100)	30 (100)	28 (93.3)	28 (93.3)
6.6-6.11 N:30	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)	29 (96.6)	28 (93.3)
7.0-7.5 N:30	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)	30 (100)	30 (93.3)	30 (100)	30 (100)	30 (100)	30 (100)
7.6-7.11 N:30	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	29 (96.6)
Total N:330	327 (99.0)	329 (99.6)	330 (100)	328 (99.3)	330 (100)	328 (99.3)	330 (100)	329 (99.6)	327 (99.0)	324 (98.1)	329 (99.6)	320 (96.9)	327 (99.0)	299 (90.6)	322 (97.5)	328 (99.3)	314 (95.1)	327 (99.0)	310 (93.9)	324 (98.1)	311 (94.2)	301 (91.2)	273 (82.7)

*Evaluation percentages of b1;'b' consonant sounds as the initial letter of the word, b2;'b' consonant sound between two vowels, b3; 'b' consonant sound in the middle of the word combined with 'r' sound, k1; 'k' consonant phoneme in the middle of the word between two vowels, k2; 'k' consonant sounds the terminal letter of the word, l1; 'l' consonant phoneme in the middle of the word, l2; 'l' consonant sound as the initial letter of the word.

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Table 6. Age-related acquisition of speech sounds in children according to the ASS

Consonants	2:6	3:0	3:6	4:0	4:6	5:0	5:6	6:0	6:6	7:0	7:6	8:0
/p/ (palto)	▓	▓	▓									
/b/ (balon)	▓	▓	▓									
/n/ (balon)	▓	▓	▓									
/t/ (tabak)	▓	▓										
/b/ (tabak)	▓	▓										
/d/ (dondurma)	▓	▓										
/g/ (güneş)	▓	▓										
/m/ (makas)	▓	▓										
/k/ (makas)	▓	▓	▓									
/h/ (havlu)	▓	▓	▓									
/l/ (havlu)	▓	▓	▓									
/f/ (fil)	▓	▓	▓									
/y/ (yatak)	▓	▓	▓									
/k/ (yatak)	▓	▓										
/ç/ (çocuk)	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓		
/c/ (çocuk)	▓	▓	▓	▓								
/ş/ (şapka)	▓	▓	▓	▓	▓							
/l/ (lamba)	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓		
/s/ (sandalye)	▓	▓	▓	▓	▓							
/z/ (zebra)	▓	▓	▓	▓	▓	▓	▓	▓				
/b/ (zebra)	▓	▓	▓									
/v/ (vantilatör)	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓		
/r/ (araba)	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	

DISCUSSION

When a literature review is performed, there are a limited number of studies examining the structure of Turkish language, physical properties of existing phonemes, learning and production patterns[14,15,19]. The aim was to obtain normative data for Turkish children between 2 and 8 years of the Articulation Screener Scale (ASS), which can be easily and practically used for screening purposes in order to evaluate the phonological development characteristics and articulation skills of children in our study. Early diagnosis of phonological delay and articulation disorders is very important in childhood. One of

the factors that affect the speech is articulation[20]. A patient diagnosed early with articulation disorder is very fortunate in terms of therapy and orientation. Some tests are used abroad and in Turkey to evaluate articulation skills. However, the ease of use of the tests for screening and the ability to perform them in a short time is very important for both the child and the practitioner.

In this study, no statistically significant difference was found in the total scores of the ASS (p>0.05) when compared to genders in each age group (p>0.05); however, a statistically significant difference was noted in favor of girls among boys and girls without age groups

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(p=0.009). In our study, it was observed that gender variables do not affect the total scores of the ASS for each age range. In our study, it has been shown that the multiple comparison end result is significant when the alphabetical upper symbols are different. For example; a statistically significant difference has been found when the total scores of the ASS of the income levels of the families of the children participating in the study have been compared (p=0.002). Moreover, according to the multiple comparison test, the total ASS score of families earning 5 times or more as minimum wage and families earning two and 3-4 times as minimum wage has been found to be significantly lower (p<0.05). When we look at the acquisition processes of the consonant phonemes in our study according to age, it seems that the phonemic abilities improve as the age increase. It has been observed that Turkish children can generate almost all sounds around the age of 6-7. Some researchers have indicated that speech and articulation levels are related to age[21-23]. Similarly, Amir and Grinfeld have reported that articulation mistakes decrease as age increases and that children aged 13 years have the best fluent speech level in their study of 144 Hebrew-speaking children aged 7-17[24].

The youngest group of children, 2 years 6 months old, was observed to have lower phonemic performance than the other children. Generally, most of the children fail to pronounce /r/ phoneme followed by /l/, /ş/, /s/, /v/, and /ç/. In a study conducted by Belgin and Ertas on 308 elementary school children, articulation disorder has been detected in 47 children. The most common failure in the study has been indicated as /z/, /ş/, /j/, /s/ and /r/ phonemes[25]. The results seem to support our study. In our study, the articulation abilities of children have been evaluated separately for the determined consonant phonemes and the phonemes with the correct generation of 100% rate in each group have been considered to be acquired. When the results have been examined, it has been observed that phonemes are acquired as the age increases in Turkish children and it has been determined that the latest acquired phonemes are / /r/, /v/, /l/ and /ç/. When the literature is examined, we see that the typical performance limit of peers of the same age in children in our country; are found to

be higher than the typical performance limit of foreign peers of the same age. In some studies on the subject, it has been reported that as the vowel phonemes are easier to acquire than consonant phonemes, those studies have focused on consonant phonemes. Ball and Munro stated that consonant voices are more important than vowel sounds when assessing phonological development. They have explained the reason for this in that the vowel sounds are acquired much earlier than the consonant sounds[26]. Dodd, on the other hand, noted that errors in the vowel sounds are confronted very little, and that even children with phonological disorders make few errors with vowel sounds and the evaluation of consonant phonemes is more accurate[27]. Similarly, this study focuses on the evaluation of consonant phonemes.

In her study with Turkish monolingual children aged between 2 and 6 years, Acarlar states that when the acquisition process considering age groups is reviewed, it may seen that there is a systematic decrease in the omission of the terminal consonants, simplification of consonants, devoicing and misplacement of adjacent consonants[14]. In our study, it was observed that as the age increases, the number of wrong sounds decreases. When the literature is searched, no short-time ASS for screening purposes, which can be used right after the language development test for the acquisition of phonemes, was found. Most of the studies are for phonological accuracy. San found that the acquisition of consonant /f/ starts at the age of 2 in 50% of cases and 90% of this acquisition is completed at the age of 5. In his study "Evaluation of articulation abilities in 3-9 years old children" that shows the normal language development. He also indicates that acquisition of consonant /v/ is 50% at the age of 2.5 and 90% of the acquisition is complete at the age of 8[15]. In our study, it was observed that at the age of 3, 100% of the acquisition of consonant /f/ is complete. According to the study of San (2004), in normal developing children, acquisition of consonant /r/ is complete around 50-90% between the ages of 4 and 6. In this study, it is complete around 60-100% between the ages of 2.5 and 7[15]. In "relation between social skills and articulation levels of children with intellectual

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disabilities" thesis of Sonmez, it was indicated that 7-year-old children had more points in Ankara Articulation Test than 9, 10, 11 and 12 years old children which means 7 years old children make more articulation mistakes. It is indicated that the scores of 8, 9, and 10 years old children are higher than those of 12 years old children, which means 8, 9, 10 years olds make more articulation mistakes than 12 years old. In this case, it is generally observed that the articulation levels of the children at the age of 7 are far behind those of the other age groups and that the articulation levels of the children at the age of 12 years have better articulation levels than the other age groups and as a result of the t test made for determining whether the scores taken from Ankara Articulation Test scores are significantly different considering the gender variable, the difference between the arithmetic average of the groups was not statistically significant (t=1.425; p>.05) (28). In our study, it was observed that as the age increases, the rate of false pronunciation decreases. In their book, Bloom and Lahey stated that some sounds are acquired earlier than others by children between ages 3 and 8 regarding speech generation and almost all of them are generated correctly at the age of 8[29]. Eriskin indicated that in his "examination of acquisition of Turkish phonemes by mentally disable children and their comparison to children with normal development" work that children with normal development acquire /m/, /p/, /b/, /t/, /d/, /s/, /y/ phonemes as initial letters of the word at the age of 2; /n/, /k/, /g/, /f/, /v/, /s/, /z/, /ç/, /h/ phonemes as the initial letters of the word at the age of 3; /l/ phoneme as the initial letter of the word at the age of 5; /r/ phoneme at the age of 6 and there are no more new phonemes to acquire between to vowels; and /z/ phoneme at the age of 7 and they learned all phonemes that are expected to be used in all positions[30] Sander found that during characteristic sound development sequences, children complete the acquisition of /p/, /m/, /h/, /n/ and /l/ sounds until the age of 3, /k/, /g/, /t/ and /d/ sounds until the age of 2-4, /f/ sound until the age of 2.5-4, /r/ sound between the ages of 3 and 7-8, /l/ sound until the age of 3-6, /s/ sound between the ages of 3-8, /z/ sound between the ages of 3.5-8, /v/ sound between the ages of 4-8[31]. Prather et al. analyzed the development of

articulation in children between the ages of 2 and 4 and indicated that they acquire the /b/, /g/, /t/ and /d/ sounds between the ages of 3 and 4, /y/ sound between the ages of 2 and 3, /r/ and /l/ sounds between the ages of 2.5 and 4, /s/ sound between the ages of 2 and 4, /v/ and /z/ sounds between the ages of 3.5 and 4[32]. Similarly, in our study it was observed that the acquisition of /r/ sound occur between the ages of 2.5 and 7. Unlike the results of Prather et al., in Turkish children, the acquisition of /z/ sound occurs between the ages of 2.5 and 6 and /v/ sound between the ages of 2.5and 7. The results of our study are almost similar to the results in the literature. Although most of the studies indicate that the /r/ sound is acquired at 3 years, it was observed in our study that children between the ages of 2.5 and 3 can also generate the /r/ sound, but only between two vowels.

CONCLUSION

In this study, a reference resource was created to evaluate the phonological development and articulation skills of Turkish children and normative data have been obtained in a scale that may be used for screening in children with articulation disorder in our country. After phonological development and articulation skills of children are screened with this scale, it has been aimed to refer them to appropriate to provide early diagnosis, treatment and rehabilitation, if recommended. Moreover, this scale, normative data obtained from Turkish children between 2 and 8 years, may be used in cases of different disabilities/disorders within this age range and may form a basis for future studies.

Statement of Ethics

The study was approved by the Medical and Health Sciences Research and Ethics Council (Project No: KA14/350 Date: 18.02.15 Issue: 15/33). Informed consent forms were signed by parents of each child who participated in the study.

Disclosure Statement

The authors have no conflict of interest to report.

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