

## Speech Intelligibility in Persian Children with Down Syndrome

Akram Valizadeh; Farhad Fatehi\* ; Abdolreza Yavari; Hamid Dalvand  
Arak University of Medical Sciences and Health Services, Arak, Iran

Nasrin Molai; Fatemeh Faraji; Behnaz Bayat  
Hamedan University of Medical Sciences and Health Services, Hamedan, Iran

**Objectives:** One of the most effective methods to describe speech disorders is the measurement of speech intelligibility. The speech intelligibility indicates the extent of acoustic signals that correctly speaker produces and hearer receives. The purpose of this study was to investigate the speech intelligibility in the Persian children with Down syndrome; age range was 3 to 5 years, who had spoken Persian.

**Methods:** This cross-sectional study investigates 12 children (6 girls and 6 boys) with Down syndrome who had referred to speech therapy clinic in Hamadan city and 12 normal children (6 girls and 6 boys) who went to the kindergarten in Hamadan city. The pictures of speech intelligibility test (in Persian language) were used to collect speech samples of participants. The participant's voice was recorded by voice recorder and was investigated in two age groups.

**Results:** The results of this study indicated the means of speech intelligibility was 92.25 for normal children and 35.08 for children with Down syndrome. The correlation between age and speech intelligibility for normal children was 0.866 and for children with Down syndrome was 0.352. The mean of speech intelligibility 2 for normal boys was 93 and for normal girls 91.5 and for boys with Down syndrome 34.66 and for girls with Down syndrome 35.5.

**Discussion:** The difference between normal children and children with Down syndrome was Significant. One of the factors that affect speech intelligibility for children with Down syndrome is difficulty with voluntarily programming, combining, organizing, and sequencing the movements necessary for speech.

**Key words:** Down syndrome, intelligibility of speech, speech disorder

Submitted: 19 November 2015

Accepted: 27 November 2015

### Introduction

One of the most effective methods to describe speech disorders is the measurement of speech intelligibility (1). The speech intelligibility indicates the extent of acoustic signals that speaker produces correctly and the listener receives. It is a bilateral participation that speaker and hearer both participate in it (2). In the past researches, has been indicated that speech intelligibility in children is same as adults (3). The causes that effected speech intelligibility includes speaker's speech disorder, listener's speech perception ability and contextual causes such as communicational context and knowledge between speaker and listener (2). Children with Down syndrome show complex phonological characteristics and motor-speech delay and difficulties with voluntarily programming, combining, organizing, and sequencing the

movements necessary for speech. These children produce consonant clusters as singleton consonant, and in their speech word-final consonant are omitted, target fricatives and affricative are produced as stops, and word final voiced obstruent's are devoiced(4). Long-standing difficulties with intelligibility can presumably be attributed to phonological patterns associated with Down syndrome. Unintelligibility is a noticeable characteristic that is indicated it in various studies (5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17). The motor speech delay and oral motor planning are two factors that effects speech intelligibility (4). Clinically, some children with Down syndrome demonstrate difficulties with oral motor skills, some demonstrate difficulties with oral motor planning, and some exhibit symptoms of both (4, 11, 12, 13, 18, 19, 20). Kumin studied Speech intelligibility and

\* All correspondences to: AkramValizadeh, email: <farhadfatehi@yahoo.com>

childhood verbal apraxia in children with Down syndrome Parents completed the survey for their children with Down syndrome. 1620 questionnaire gathered and then results were analyzed. A Pearson correlation between gender and intelligibility ratings was significant at the .01 level (2-tailed). Girls had higher speech intelligibility ratings (easier to understand speech) than boys .A Pearson correlation between age and speech intelligibility ratings was significant at the .01 level (2-tailed). Older children had higher speech intelligibility ratings than younger children (18). Kumin and Adams studied seven children with Down syndrome who were experiencing difficulties with speech intelligibility. They used The Apraxia Profile which is a published test for surveying speech characteristics. They also analyzed the results of a parent questionnaire, and analyzed a conversational connected speech sample to determine whether the children showed the characteristics of childhood verbal apraxia. Results of The Apraxia Profile indicated that all subjects had test scores leading to a diagnosis of childhood verbal apraxia. Analysis of the parent questionnaire and the conversational sample also showed that all seven children demonstrated characteristics of childhood verbal apraxia. The most common characteristics displayed by the subjects included decreased intelligibility with increased length of utterance, inconsistency of speech errors, decreased ability to perform voluntary tasks as compared to automatic tasks, and difficulty sequencing oral movements and speech sounds. All of these clinical symptoms found in the seven children with Down syndrome are common symptoms of childhood verbal apraxia cited in studies of typically developing children (20). Kumin's analyzing 937 parent questionnaires revealed that nearly 60% of parent reported that their children (aged birth to 4+ years) "frequently" had difficulty being understood (10). Pueschel and Hopman also used a questionnaire to gain information on the parent's views of their children's speech and language skills. Although parents reported that their children were generally capable of making themselves understood. 71-94% of parent of children aged 4-21years noted that their offspring had problems with articulation. It is likely that the perceived level of unintelligibility are associated with variable phoneme production noted in the previous section, factors which increase the difficulty of identifying a target word (21). Sara Heydari et al developed a speech intelligibility measurement test for 3 to 5 years old normal

children. The aim of this test was the measurement of speech intelligibility among Persian children aged 3 to 5 years old (22). According to what has been said above, children with Down syndrome have difficulties with speech and language that lead to unintelligibility. The test of speech intelligibility measurement is designed and there is normal data for it. All of the researches that have investigated speech intelligibility have utilized parent questionnaires or conversational sample in which a certain speech sample was not produced. This study aims to investigate speech intelligibility in children with Down syndrome by a speech intelligibility measurement test for normal children from 3-5 years old. Speech intelligibility not only was investigated in a certain speech sample but also it was studied according to standard test. In addition, thorough determining limits of children's ability, we can accurately assess intelligibility before and after intervention and also evaluate treatment method.

#### **Methods**

This study was a crass-sectional study which was conducted in 2014 in Hamedan city. 12 children with Down syndrome and 12 normal children (36 to 60 month) participated in the study. Children with Down syndrome were selected among children who had referred to speech therapy clinics and normal children were selected among Hamadan kindergartens. In this study, a speech intelligibility measurement test for 3 to 5 years old normal Persian children was used (22). First, we met supervisor of rehabilitation clinics, then, he /she became aware of the method of project. Then we asked for information about program of children with Down syndrome from him/her, In the clinic in intended age range .Children with Down syndrome had diagnosed by genetic test and this diagnose has reported in their clinic records. Parents of Children with Down syndrome were informed of research and after accepting to participate in the study they were asked to fill the general health questionnaire. Before starting the speech therapy plan, we tested speech intelligibility.

Include criteria: Persian monolingual, age range of 36- 60 months, no hearing problem, no motor-speech problems and craniofacial abnormalities, Not having a cold and adenoidal time of sampling, To have general health (by questionnaire), Down syndrome diagnose has been confirmed by a specialist. Exclude criteria were: Child's Lack of cooperation, history of speech therapy, lack of

consent of the parents or child care authorities. Before the hearing screening test, we had used a test to ensure the child's hearing health. Then, in a quiet room of speech therapy part, first, we communicated with the child. Then, we had presented a couple of test images to him and we explained the method of test. After the child had learned what to do, we presented the test images to him/her and asked to name them. Images were presented to child by a MSIcx480 Laptop. At the same time, his/her voice was recorded using a voice recorder (the King Stone DVR-902model). The recorded voices were played for three speech-language pathologists. Those were asked to listen to sample recordings. According to a scale of unintelligible speech=1semi-intelligible

speech=2, intelligible speech = 3 for each of the words were heard, they rated the sample. The total score for each sample was calculated and was converted to a percentage. The total test score is 87. If all the words were intelligible the rate of sample will be 87 score; this means that speech intelligibility of each child will be 100%.

### Results

According to table (1) and table (2), the mean of speech intelligibility score in normal children was 92.25 with a standard deviation 5.9 and in children with Down syndrome this score was 35.08 with a standard deviation 4.27.

**Table 1.** Distribution of central tendency and dispersion parameters of speech intelligibility score in normal children

variation	N= 12			
	mean	min	max	standard deviation
speech intelligibility	92.25	80	100	5.92

**Table 2.** Distribution of central tendency and dispersion parameters of speech intelligibility in children with Down syndrome

variation	N= 12			
	mean	Min	Max	standard deviation
speech intelligibility	35.08	33	45	4.027

Correlation between age and the speech intelligibility score in normal children was 0.866 and in children with Down syndrome it was 0.352. Average of speech intelligibility score in normal boys was 93 with SD of 4.33 and in normal girls it was 91.5 with SD 7.55. The P-Value of t-statistics in

the two groups was 0.422. Average of speech intelligibility score in boys with Down syndrome was 34.66 with SD 4.08 and in girls with Down syndrome it was 35.5 with a standard deviation 4.8. The P-Value of t-statistics in the two groups was 0.324 (tables 3 and 4).

**Table 3.** Compares average percentage of speech intelligibility in normal children in genders.

Variation	N= 12				Value t	
	boy		Girl			
	mean	SD	mean	SD		
Speech intelligibility	93	4.33	91.5	7.55	0.422	0.682

**Table 4.** Compares average percentage of speech intelligibility in children with Down syndrome in genders.

variation	N= 12				Value t	
	boy		Girl	Value t		
	mean	SD	Mean	SD		
Speech intelligibility	34.66	4.08	35.5	4.8	-0.324	0.753

### Discussion

Statistical analysis of the data showed that speech intelligibility in children with Down syndrome is lower than normal children. The mean of speech intelligibility score in the speech of normal children was 92.25 with a standard deviation 5.9 and in children with Down syndrome it was 35.08 with a standard deviation of 4.27. The correlation between

age and speech intelligibility score in normal children was 0.866 and it was 0.352 in children with Down syndrome. So we can conclude that children with Down syndrome are not their age-appropriate verbally. This finding is consistent with the findings of Adams in 2000 and Bucleys and Chapman and Hesselwood and Horstmeier and kumin and kumin and miller. Kumin in 1994 showed that 94% -71%

of parents had reported difficulties of articulation that reduced speech intelligibility (21). Oral motor skills, speech and motor planning are two of the factors that will affect the speech intelligibility (4). Many children with Down syndrome clinically showed problems with motor skills, speech and motor planning, speech, or both (4, 11, 12, 13, 18, 19, 20). In addition, Adams showed that these children have symptoms of childhood verbal apraxia so that clearly, speech intelligibility decreases with decreasing length of sentences, including articulation errors in stability, difficulty in mouth movements and speech sounds (20). Average of speech intelligibility in normal boys was 93 with SD 4.33 and in normal girls it was 91.5 with SD 7.55. Value of t-statistics in the two groups was 0.422. Result of this study is consistent with previous researches. Significant difference in speech intelligibility was seen between male and female in normal children. Average speech intelligibility in boy with Down syndrome was 34.66 with SD of 4.08 and in girls with Down syndrome it was 35/5 with standard deviation of 4.08. T-statistics in the two groups' was 0.324 Speech intelligibility in

children with Down syndrome in this group were not significantly different. Kumin's findings in 2006 were not similar with our result, Kumin had used a questionnaire completed by parents and children under the speech therapy and untreated children had been not considered. Therefore we can conclude that the factors listed above may have different results.

### Conclusions

According to the result of recent researches, a child with Down syndrome could not clearly deliver their speech as their peers. This is the most important criteria for educational planning in this group. Based on The findings of this study we can conclude that speech intelligibility in normal children is very different than children with Down syndrome and that this much delay can be attributed to speech problems and motor-speech skills associated with speech and language planning of this group.

### Acknowledgements

Hereby the authors thank the parents, children and rehabilitation center's staff for their enthusiasm and Intimacy in conducting the research.

### References

1. Tomblin JB, Morris HL, Spriestersbach D. Diagnosis in speech-language pathology. California: Singular Publishing Group; 2000.
2. Weismer G. Motor speech disorders: essays for Ray Kent. Australia: Plural Publishing; 2007.
3. Pella-Brooks A, Hegde M. Assessment and treatment of articulation and phonological disorders in children. United States: PRO-ED; 2007.
4. Kumin L. Early communication skills for children with Down syndrome: A guide for parents and professionals. Bethesda: Woodbine House; 2003.
5. Rondal J, Buckley S. Speech and language intervention in Down syndrome. London: Whurr Publishers Ltd; 2003.
6. Chapman RS, Hesketh LJ. Behavioral phenotype of individuals with Down syndrome. Mental retardation and developmental disabilities research reviews. 2000;6(2):84-95.
7. Chapman RS, Seung H-K, Schwartz SE, Bird EK-R. Language Skills of Children and Adolescents With Down Syndrome II. Production Deficits. Journal of Speech, Language, and Hearing Research. 1998;41(4):861-73.
8. Heselwood B, Bray M, Crookston I. Juncture, rhythm and planning in the speech of an adult with Down's syndrome. Clinical Linguistics & Phonetics. 1995;9(2):121-37.
9. Horstmeier D. But I don't understand you-the communication interaction of youths and adults with Down syndrome. Pueschel, S The Young Person with Down Syndrome Baltimore: Paul Brookes Publishers. 1988.
10. Kumin L. Intelligibility of speech in children with down syndrome in natural settings: Parents'perspective. Perceptual and Motor Skills. 1994;78(1):307-13.
11. Kumin L. Speech intelligibility in individuals with Down syndrome: A framework for targeting specific factors for assessment and treatment. Down Syndrome Quarterly. 2001;6(3):1-8.
12. Kumin L. Why can't you understand what I am saying: Speech intelligibility in Daily Life. Disability Solutions. 2002;5(1):1-15.
13. Kumin L. Maximizing speech and language in children and adolescents with Down syndrome. Down syndrome: Visions for the 21st century. 2002:407-19.
14. Miller J, Leddy M, Leavitt LA. Improving the communication of people with Down syndrome. In: Miller JF, Leddy M, Leavitt LA, editors. Verbal fluency, speech intelligibility, and communicative effectiveness. Brookes Publishing Co.: Baltimore, MD: Paul H; 1999. p. 81-91.
15. Rosin P, Swift E. Communication intervention. In: Miller JF, Leddy M, Leavitt LA, editors. Improving the communication of people with Down syndrome. Baltimore, MD: Paul H Brookes Publishing Co; 1999. p. 133-60.
16. Swift E, Rosin P. A remediation sequence to improve speech intelligibility for students with Down syndrome. Language, Speech, and Hearing Services in Schools. 1990;21(3):140-6.
17. Stoel-Gammon C. Down syndrome phonology: Developmental patterns and intervention strategies. Down Syndrome Research and Practice. 2001;7(3):93-100.
18. Kumin L. Speech intelligibility and childhood verbal apraxia in children with Down syndrome. Down Syndrome Research and Practice. 2006;10(1):10-22.
19. Schoenbrodt L. Childhood communication disorders: Organic bases. United States: Cengage Learning; 2014.

20. Kumin L, Adams J. Developmental apraxia of speech and intelligibility in children with Down syndrome. *Down Syndrome Quarterly*. 2000;5(3):1-7.
21. Pueschel S, Hopmann M. Speech and language abilities of children with Down syndrome. *Enhancing children's communication: Research foundations for interventions* London: Brookes; 1993.
22. Heydari S, Torabi Nezhad F, Agha Rasouli Z, Hoseyni F. Development of speech intelligibility measurement test for 3 to 5 years old normal children. *Audiology*. 2011;20(1):47-53.