**Original Article**

# The Phonemic Awareness Skills of Cochlear Implant Children and Children with Normal Hearing in Primary School

Aliakbar Dashtelei*; Hoda Mowzooni; Atiye Ashtari; Maryam Delfi; Gita Movallali
Ahmad Salmani, Farzad Eshkenani
*University of Social Welfare and Rehabilitation Sciences, Tehran, Iran*

**Objectives:** Phonemic awareness skills have a significant impact on children speech and language. The purpose of this study was investigating the phonemic awareness skills of children with cochlear implant and normal hearing peers in primary school.

**Methods:** Phonemic awareness subscales of phonological awareness test were administered to 30 children with cochlear implantation at the first to sixth grades of primary school and 30 children with normal hearing who were matched in age with cochlear implant group. All of children were between 6 to 11 years old. Children with cochlear implant had at least 1 to 2 years of implant experience and they were over 5 years when they receive implantation. Children with cochlear implant were selected from Special education centers in Tehran and children with normal hearing were recruited from primary schools in Tehran. The phonemic awareness skills were assessed in both groups.

**Results:** The results showed that the Mean scores of phonemic awareness skills in cochlear implant children were significantly lower than children with normal hearing ($p < .0001$).

**Discussion:** children with cochlear implant, despite Cochlear implantation prosthesis, had lower performance in phonemic awareness when compared with normal hearing children. Therefore, due to importance of phonemic awareness skills in learning of literacy skills, and defects of these skills in children with cochlear implant, these skills should be assessed carefully in children with cochlear implant and rehabilitative interventions should be considered.

**Key words:** phonemic awareness, cochlear implant, children

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## Introduction

Several factors contributing to language acquisition in children with CIs, such as auditory processing, non-verbal IQ, working memory, and phonological awareness (1). Phonological awareness refers to individual's understanding of the phonological structure of a word of his or her language (2). There are at least three forms of phonological awareness that include Syllabic awareness (including syllable Blending and segmentation), the rhyme awareness (including alliteration and rhyme) and Phonemic awareness (including phonemic blending, Recognizing words with the same initial phonemes, Recognizing Words with the same final phoneme, Phonemic segmentation, Naming and delete the final phoneme, Naming and delete the middle phoneme and naming and deletion of first phoneme) (1, 3-5). The most of the syllable awareness skills is formed as early as 3 years. With increasing age, children are more aware of rhyme units such as the alliteration (vowel or consonant cluster before vowel in a syllable) and rhyme (vowel and consonant of the end of word). Finally, school-age children can be mastered in phonemic awareness skills. Phonemic awareness is the ability to identify phonemes as parts of syllables and words. Proficiency and skills in phonemic awareness appear at 6-7 years of age (3).

Children with profound deafness are at risk for serious reading difficulties (7). Multiple factors affect their development of reading skills, including use of cochlear implants. The results from studies indicate that benefit of CIs is first observable at the syllable level (5). Children with cochlear implants have better phonemic skills than children having hearing aids(6, 8). Several factors influence the overall success of children experience with their cochlear implants. These factors include the age at which they receive an implant, duration of CIs,

* All Correspondences to: Aliakbare dashtelei, Email:<Ali_dashtelei@yahoo.com>

vocabulary skills, preoperative residual hearing, and socioeconomic status (9). A variety of recent studies have demonstrated benefits to hearing, language, and speech from implants, leading to assumptions that early implantation (age of CIs) and duration of implant should be associated with higher phonological and reading skills (1, 9-11). Individual differences in age at implant, duration of CIs and phonological development were all strongly associated with progress in phonemic skills and reading achievement in cochlear implants children for the deaf implanted children (1). To the extent that use of a cochlear implant is associated with greater use of phonological coding strategies that has a facilitative effect on the acquisition of literacy. Therefore reading scores are strongly correlated with measures of phonemic awareness (12, 13). So if the child has insufficient phonemic skills, his or her reading skills will face problem (1). Phonemic awareness needs a developed phonological system of phonemes representations(14). Thus, in children with cochlear implant, before the operation and in pre-lingual course, deprivation of auditory system has a negative effect on the development of phonological skills (14). Following this problem, children's literacy skills will be problematic (13, 15, 16).

Therefor understanding phonological features of this group, helps teachers and rehabilitation specialist for proper planning and intervention and because studies in investigating phonemic awareness in children with cochlear implants are rare; the aim of this study was to compare the phoneme skills in children with cochlear implant and normal children in primary school.

## Methods

Present study employed a Cross-sectional design and was done on 30 children with cochlear implantation at the first to sixth grades of primary schools and 30 children with normal hearing who were matched in age with cochlear implant group. Children with cochlear implant were selected from Special education centers in Tehran and children with normal hearing were recruited from primary schools in Tehran. Inclusion criteria were being monolingual, having cochlear implant, age of implantation is over 5 years, and at least 1 to 2 years benefited from cochlear implantations. Exclusion criteria were children with structural defect in the speech organs movement, neuromuscular problems, and history of epilepsy, seizures and brain injury.

In this study, phonological awareness test of Soleimani's et al. was used. This visual test includes three parts: syllabic awareness, rhyme awareness and phonemic awareness. In total, the test has 10 subscales and the subscales include 10 questions. Phonemic awareness includes seven subscales: phonemic blending, identify words with the same initial phoneme, identify words with the same final phoneme, phonemic segmentation, naming and deletion final phoneme, middle phoneme deletion, and naming and remove the initial phonemes. The demographic personal information questionnaire, inclusion and exclusion criteria were collected from the teachers. The test was performed for each subject in a relaxed and convenient environment. For each correct response, rating 1 was assigned and for each incorrect response, rating 0 was assigned, and the total numbers of test results were recorded. In some of subscales, normal distribution of data and homogeneity of variances were observed, so the parametric independent t-test was used. But in other subscales because data distribution was not normal and Homogeneity of variances was not observed, therefore nonparametric Mann-Whitney U test was used for comparing the phonemic awareness in subscales in both control and experimental groups.

## Results

Totally 60 children, 30 children with cochlear implant and 30 normal hearing children were participated in the study. Most of them were in first grade of primary school (26.7 percent) and least of them were in second and sixth grade (13.3).the participants aged between 6 and 11 years. The mean age and standard deviation of participants were respectively 8.21 and 1.77. In table (1) mean, standard deviation and T test have been reported in two groups.

**Table 1.** Mean, standard deviation, and T-test of two independent groups

| variable | Groups | numbers | mean | Standard deviation | T | P | $Eta^2$ |
|---|---|---|---|---|---|---|---|
| Phonemic awareness | Children with CI | 30 | 22.87 | 18.902 | 8.62 | 0.000 | 0.56 |
| | Children with NH | 30 | 59.57 | 13.642 | | | |
| Phonemic segmentation | Children with CI | 30 | 2.47 | 2.801 | 9.323 | 0.000 | 0.60 |
| | Children with NH | 30 | 8.23 | 1.906 | | | |
| Naming and deletion the middle phoneme | Children with CI | 30 | 1.57 | 2.979 | 8.077 | 0.000 | 0.53 |
| | Children with NH | 30 | 7.70 | 2.902 | | | |
| Naming and deletion the first phoneme | Children with CI | 30 | 1.37 | 2.723 | 8.225 | 0.000 | 0.54 |
| | Children with NH | 30 | 7.57 | 3.104 | | | |

According to information obtained from the above table, we know that the mean of phonemic skill scores in normal hearing children were more than twice of cochlear implant children. The same situation observed between its normal subscales. Thus, the phonemic segmentation, naming and middle phoneme deletion, and naming and first phoneme deletion in normal hearing children are significantly more than cochlear implant children. T-test results show that phonemic skills score has statistically significant differences between two groups (T=8.623, P<0.0001). In other words, phonemic skills were statistically significant difference between two groups. It is also a significant difference in the normal subscales of phonemic skills between two groups (P<0.0001). According to the size effect scores (Eta square) can be concluded that the minimal difference between two groups is in the naming and deletion the middle phoneme subscales ($0.53=Eta^2$) and the maximum difference is in the Phonemic segmentation subscales ($0.60= Eta^2$).

The mean rating of phonemic awareness subscales and Mann-Whitney U were evaluated in the table (2):

**Table 2.** The mean rating and Mann-Whitney U test for comparison abnormal subscales phonemic awareness skills

| Variable | group | number | Mean rating | Z | p |
|---|---|---|---|---|---|
| Phonemic blending | Children with CI | 30 | 19.65 | 5.09 | 0.000 |
| | Children with NH | 30 | 41.35 | | |
| Recognizing words with the same initial phonemes | Children with CI | 30 | 17.72 | 5.85 | 0.000 |
| | Children with NH | 30 | 43.28 | | |
| Recognizing words with the same final phoneme | Children with CI | 30 | 18.88 | 5.26 | 0.000 |
| | Children with NH | 30 | 42.12 | | |
| Naming and deletion the final phoneme | Children with CI | 30 | 20.18 | 4.73 | 0.000 |
| | Children with NH | 30 | 40.82 | | |

As above table, mean rating of phonemic blending, recognizing words with the same initial phonemes, recognizing Words with the same final phoneme, and naming and deletion the final phoneme in normal hearing children are significantly more than children with cochlear implant. Therefor children with cochlear implant and normal hearing children in abnormal phonemic awareness subscales are statistically significant differences (p<0.0001).

## Discussion

The main aim of this study was to evaluate and compare the phonemic awareness in children with cochlear implant and normal hearing children who were in primary school. The results of this study (table 1) have been showed, generally, children with cochlear implant showed weaker performance on phonemic awareness tasks in comparison to normal hearing children. Also, results from seven subscales of phonemic awareness skills revealed that children with cochlear implantation lag those of normal hearing children. These findings are in agreement with previous studies (1, 8, 17-22). Consistent with previous studies, there is a strong relationship between phonemic awareness and literacy skills. Therefore weak performance of children with cochlear implant in phonemic awareness skills leads to the literacy problems. Also results of Table 3 showed that children with cochlear implant have lower performance in comparison with normal hearing children in all subscales of phonemic awareness skills(1, 9, 11, 12, 14, 16, 18, 23, 24). Spencer and Oleson in their study examine phonemic awareness in cochlear implants children and normal ones and report that the performance of children with cochlear implant in a phonemic awareness tasks (phonemic blending task) is near to normal hearing children But in a phonemic segmentation tasks, children with cochlear implant did in a lower level than the normal hearing children (16). While our study showed that not only phonemic segmentations skills in cochlear implants children and normal hearing children, are significantly different (consistent with the Spencer and Oleson findings), but phonemic blending skills are also significantly different (not consistent with Spencer and Oleson findings). In fact, it can be argued that there is a significant difference in phonemic awareness skills between the children with cochlear implant and normal hearing children. Although according to previous studies children with cochlear implant had better performance compared with children with hearing loss who use hearing aids but they show lower performance in phonemic awareness when compared to normal hearing children (6, 8, 16). This may be due to factors such as age of implantation or duration of using the implant prosthesis. In fact, previous studies

have reported that if Cochlear implantation perform in early ages and duration of using the prosthesis be long, difficulties in phonemic awareness skills in cochlear implant children will be fewer and the difference in performance with normal children will be lower (10, 11, 25-27).

## Conclusion

Generally the results of this study showed that phonemic awareness skills in Children with Cochlear Implant are lower than normal hearing children. This weakness can lead to problems in the children's literacy. Therefore Assessment of phonemic awareness skills is essential to identify defects in these skills and also to prevent literacy problems in cochlear implants children. The limitations of this study was the small number of Cochlear Implanted Children at primary school and lack of gender variable in the analysis due to limited number of each sex, and the hope is that these restrictions will be removed in future studies.


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