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A comparison of morpho-syntactic abilities in deaf children with cochlear implant and 5-year-old normal-hearing children

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ABSTRACT

Introduction: Children with cochlear implants (CIs) have problems in morpho-syntactic abilities more than other language skills. The current study was aimed to evaluate the language samples of children with CIs by using a numerical measurement tool, Persian developmental sentence scoring (PDSS).

Method: In this cross-sectional, descriptive, analytical study, 33 children (22 children with CIs and 11 with normal hearing) were recruited. Language samples of the children were recorded during the description of pictures. The PDSS was used as a reliable numerical measurement tool for analyzing the first 100 consecutive intelligible utterances.

Results: We found a significant difference in the mean PDSS total scores ($p = 0.0001$) between the normal-hearing children and deaf children using CIs for 5 years. Similarly, the results revealed a significant difference in the mean PDSS total scores ($p = 0.0001$) between the normal-hearing children and 5-year-old deaf children with CIs. There was no significant difference in the mean PDSS total scores between the two groups of children with CIs.

Conclusion: Children with CIs can form simple sentences but probably exhibit poor abilities for using complex sentences and essential morphology items.

1. Introduction

Language development is one of the most important issues in deaf children. Problems with the morpho-syntactic skills in children with hearing impairment have been reported more than the other linguistic domains [1–6]. Disabilities in using syntactic rules, including the use of grammatical morphology, prepositions, adjectives, and pronouns, word ordering, and sentence making, are issues that can be addressed in children with hearing impairment [7]. Studies show that many deaf children after cochlear implantation can acquire language and speech skills [4]. However, children with cochlear implants (CIs) also have problems in the morpho-syntactic abilities more than other language skills [8]. Desjardin et al. concluded that the language age of children with hearing impairment was lower than their chronological age [9]. Young & Killen reported that morpho-syntactic production in children with CIs was poor compared with expression of the words and semantic skills [10].

Lynce et al. compared language expression of children with CIs and

normal-hearing peers and reported that children with CIs used shorter grammatical expression than those used by normal children [11].

Faes et al. Tavakoli et al., and Desjardin et al. reported that the mean length of utterance (MLU) in children with CIs was lower than that of normal-hearing children [8,9,12].

Rahimi et al. evaluated the language skills of children by using Test of Language Development-Primary, 3rd edition (TOLD-P3), and concluded that the morpho-syntactic scores of children with CIs were lower than that of normal children [13].

The current study was aimed at evaluating the language expression of children with CIs by using a numerical measurement tool, Persian developmental sentence scoring (PDSS). PDSS was developed as a tool to assess the morpho-syntactic abilities of Persian-speaking children [14,15]. Moreover, we compared the scores of Persian grammatical categories: verb morphology, modal, and compound verbs, grammatical morphemes, pronouns, question words, and prepositions and conjunctions between two study groups, children with CIs and normal-hearing children.

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Table 1
The mean (SD) of chronological age, age of Implantation and hearing age.

Groups		chronological age (months)	Age of Implantation (months)	Hearing age (months)
I	5-Year- old normal hearing children	Mean	58.91	–
		Standard Deviation	2.77	–
II	5-Year- old deaf children with CIs	Mean	60.91	29.55
		Standard Deviation	3.62	10.37
III	Deaf children after 5 years CIs use	Mean	108.82	49.64
		Standard Deviation	15.90	15.51

2. Methods

2.1. Participants

In this descriptive, analytical, cross-sectional study, 33 monolingual Persian-speaking children participated. They had no history or symptoms of movement delay, physical damage, neurological problems, seizures, brain damage, or any other disorders. The children were divided into three groups: group I consisted of 11 normal-hearing 5-year-old children (mean chronological age = 58.91 months, standard deviation = 2.77); group II included 11 deaf children with CIs aged 5 years (mean chronological age = 60.91 months, standard deviation = 3.62, mean hearing age = 31.36 months, standard deviation = 10.15), and group III included 11 children who had used CIs for 5 years (mean hearing age = 59.18 months, standard deviation = 2.09). The deaf children were recruited from the Farhangiyani clinic and Sokhan center of rehabilitation in, and normal-hearing children were recruited from a kindergarten in Qom city.

This study was approved by the Ethics Committee of the Iran University of Medical Sciences. The parents signed the consent form and were allowed to withdraw from the study at any stage.

2.2. Data collection & statistical analysis

The collection of the language samples of all children was done in an appropriate room (with minimum noise and enough light). The children were asked to describe 30 colorful pictures (20 × 25 cm) representing daily family activities, portraying a mother, father, and children at home, at the park, at the doctor's office, at a birthday party, and at the seaside. Language samples of 20–30-min conversations between the children and the examiner were recorded using a Kingston-DVR-902 digital voice recorder that was placed in a container to avoid distracting the child at a distance approximately 40 cm from speaker. Language samples of 33 participants were collected. The collected language samples were orthographically transcribed by the examiner. Repeated utterances, one-word utterances, utterances without a verb, and unintelligible utterances were excluded. The language samples comprised a maximum of the first 100 consecutive intelligible utterances.

To examine the inter-rater reliability [16], 20% of the language samples were re-transcribed by a second transcriber. The point-to-point agreement indicated 91% and 93% inter-rater agreements for utterance and morpheme segmentation, respectively.

The PDSS was used as a reliable numerical measurement tool. We calculated the PDSS total scores and the scores of the Persian grammatical categories: verb morphology, modal and compound verbs, grammatical morphemes, pronouns, question words, prepositions and conjunctions, sentence structure, and total correct sentence scores. The PDSS was calculated from the total sentence scores of the language sample and divided by 100 (the total number of the sentences = 100). The total scores for each grammatical categories for every language sample were also calculated [14,15].

To examine the inter-rater reliability, 20% of the language samples

were re-calculated by a second examiner. The point-to-point agreement indicated 90% inter-rater agreement for the PDSS total scores.

Statistical analysis was conducted using SPSS software (version 21). The mean and standard deviations for age, the PDSS total scores, and the total scores for each grammatical categories were calculated for every participant. A Kolmogorov-Smirnov test at $p > 0.05$ was conducted, which indicated that the data were non-normally distributed. To compare between groups, the Mann-Whitney U test were used. A P -value less than 0.05 was considered significant.

3. Results

In the current study, three groups of Persian-speaking children (17 girls and 16 boys) participated. Table 1 shows the mean (SD) chronological age, the age at cochlear implantation, and hearing age of the study groups.

Table 2 and Fig. 1 shows the mean PDSS total scores for the three groups of children. There was a significant difference in the mean PDSS total scores ($p = 0.0001$) between the normal-hearing children and deaf children after 5 years of CI use. Similarly, the results revealed a significant difference in the mean PDSS total scores ($p = 0.0001$) between the normal-hearing children and 5-year-old deaf children with CIs. No statistically significant difference was found in the mean PDSS total scores ($p = 0.470$) between the two groups with CIs.

Table 3 shows the mean (SD) total scores for each grammatical categories in the normal-hearing children and 5-year-old deaf children with CIs. Table 4 shows the mean (SD) total scores for each grammatical categories in the normal-hearing children and deaf children after 5 years of CI use. There was a significant difference between the normal-hearing children and 5-year-old deaf children with CIs in the mean scores for verb morphology ($p = 0.010$), grammatical morphemes ($p = 0.0001$), pronouns ($p = 0.001$), prepositions and conjunctions ($p = 0.001$), sentence structure ($p = 0.009$), and correct sentence scores ($p = 0.007$). Similarly, there was a significant difference between the normal-hearing children and deaf children after 5 years of CI use in the mean scores for verb morphology ($p = 0.002$), modal and compound verbs ($p = 0.013$), grammatical morphemes ($p = 0.0001$), pronouns ($p = 0.001$), prepositions and conjunctions ($p = 0.001$), and sentence structure ($p = 0.03$).

Table 5 shows the mean (SD) total scores for each grammatical categories in the 5-year-old deaf children with CIs and deaf children after 5 years of CI use. There were no significant differences between the two groups of children with CIs in the means scores for grammatical categories.

Table 2
The mean and Standard Deviation of PDSS total scores for 3 groups of children.

Groups		Mean	SD
I	5-Year- old normal hearing children	11.80	.76
II	5-Year- old deaf children with CIs	8.57	1.67
III	Deaf children after 5 years CIs use	8.11	1.21

Persian Developmental Sentence Scoring (PDSS).

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