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RESEARCH ARTICLE

Development of expressive language and social skills in children with normal hearing and hearing impairment

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Abstract

Background and Aim: Expressive language is the most basic and widespread means of communication; children with hearing impairments are one of the largest groups of children with speech and language disorders. Therefore, this study compares the relationship between the development of expressive language and social skills in children with cochlear implants (CIs), hearing aid (HA) users and normal Persian-speaking peers aged five to seven years old.

Methods: The present study is a cross-sectional comparative study. 45 children in three groups; normal hearing, CIs and HA users were selected by convenience sampling. The child's communication and social skills were assessed using Matson and children's communication checklist (CCC) tests. Through the analysis of a descriptive speech sample of language indicators, the mean length of utterance- morpheme (MLU-m), number of different words (NDW) and the percentage of intelligible utterances (PIU) of the child were obtained and examined. ANOVA test was used to compare the groups and Pearson test was used to examine the correlation between variables.

Results: The mean score of CCC test, PIU and NDW are significantly different in the three groups. MLU and Matson subtests are not significantly different in three groups. Correlation between variables was different in each group.

Conclusion: Communication skills, intelligibility, and lexical diversity are significantly different between normal and hearing- impaired children. MLU and Matson subtests are not significantly different in three groups. The correlation patterns among different subtests of CCC and Matson for children with hearing impairment were different form normal hearing children.

Keywords: Hearing impairment; communication skills; mean length of utterance; percentage of intelligible utterances; number of different words; social skills

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Introduction

Persistent childhood hearing loss is a chronic disability that happen approximately 1-1.3 in every 1,000 children born alive [1,2]. Hearing impairment can cause speech and language problems. These problems depend on the degree of hearing loss, the age of diagnosis, the age of the intervention and the types of interventions received [3]. Various studies show that many children who are born deaf or become deaf before the

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age of three are significantly behind their normal peers in expressive language, writing, and gesture skills [4]. These problems can reduce a child's ability in communication, development and improvement social interaction, self-awareness, development of independent thinking and improvement problem-solving skills [5,6]. On the other hand, with the advancement of medical science and using cochlear implants (CIs) for some deaf or hard of hearing loss children, these children are able use their sense of hearing and achieve spoken language. Therefore, it is likely that these children compensate many of their problems that hearing-impaired children face [4,7].

Social skills are a set of abilities and behaviors that increase social interactions and are highly related to pragmatic language abilities [8]. Social skills also enable us to communicate and interact verbally and non-verbally with others through gestures, body language, or personal appearance, which maximizes the rate of positive response and minimizes the strength of punishment from others [9]. Impairment in social skills may be associated with broader problems such as developmental disabilities, hyperactivity and attention deficits, depression, anxiety, antisocial behaviors, and other problems associated with sensory and mental impairments [10]. Sensory impairments include hearing and vision problems that will have a significant impact on the problem of social skills of these people compared to their normal peers [11,12]. On the other hand, theoretical data and various studies have shown expressive language and social competence interrelate during childhood development [13,14].

Several studies have been conducted in children with normal hearing and showed a clear link between language delay and the acquisition of social and emotional skills [15-17]. Various investigations have found this association in deaf and hearing-impaired children. It was found that these children showed more social and emotional development problems than their hearing peers [18]. It is shown compared to normal peers, CI children experience a significant delay in social competence along with language delay even eight years after implantation [19].

There is an internal connection between linguistic and other aspects such as attention, behavioral aspects, and emotion regulation [6]. It is predicted that a defect in one area will affect other areas. Children with CIs and hearing impaired children who experience disabilities in language development are more likely to have numerous disabilities in several aspects of social skills and social development [6].

To the best of our knowledge, there is no study to compare the impact of hearing sense on language and social development in three groups of children including CI, severe to profound hearing loss, and normal hearing children. Therefore, the aims of the present study were to compare language and social skills among these three groups of children and to study the relationships of these two skills in each group.

Methods

Participants

Participants in this study were 45 Persian-speaking children aged 5-7 years who were divided into three groups; CI (n = 15) users, HA users with severe to profound hearing loss (n = 15), and their normal hearing peers (n = 15). Children with CI and HAs were recruited from two speech therapy clinics, three hearing loss center and school of hearing loss by using convenience sampling method in Tehran and Alborz provinces. Normal hearing children randomly selected from kindergartens in Tehran province using convenience sampling method.

All participants were native Farsi speakers. Children with hearing impairment communicated verbally. They had no history of medical problems, structural or motor abnormalities in the speech organs, neuromuscular diseases, and genetic diseases and they had the normal intelligence. Children using HAs had congenital severe to profound hearing loss (pure tone averages $\geq$ 71 dB), with at least two years of history of HA use. Children with CIs had severe to profound congenital hearing loss before implantation. Moreover, they used a HA before cochlear implantation for at least two years and implanted at least the last two years before the time of experiment.

This study approved by Ethic Committee in Tehran University of Medical Sciences with Number IR.TUMS.FNM.REC.1398.151. The parents of all children signed content form and allowed their children participated in this study.

Data collection

This study was conducted between July 2019 and March 2020. After completion of the personal information form by parents, they were asked to complete the Matson evaluation of social skills with youngsters-II (MESSY-II) and the children's communication checklist (CCC) at random [20,21]. Then, language samples were obtained from the children using telling two pictured stories (A1 and A3 of the Farsi Narrative Norms Tool). The children were learned the storytelling task with a training story, after that the main stories randomly given and asked to tell them. The child's voice was recorded while describing the main stories. The language sample of all participants were transcribed and analyzed by a trained person and the mean length of utterance (MLU), number of different words (NDW) and the percentage of intelligible utterances (PIU) of the child were obtained from it.

Ten percent of the language samples were randomly selected and the language measures were analyzed for the second time by another trained person. The percentage of point-to-point agreement between the two individuals was 100% for transcription and 85% for data analysis.

Language assessment measures

Lexical diversity using NDW, syntactic complexity using MLU in morphemes (MLU-m), and PIU calculated from language sample. MLU-m was obtained by dividing the total number of morphemes by the total number of utterances. The utterances were separated on the basis of the change of the terminal intonation and/or pauses of 2-3 seconds. In addition, clauses that are connected by conjunctions (such as but (/amma/ in Farsi), when (/zamani ke/ in Farsi), if (/agar/ in Farsi), before (/qabl/ in Farsi), after (/baad/ in Farsi), were considered in a single utterance [22]. Morphemes were counted based on the Persian language assessment remediation and screening procedure scale [23]. NDW were obtained by counting the number of different word roots and deleting duplicate. In order to calculate PIU, the number of intelligible utterances calculated and divided by the total utterances. The proportion multiplied by 100.

Social and communication skills assessment measures

Communication skills was also measured using Persian version of CCC-2, a questionnaire consisting of 70 questions in 9 subsets (speech, syntax, inappropriate initiation, coherence, stereotyped language, use of context, rapport, social relationships, interests) [21]. Each question has a positive or negative charge in terms of language and social competencies which are rated on a Likert scale. A score of zero to two is assigned to each question and the parent should choose one of these options based on their child's ability.

The Matson social skills questionnaire was used to assess children's social skills by parents. These forms consisted of up to 55 questions and 5 subtests (appropriate social behavior, inappropriate social behavior, impulsive/recalcitrant behavior, overconfident, relationships with peers) in the Persian version which are each rated on a Likert scale from 1 ‘‘not at all’’ to 5 ‘‘very much’’ [20]. The parent should choose one of these options based on their child's ability.

Data analysis

A Kolmogorov–Smirnov test was used to evaluate the normality of the data. In order to compare the differences of linguistic and social variables in three groups, the ANOVA test was used to compare the mean for MLU-m, NDW, different subtests of Matson and total score of CCC. Due to not following the normal distribution, the Kruskal-Wallis test was used to compare the mean of PIU. Pearson correlation coefficient was used to determine the relationship variables. All data were analyzed with SPSS 26. Statistical significance of $p < 0.05$ was considered.

Table 1. Mean scores of different variables in children with normal hearing, cochlear implant, and hearing aid users

	Normal group			CI group			HA group		
language and social skills	**Mean (SE)**	**Median**	**Min-max**	**Mean (SE)**	**Median**	**Min-max**	**Mean (SE)**	**Median**	**Min-max**
NDW	82.87 (23.53)	81	48-122	65.53 (15.74)	63	46-98	53.73 (13.28)	60	31-69
MLU	2.33 (0.45)	2.33	1.28-3.29	2.39 (2.39)	2.24	1.80-3.03	2.27 (0.50)	2.22	1.66-3.10
Appropriate social behaviors	64.93 (10.16)	63	48-81	63.20 (7.40)	62	52-75	66.80 (10.57)	64	48-84
Inappropriate social behaviors	22.33 (3.61)	22	15-28	24.33 (6.52)	23	16-38	25.73 (8.25)	29	17-40
Impulsive/recalcitrant Behavior	23.80 (3.95)	24	17-31	27.13 (9.46)	24	14-46	27.87 (7.31)	29	17-40
Overconfident	18.20 (4.41)	18	11-24	20.33 (5.09)	21	12-29	16.73 (7.71)	17	6-31
Relationships with peers	23.47 (2.97)	24	17-29	23.73 (3.28)	23	20-31	24.53 (3.5)	3.04	19-29
Total ccc	40.13 (8.41)	40	25-57	28.80 (9.57)	28	12-43	18.53 (13.44)	19	0-44
PIU	100 (0)	100	100-100	99.87 (0.51)	100	98-100	97.07 (4.36)	98	83-100

CI; cochlear implant, HA; hearing aid, SE; standard error, NDW; number of different word, MLU; mean length of utterance, CCC; children's communication checklist, PIU; percentage of intelligible utterances

Results

The descriptive data of the variables are reported in Table 1. The comparison analyzes using ANOVA and Kruskal-Wallis tests showed a significant difference for PIU ($p \leq 0.001$), CCC ($F_{(42,2)} = 15.303$, $p \leq 0.001$), NDW ($F_{(42,2)} = 5.267$ and $p = 0.009$) among three groups (Table 2). There were significant differences among the three groups in the subtests of CCC including speech ($F_{(42,2)} = 18.639$, $p \leq 0.001$), syntax ($p \leq 0.001$), inappropriate initiation ($p = 0.031$), coherence ($p \leq 0.001$) and use of context ($F_{(42,2)} = 4.221$, $p=0.021$). There was no significant difference between MLU ($F_{(42,2)} = 0.254$ and $p = 0.777$), and subtests of Matson among three groups. The results of multiple comparisons of NDW and CCC variables are reported in Table 2.

The results of Pairwise comparisons of PIU showed significant differences between children with CI and HA users ($t = 3.82$, $p \leq 0.001$); and HA users and normal hearing children ($t = 4.19$, $p \leq 0.001$). There was no difference between children with normal hearing and CI children ($t = 0.369$, $p = 0.71$).

The results of significant correlation among different language variables and social skills are in Tables 3−5 for each group separately.

Discussion

The results of this study showed that CCC score is higher in children with normal hearing than the other two groups. Moreover, differences in speech, syntax, inappropriate initiation, and coherence, use of context subtests were significant in the three groups. The PIUs in normal children is significantly higher than CIs and HA users. These results are consistent with Ashouri et al. and Chin et al. They showed that speech clarity in normal children is significantly higher than children using HAs and CIs [24,25]. González-Cuenca et al. and Le Maner-Idrissi et al. showed that children with hearing impairment performed lower in higher-level language skills such as irony than their hearing peers [26,27]. Hearing-impaired children do not experience normal interactions with their hearing peers due to their hearing impairment. Therefore, they are less likely to acquire communication skills [28,29].

Table 2. Multiple comparisons for number of different words and children's communication checklist variables

	Mean difference (SE)	p	95% Confidence interval (lower - upper)
NDW			
Normal			
CI	17.333 (6.72)	0.013	3.77 - 30.99
HA users	20.133 (6.72)	0.005	6.57 - 33.96
CI			
Normal	−17.333 (6.72)	0.013	−30.90 - −3.77
HA users	2.799 (6.72)	0.679	−10.76 - 16.36
HA users			
Normal	−20.133 (6.72)	0.005	−33.69 - −6.57
CI	−2.799 (6.72)	0.679	−16.36 - 10.76
CCC			
Normal			
CI	11.333 (3.90)	0.006	3.45 - 19.22
HA users	21.600 (3.90)	0.001	13.72 - 29.48
CI			
Normal	−11.333 (3.90)	0.016	−19.22 - −3.45
HA users	10.267 (3.90)	0.012	2.38 - 18.15
HA users			
Normal	−21.600 (3.90)	0.001	−29.48 - −613.72
CI	−10.267(3.90)	0.012	−18.15 - −2.38

SE; standard error, NDW; number of different word, CI; cochlear implant, HA; hearing aid, CCC; children's communication checklist

MLU is a more reliable indicator for assessing syntax in children. This measure was not different between three groups of children in this study. It seems that MLU in children with CIs and HA users is similar to normal hearing peers due to receiving long-term rehabilitation services. The results of the work of Ertmer et al. Showed that the rate of development of grammar complexity in children with CIs is slower than children with normal hearing [30]. DesJardin et al. found MLU growth rate of children with CIs and hearing loss aged 3−5 years is lower than their hearing peers [31]. Tavakoli et al. studied 3 groups of children: CI children with a chronical age of 60-72 months, CI with a history of 60−72 months using the implant device, and normal peers aged 60-72 months. They showed that MLU of children who used CIs for 60-72 months were not significantly different from their peers, but in the other group the differences were significant [32]. These results showed MLU index in children with hearing impairment is related to

Table 3. The relation among different language variables and social skills for normal hearing children

Language variables and social skills	Correlation coefficient	p
NDW and overconfident	0.697	0.004
Total score of CCC and appropriate social behavior	0.533	0.041
Total score of CCC and relationships with peers	0.523	0.046
Appropriate social behavior and rapport	0.672	0.006
Appropriate social behavior and social relationships	0.573	0.025
Overconfident and rapport	0.531	0.042
Relationships with peers and coherence	0.553	0.032
Relationships with peers and use of context	0.540	0.038
Relationships with peers and rapport	0.534	0.040
Inappropriate social behaviors and use of context	−0.555	0.032
Inappropriate social behaviors and stereotyped language	−0.632	0.012

NDW; number of different word, CCC; children's communication checklist

several factors such as age of diagnosis, the time of using device, and age of starting intervention services.

Hearing impairment influence on acquiring different aspects of language such as speech clarity and high-level language skills. This study showed children with hearing impairment experienced difficulty in these aspects despite receiving speech therapy services. Although these services had effective influence on MLU and verbal communication.

According to the findings of this study, no significant difference was found between three groups in the different subtests of Matson. These results were not similar to previous studies. Tye-Murry et al. using the Meadow-Kendall Social-Emotional Assessment Inventory indicated children with hearing impairment aged 8-9 had good pragmatic skills but their skills were not similar to their peers [33]. In Rezaei Dehnavi et al.'s study which was performed using Matson test, CI children performed better in appropriate social skills than their HA user peers. But impulsive/recalcitrant behavior, overconfident and relationships with peers were lower than their HA peers [34].

Lack of significant difference among social skills in three groups of children can be related to the characteristics of the questionnaire. Matson is a questionnaire that parents fill in it. Social skills are highly dependent on the context in which the child grows up. Children with hearing impairment, especially HA users, frequently communicate with the peers that have similar problems. Furthermore, these children use appropriate verbal and nonverbal skills for communication with other people. On the other hand, the children with hearing impairment have intensive rehabilitation services, so that some language measures such as MLU were similar to normal hearing peers. In our opinion, above mentioned reasons have resulted in that parents reported their children have desired behavior with the peers and others in the present study.

Another language measure that assessed in this study was lexical diversity. Normal children use NDW significantly higher than CI children and HA users. However, there was no significant difference between the CI group and the HA user. Ertmer et al. showed that the growth rate of

Table 4. The relation among different language variables and social skills for cochlear implant children

Language variables and social skills	Correlation coefficient	p
MLU and NDW	0.514	0.050
NDW with rapport	0.525	0.044
Appropriate social behavior and speech	−0.652	0.008
Appropriate social behavior and syntax	−0.521	0.046
Appropriate social behavior and inappropriate initiation	−0.573	0.026
Inappropriate social behaviors and use of context	−0.635	0.011
Inappropriate social behaviors and social relationships	0.680	0.005
Inappropriate social behaviors and interests	−0.529	0.042
Impulsive/recalcitrant behavior and social interaction	−0.631	0.012
Impulsive/recalcitrant behavior and interests	−0.597	0.019
Use of context	−0.545	0.036
Overconfident and social relationships	−0.613	0.015
Relationships with peers and coherence	−0.710	0.003
Relationships with peers and interests	−0.734	0.002

MLU; mean length of utterance, NDW; number of different word

lexical diversity in children with CIs is slower than in children with normal development [30]. DesJardin et al. found children with hearing impairment show slow growth rate of this skill and these children can largely compensate this gap with increasing age [31].

In the present study, correlation among language variables and social skills are assessed. The results are discussed as follows:

There was a positive correlation between MLU and NDW only in the CI group. The relationship between vocabulary storage and syntactic structure are reported in normal growth in children as well [18].

Social skills are related several factors such as the type of personality, language skills, and motivation. This study gathered the mothers' opinions about social skills of their children. The results of correlation between different subtests of CCC and Matson in three groups of children did not show a systematic pattern. It is probably that the questions that measure these skills are not related exactly. There are not many questions in Matson that related to language skills. Furthermore, it seems similar to normal hearing children, social skills for children with hearing impairment depend on motivation, tendency to communication, and personality.

The correlation patterns for children with hearing impairment were different form normal hearing children. These correlations are discussed. It is worth nothing, the results of this part of the research findings with other studies did not compare. Because we could not find any study that separately measured the relationship between social and communication skills.

In CI children, increasing the ability in use of context, (which includes questions that measure non-literal and ironic language, etc.), as well as better social relationships (which includes questions that assess the child's relationship with peers) and increase the child's interest in

Table 5. The relation among different language variables and social skills for hearing aid user children

Language variables and social skills	Correlation coefficient	p
NDW and PIU	0.536	0.039
NDW and speech	0.521	0.047
NDW and coherence	0.626	0.012
NDW and use of context	0.577	0.024
Appropriate social behavior and rapport	0.578	0.024
Total score of CCC and inappropriate social behaviors	−0.668	0.006
Total score of CCC and impulsive/recalcitrant Behavior	−0.572	0.026
Total score of CCC and relationship with peers	−0.775	0.001
Inappropriate social behaviors and speech	−0.593	0.020
Inappropriate social behaviors and stereotype language	−0.542	0.037
Inappropriate social behaviors and social relationships	−0.774	0.001
Impulsive/recalcitrant behavior and speech	−0.514	0.050
Impulsive/recalcitrant behavior and stereotyped language	−0.551	0.033
Impulsive/recalcitrant behavior and rapport	−0.591	0.020
Impulsive/recalcitrant behavior and social relationships	−0.727	0.002
Overconfident and inappropriate initiation	0.819	0.000
Relationships with peers and speech	−0.617	0.014
Relationships with peers and inappropriate initiation	−0.752	0.001
Relationships with peers and stereotyped language	−0.610	0.016
Relationships with peers and use of context	−0.622	0.013
Relationships with peers and social relationships	0.736	0.002
Relationships with peers and interests	−0.537	0.039

NDW; number of different word, PIU; percentage of intelligible utterances, CCC; children's communication checklist

age-appropriate behaviors, (including interest in playing with peers and watching age-appropriate programs) reduces inappropriate social behaviors.

On the other hand, higher social interaction and more interest in these children were associated with less aggressive and impulsive behaviors. Increased overconfident score (including questions that measure show off and pretending to know everything) were accompanied by a decrease in items of use of context and social relationship. It is probably that these children have less understanding and using of context than normal children, and they express themselves incorrectly in a way that causes others to ignore them.

Furthermore, these children showed a negative correlation between speech subtests (measure speech clarity, inappropriate initiation and

syntax) with appropriate social behavior. This result is pretty strange. It is required further study to interpret the exact relationship between speech abilities and social behavior.

A negative correlation was seen in the relationship with peer's subtest of the Matson test with coherence (which measures the child's coherent descriptive skills) and the interest's subtests of the CCC. There are two possibilities for these outcomes, one may be due to the child's ability to use non-verbal skills and the other may be due to the fact that relationship with peers is a multifactor skill and cannot be examined with an item such as interest.

For HA user group, children with speech clarity had better social relationship less inappropriate social behavior, less impulsive/recalcitrant behavior, and higher rapport that correlated with appropriate social behavior and less impulsive/recalcitrant behavior.

As we expected, better relationship with peers was associated with a low score of inappropriate initiation, and stereotyped language. There was a negative correlation among speech, use of context, and interest with relationship with peers. This finding may be due to the fact that these children use verbal and non-verbal skills to compensate their defects. Overconfident was negatively correlated with inappropriate initiation in these children, and it is likely that these children showed less inappropriate initiating behavior with higher overconfident.

The results of this study showed that there is a positive correlation between the NDW and the PIU in the CI group. These findings can be interpreted as increasing vocabulary and their diverse use of words are effective on listeners' perception of the speaker. This relationship was not found in the other two groups. According to searches conducted, no studies were found that examine the relationship between these two measures.

The results of this study showed that there is a positive and significant correlation between lexical diversity and CCC in the HA user group. This positive correlation was found among NDW with speech, coherence, use of context, and rapport in HA children; and with rapport in the CI group. The authors expected that these correlations would be observed in the group of children of normal development. But there was no correlation in this group. One possibility could be that children who use HAs and CIs acquire communication and social skills in a different way than normal children. Netten et al. found that children with more vocabulary had higher communication skills as well as fewer behavioral problems [18]. No other study was found to measure correlation between vocabulary diversity and communication skills. It seems that CI children and HA with higher speech and language skills have higher communication skills. It is due to reduced failure in daily interactions.

There was only a positive correlation between NDW and overconfident in normal children. Normal children, who have more vocabulary, have a better ability to convey information to others. Therefore, self-confidence increase in these children. Netten et al., showed that children who had more vocabulary had higher communication skills as well as fewer behavioral problems [18].

This study has some limitations. The data of age of using device in children with hearing impairment, and history of receiving intervention are not available. We could not match three groups of children based on language skills. Because there is no standard test for assessment of language skills in children in Persian. Therefore, children matched based on chronical age.

As our best knowledge, Matson is just a reliable and available test for assessment of social skills in Persian. It is suggested future research investigate social and language skills with different measures.

Conclusion

Communication skills, intelligibility, and lexical diversity are significantly different between children with normal hearing and children with hearing impairment. Mean length of utterance and Matson subtests are not significantly different in three groups. The results of correlation between different subtests of children's communication checklist and Matson in three groups of children did not show a systematic pattern. The

correlation patterns for children with hearing impairment were different form normal hearing children.

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Conflict of interest
The authors declared no conflicts of interest.

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