




## Rehabilitation of children with cochlear implant in Iran: A scoping review

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### Abstract

**Background:** Recovery of children does not appear on its own after cochlear implantation. Coherent, thoughtful, and comprehensive rehabilitation is needed to achieve complete success. The purpose of this study was to identify the types of rehabilitation interventions for children with cochlear implants that have been performed in Iran.

**Methods:** A scoping review study was conducted. An electronic search was carried out both in English and Persian. In English, the following keywords were used: cochlear implantation, child, cochlear implants, auditory rehabilitation, deaf, hearing loss, comprehensive, interventions, rehabilitation, and telerehabilitation and a combination of them in ProQuest, PubMed, Science Direct, and Scopus databases, Web of Sciences, Medline and Embase. Persian electronic search was conducted in the Scientific Information Database (SID) of Jihad Daneshgahi, Iran Journals Database (MagIran), and Islamic World Science Citation Database (ISC). Searches were done using articles published until September 25, 2020, and a total of 902 articles were found, of which 14 were directly related to the purpose of the study. Interventional studies were included in the study, and the quality of studies was measured using the Structured Effectiveness Quality Evaluation Scale.

**Results:** The results showed that using music and rehabilitation equipment, different methods of speech therapy and auditory training, story-based instruction, creative play, family-centered instruction, and occupational therapy are interventions in cochlear implant rehabilitation. Speech therapy accounts for 54% of the rehabilitation share. The mean number of rehabilitation sessions was 26. These interventions were all somehow effective in children with cochlear implantation; the longer the training duration, the better the results.

**Conclusion:** The process of cochlear implant rehabilitation in children is multi-professional; auditory training and speech therapy possesses the highest share of rehabilitation. Therefore, it is recommended to develop speech therapy centers in Iran.

**Keywords:** Rehabilitation, Cochlear Implant, Child, Iran

**Conflicts of Interest:** None declared

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### Introduction

Deafness is called a hidden disability. Hearing loss is the most common type of neurosensory disability, and its incidence is increasing (1). According to the World Health Organization (WHO) in 2017, more than 5% of the world's population, about 360 million people, 328 million

adults, and 32 million kids, suffer hearing loss (2). According to statistics provided by ENT and Head & Neck Research Center in 2007, approximately 2,100,000 to 3,500,000 of the Iranian population have moderate to severe hearing impairment (3). Technology facilities are

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#### ↑What is “already known” in this topic:

Previous studies have investigated cochlear implant rehabilitation in a single professional field, such as speech therapy and auditory training in Iran.

There is no systematic review on Types of rehabilitation in children with CI.

#### →What this article adds:

Auditory training and speech therapy possesses the highest share of rehabilitation; other aspects of the rehabilitation process have been studied less.

available for children born with hearing loss, which improve the hearing threshold of these children and enable them to better understand speech and language (4). Audiologists believe that a cochlear implant represents a marvelous medical and engineering success that is more compatible with the human nervous system compared to any other prosthesis (5). In fact, the earliest attempts to assist the deaf in understanding speech began with electrical stimulation of the auditory nerve in the 1950s and 1960s (6). In 1977, the first implantation surgery was carried out on children, and Claude-Henri Chouard implanted two young children, one 10 years old and the other 14 years old in France (7, 8). The first young child, a 3-year-old kid, was operated on by Dr. House in 1981 (8).

The first attempts in Iran for cochlear implantation began in Rasool-e-Akram and Amir A'lam Hospitals in 1991. In the same year and in Rasool-e-Akram Hospital, Dr. Farhadi officially launched the project after conducting preliminary studies and preparing protocols for selecting the appropriate candidate for assessment scales and auditory-verbal rehabilitation programs (9). There are currently 11 cochlear implantation centers in Iran (10). Children undergo a rehabilitation program following surgery. This is a surgical supplement program (11). A review of different studies shows that parents are important in the rehabilitation process, and they are important members of the rehabilitation process (12-15). They experience more stress compared to parents having children with normal hearing; they experience the highest level of stress immediately after implantation, usually two years thereafter, and adaptability problems after implantation are their primary source of stress. Studies with quantitative approaches have also shown that the family environment influences the outcomes of cochlear implants in children (16). Reviews also reveal that parents, music, and new technologies are effective in the rehabilitation of these clients (17-20).

One of the challenges in the rehabilitation process is that these children are relatively late in developing their syntax skills compared to their peers (21). Also, comparing the speech intelligibility of cochlear implant children with hearing aids and children with normal hearing demonstrated that speech intelligibility in children with normal hearing was better than cochlear implant children with hearing aids. Hence special rehabilitation is needed to further develop the speech skills of cochlear implant children (22).

Moreover, the most important challenge of comprehensive cochlear implant rehabilitation is the lack of progress in the psycho-social development of these children compared to their hearing peers. Despite academic achieve-

ment almost equal to their hearing peers, they report loneliness and lack of intimate friendships in integrated environments; they often have difficulty in social and emotional functions and communicating with other children (23). Special attention has been paid to the rehabilitation of these children in recent years, and various studies have been conducted in different fields. Most studies have investigated cochlear implant rehabilitation in a single professional field, such as speech therapy and auditory training. However, no study has comprehensively examined the rehabilitation of children with a cochlear implant, considering the share of each profession in the cochlear implantation team. Rehabilitation is also influenced by background, context, type of disease, culture, the severity of illness, and age of clients (24). World Health Organization states that the establishment, modification of national rehabilitation programs and the capacity to implement these plans to improve access to rehabilitation is important (25).

In order to clarify different methods of rehabilitation, the present study set to systematically what kind of rehabilitation interventions for children with cochlear implants have been performed in Iran and which dimensions of rehabilitation are paid less and which dimensions are paid more attention in Iran. We believe that the results of this study will hopefully give us more insight into the rehabilitation of these children and help policymakers and researchers adopt rehabilitation strategies.

## Methods

All studies published in English and Persian from 1975 to September 25th, 2020, which examined the rehabilitation of children with a cochlear implant, were systematically reviewed in accordance with the PRISMA guidelines.

This study was conducted using a scoping review method. To obtain scientific documentation and evidence relevant to the study, an electronic search was carried out in English using the following keywords: Mesh, cochlear implantation, child, cochlear implants, auditory rehabilitation, deaf, hearing loss, comprehensive, interventions, rehabilitation, and telerehabilitation and a combination of them in ProQuest, PubMed, Science Direct, and Scopus databases, Web of Sciences, Medline and Embase. Persian electronic search was conducted in the Scientific Information Database (SID) of Jihad Daneshgahi, Iran Journals Database (MagIran), and Islamic World Science Citation Database (ISC). The searches for this study were done using articles published until September 25th, 2020. The search method in the PubMed database is given in **Box 1**. The main question to answer was what kind of rehabilitation interventions are performed in cochlear im-

### Box 1. PubMed Search Method

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((cochlear implants"[MeSH Terms] OR "cochlear"[All Fields] AND "implants"[All Fields]) OR "cochlear implants"[All Fields] OR ("cochlear implantation"[MeSH Terms] OR ("cochlear"[All Fields] AND "implantation"[All Fields]) OR "cochlear implantation"[All Fields])) AND (("rehabilitation"[Subheading] OR "rehabilitation"[All Fields] OR "rehabilitation"[MeSH Terms] OR ("telerehabilitation"[MeSH Terms] OR "telerehabilitation"[All Fields]) OR ("rehabilitation of speech and language disorders"[MeSH Terms] OR ("rehabilitation"[All Fields] AND "speech"[All Fields] AND "language"[All Fields] AND "disorders"[All Fields]) OR "rehabilitation of speech and language disorders"[All Fields])) AND (("child"[MeSH Terms] OR "child"[All Fields]) OR ("child"[MeSH Terms] OR "child"[All Fields] OR "children"[All Fields])) AND ("iran"[MeSH Terms] OR "iran"[All Fields])
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plant children in Iran.

### Inclusion criteria

All quantitative interventional articles and articles published in English and Persian that examined different areas of rehabilitation in pre-lingual cochlear implant deaf children (0-16 years old) were included in the study.

### Exclusion criteria

Articles examining rehabilitation of adults, the elderly, and children with various syndromes, studies with lack of access to full text, qualitative articles, observational studies, gray literature (reports, thesis, and conferences), and studies on children with mental health problems were excluded.

### Data extraction

A form, including variables of the first author, year of publication, the purpose of study, type of intervention, sample size, and the most important findings, was used for data extraction. Data were extracted independently by two authors (MF and MM), and if the two authors disagreed, the article was judged by the second author (EM). After completing this form, the results of the articles' analyses were summarized and reported (Table 1).

### Critical review of articles

The quality of the studies compiled by two authors (MM and MF) was reviewed, and disagreements were resolved by the second author (EM). The methodological quality of the interventions was assessed based on the SEQES tool used in various interventional studies. The tool consisted of 24 items. Each item had a score ranging from 0 to 2; 0-16 score indicated low-quality, 17-32 score average-quality, and 33-48 score indicated high-quality methodology. The basis of the studies was analyzed separately based on the status of the method's quality (Table 2).

### Results

According to the inclusion criteria, 902 articles were initially selected; 20 articles were excluded as they were duplicates in different databases; 845 articles were excluded after assessing their titles and abstracts, these articles were about cochlear implants in adults or the treatment of hearing loss, and five other articles were excluded due to evaluation of children with pre-lingual hearing loss along with other syndromes. Four review articles and 14 articles related to rehabilitation but having no intervention were excluded. The process of selecting articles is illustrated in the PRISMA flowchart (Fig. 1).

A total of 14 articles have been reviewed in this study. Table 1 summarizes the language of studies, objectives, sample size, study method, and the results. Of the 14 articles reviewed, three were published in foreign journals and nine in domestic journals in Persian.

Among the articles reviewed, one study was about music, one about speech therapy, two articles about family-centered instruction, two studies for auditory training, one

study for occupational therapy, one study for storytelling, one article about the creative presentation of a study, one study regarding the visual and auditory use, and one for the impact of rehabilitation. In the articles, the average number of rehabilitation sessions was 26 (minimum 6 and maximum 80 sessions).

Table 3 shows the number of rehabilitation articles and sessions in terms of various types of rehabilitation; of the 14 articles reviewed, only 32% of the articles (four articles) referred to the length of rehabilitation. Shah-Panah et al. utilized 24 sessions of music therapy along with 6 months of rehabilitation. Qassimzadeh et al. reported performing a creative play in 20 weeks; Hamed et al. elaborated on 6 weeks of occupational therapy, and Hashemi et al. referred to 80 sessions of auditory training within a year. The highest duration of rehabilitation was related to auditory training in 80 sessions within a year. Overall, hearing and speech training sessions included the most rehabilitation sessions (54%).

### Discussion

This is the first systematic review that has comprehensively examined interventions in the rehabilitation of children with a cochlear implant. Nearly 15 percent of articles have examined family-related factors. As parents and family are important components of the rehabilitation team of children with a cochlear implant (12), in the current study, most studies were found to have focused on the role of the family in child rehabilitation and family-centered education in cochlear implantation.

One of the studies had investigated the impact of music on the rehabilitation of children with cochlear implants. Music stimulates many areas of the brain, in addition to the auditory cortex. Studies show that music induces the secretion of different types of neurotransmitters and mediators in the central and peripheral nervous system, which affects neurons' metabolism, enhances synaptic learning, causes structural changes in synapses, and increases the production of neurons. Using basic musical concepts at the beginning of the hearing age along with devices such as cochlear implants can make the listening experience more enjoyable for these children; so that they are more willing to use their sense of hearing and enjoy this feeling in a completely natural way (26). Hosseini et al. (2016) also demonstrated the positive effects of music therapy combined with traditional therapy on speech clarity of children with a cochlear implant. Therefore, music classes in rehabilitation centers, if possible, can improve the rehabilitation of these children (27).

Studies have focused on different ways of improving speech in children with a cochlear implant, including cued speech and story-based instruction. The cued speech method makes speech perception very easy. It also improves lip-reading skills and the ability to use residual hearing in hearing-impaired children. Cued speech enhances the ability to communicate, understand, and differentiate speech from an early age and improves speech and the ability to benefit from cochlear implantation. Cued speech is one of the verbal forms that makes all sounds visible and accessible (28).

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## Rehabilitation in cochlear implant

*Table 1.* General characteristics of rehabilitation interventions of children with cochlear implant

Article Number	Article language	Authors/Year	Purpose	Group 1 intervention	Group 2 intervention	Group 3	Study method	Sample size	Summary of findings	Quality of studies
1	Persian	Hashemi et al. 2011 (41)	Evaluation of the child's development of language skills such as general information development, calculation, vocabulary and comprehension following surgery and rehabilitation	intervention 23 children of the verbal section of Wechsler scale	-	-	Quasi-experimental intervention	23 children with cochlear implant	Following surgery and rehabilitation program, the level of verbal intelligence of children with cochlear implants increased, but did not reach the level of normal children of their age. One of the influential factors was the age of the child and the level of family education. There was no significant correlation between verbal and non-verbal intelligence.	Average
2	English	Zamani et al. 2018 (42)	Evaluation of story-based language learning in storytelling structures of children with cochlear implant	Group 1 in 24 1-hour sessions of NBLI therapy group	Participants in group 2 each attended 24 1-hour sessions of private NBLI training.	Group 3 participated in 24 24-hour sessions of conventional speech therapy (CST).	Randomized control trial	36 children with cochlear implant	Group 1 and group 2 had significantly better results than group 3 in all components of the narrative speech structure at T1 ( $P \geq 0.04$ ) and T2 ( $P \geq 0.04$ ), respectively, compared to T0. But, no difference was found between NBLI approaches ( $P > 0.05$ ). All three intervention programs significantly improved the overall structure of speech narrative in children with cochlear implant.	High
3	English	Zanjani et al. 2013 (43)	Comparison of language, auditory, and speech development in children trained with one sense (auditory) and two senses (auditory and sight)	10 people only trained with auditory sense	11 individuals trained with two auditory and sight senses	-	Randomized controlled trial	22 children with cochlear implant	Training with one sense (auditory training) and with two-senses (auditory and visual training) are both effective for children with cochlear implants, and there is no significant difference between them.	High

Table 1. Ctd

Article Number	Article language	Authors/Year	Purpose	Group 1 intervention	Group 2 intervention	Group 3	Study method	Sample size	Summary of findings	Quality of studies
4	Persian	Shahpanah et al. 2016 (47)	Evaluation of the effectiveness of music therapy on enhancing reading ability in primary school children with cochlear implant	10 people randomly assigned to experimental music therapy group with rehabilitation  24 sessions in 6 months in music therapy sessions with rehabilitation	10 people in the control group (regular rehabilitation sessions)	-	Experimental study with pretest-posttest and control group	30 children with cochlear implant	According to the findings, music therapy measures are effective on the reading skill of preschool children with cochlear implants.	High
5	Persian	Amrayi et al. (48)	The purpose of this study was to investigate the effect of family-centered education program of social skills on improving social skills of children with cochlear implant.	Participants of 12 60-75-min session group undergoing social skills training	-	-	Experimental type	16 families with children with cochlear implant	The results showed that family-centered training program of social skills had a positive and significant effect on assertiveness ( $P<0.01$ ), self-control ( $P<0.01$ ), and overall social skills ( $P<0.01$ ), but it had not significant effect on cooperation and participation skills ( $P>0.05$ ).	Average
6	Persian	Mirza Agabeighi et al. 2015 (28)	The effectiveness of cued speech on topic maintenance, basic information, and sequence of events in the story in hearing-impaired pre-lingual students with late cochlear implantation	Cued speech training program in 16 individual 60-minute sessions and 180-minute group sessions during 8 weeks	-	-	Experiment type, pre-test-post-test design	9 CI students	The findings revealed that cued speech training had a positive and significant effect on topic maintenance, basic information, and sequence of story events in hearing-impaired students with late cochlear implantation.	High
7	English	Jeddi et al. 2014 (49)	Rehabilitation of children with cochlear implant	Evaluation of the benefits of auditory rehabilitation regarding cognitive, social communication, and motor skills	-	-	Intervention	15 children with cochlear implants	Auditory rehabilitation enhances cognitive, social communication, and motor skills in children with cochlear implants.	Average

## Rehabilitation in cochlear implant

Table 1. Ctd

Article Number	Article language	Authors/Year	Purpose	Group 1 intervention	Group 2 intervention	Group 3	Study method	Sample size	Summary of findings	Quality of studies
8	Persian	Qasemzadeh et al. 2017 (37)	The effect of an intervention program based on creative-play on children's language skills with cochlear implant	The intervention consisted of 20 90-minute sessions once a week	-	-	Pre-test, post-test intervention	30 CI	Creating play conditions and teaching linguistic structures had an indirect considerable impact on the language skills of these children.	High
9	Persian	Manuchehri et al. 2011 (50)	Evaluation of the progress of speech perception in children with cochlear implant	10-43 sessions with an average of 23 sessions 1-hour of auditory training rehabilitation	-	-	Intervention	30 children with cochlear implants	Sound awareness is a rapidly evolving ability, requiring broader training to access other speech and non-speech differentiation capabilities, especially speech comprehension, which is the last and most important ability for communication.	Average
10	Persian	Hamed et al. 2017 (38)	Evaluation of task-based occupational therapy on Interventions on balance performance of hearing-impaired children with cochlear implant	6 weeks, 3 sessions per week and 30 minutes per session in the intervention group	-	-	Quasi-experimental	30 children with cochlear implants	Task-based occupational therapy interventions can improve balance control in children with cochlear implants.	High
11	Persian	Hasanzadeh et al. 2017 (40)	Evaluation of the effectiveness of auditory rehabilitation program developed as Navayesh on primary communication and language skills of children candidate for cochlear implantation	Running Navayesh rehabilitation program in 5 steps and 6 group sessions	The control group had no intervention	-	Quasi-experimental	62 children with cochlear implants	The program was effective in enhancing communication abilities, auditory perception, and speech production of deaf children in comparison with the control group. The follow-up of sustainability results revealed the effectiveness of the program. Given the increasing decline in the diagnosis age of hearing loss, using this program can be effective in the auditory rehabilitation of deaf children.	High

Table 1. Ctd

Article Number	Article language	Authors/Year	Purpose	Group 1 intervention	Group 2 intervention	Group 3	Study method	Sample size	Summary of findings	Quality of studies
12	Persian	Hashemi et al. 2007 (51)	Improvement of 30 patients in Fars Center in auditory, speech, and language skills was investigated.	Hearing skills, language acquisition, and speech comprehension 80 sessions during a year			Intervention	30 children with cochlear implants	There is a close relationship between the low age of the child and progress in a rehabilitation program. The longer the duration of post-surgical rehabilitation, the better the child's performance in learning auditory, language, and speech skills.	High
13	English	Monshizadeh et al 2019 (44)	Comparing of routine language rehabilitation and new intervention protocol specifically designed to enhance receptive vocabulary development in cochlear implanted children.	a routine auditory-verbal intervention and a new cognitive based intervention protocol	a routine auditory-verbal intervention		prospective experimental study	51 cochlear implant children	New protocol was more effective	High
14	English	Mehrkiyan et al 2019 (46)	to evaluate the effect of wireless Remote Microphones on speech discrimination scores in noise in child CI users.	using the Words-in-Noise test at a constant signal-to-noise ratio of dB, in the presence and absence of a wireless RM.			Interventional	20 children with cochlear implants	wireless Remote Microphone was effective	High

Table 2. Review of quality of studies with SEQES (52)

Articles	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Study question														
1. Was relevant background work cited to establish a foundation for the research question?	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Study design														
2. Was a comparison group used?	0	2	2	2	0	2	0	2	2	2	2	0	2	2
3. Was patient status at more than 1 time point considered?	2	1	2	2	2	1	2	2	2	2	2	0	2	0
4. Were data collection performed prospectively?	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5. Were patients randomized to groups?	0	2	2	0	0	0	0	2	2	2	2	0	2	0
6. Were patients blinded to the extent possible?	0	0	0	0	0	0	0	0	0	2	2	2	2	0
7. Were treatment providers randomized to the extent possible?	0	0	2	0	0	0	0	0	0	1	1	1	2	1
8. Was an independent evaluator used to administer the outcome measures?	1	1	1	1	1	1	1	1	1	1	1	2	2	2
Subjects														
9. Did sampling procedures minimize sample/collection biases?	2	2	2	2	2	2	1	2	2	2	2	2	2	2
10. Were inclusion/exclusion criteria defined?	2	1	2	2	2	1	1	0	2	2	2	2	2	2
11. Was an appropriate enrollment obtained?	2	2	2	2	2	2	2	2	2	2	2	2	2	2
12. Was appropriate retention/follow-up obtained?	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Intervention														
13. Was the intervention applied according to established principles?	2	2	2	2	2	2	2	2	2	2	2	2	2	2
14. Were biases due to the treatment provider minimized?	1	1	1	1	1	1	1	1	2	2	2	2	2	2
15. Was the intervention compared with the appropriate comparator?	0	2	2	2	0	2	0	2	2	2	2	0	2	1
Outcomes														
16. Was an appropriate primary outcome defined?	2	2	2	2	2	2	1	1	2	2	2	2	2	2
17. Was an appropriate secondary outcome considered?	0	2	1	2	2	2	2	2	2	2	2	1	1	0
18. Was an appropriate follow-up period incorporated?	0	2	0	0	2	2	2	2	2	2	2	0	2	0
Analysis														
19. Was an appropriate statistical test performed to indicate differences related to the intervention?	0	2	2	2	2	2	2	2	2	2	2	2	2	2
20. Was it established that the study had significant power to identify treatment effects?	1	2	1	1	1	1	1	1	2	2	2	2	2	2
21. Was the size and significance of the effects reported?	2	2	2	1	1	1	1	1	2	2	2	2	2	2
22. Were missing data accounted for and considered in interpreting results?	2	0	0	0	0	0	0	0	0	0	0	0	0	0
23. Were clinical and practical significance considered in interpreting results?	2	2	2	2	2	2	1	2	2	2	2	2	2	2
Recommendations														
24. Were the conclusions/clinical recommendations supported by the study objectives, analysis, and results?	2	2	2	2	1	2	1	2	2	2	2	2	2	2
Total	28	38	38	34	31	34	27	35	41	44	44	34	45	34

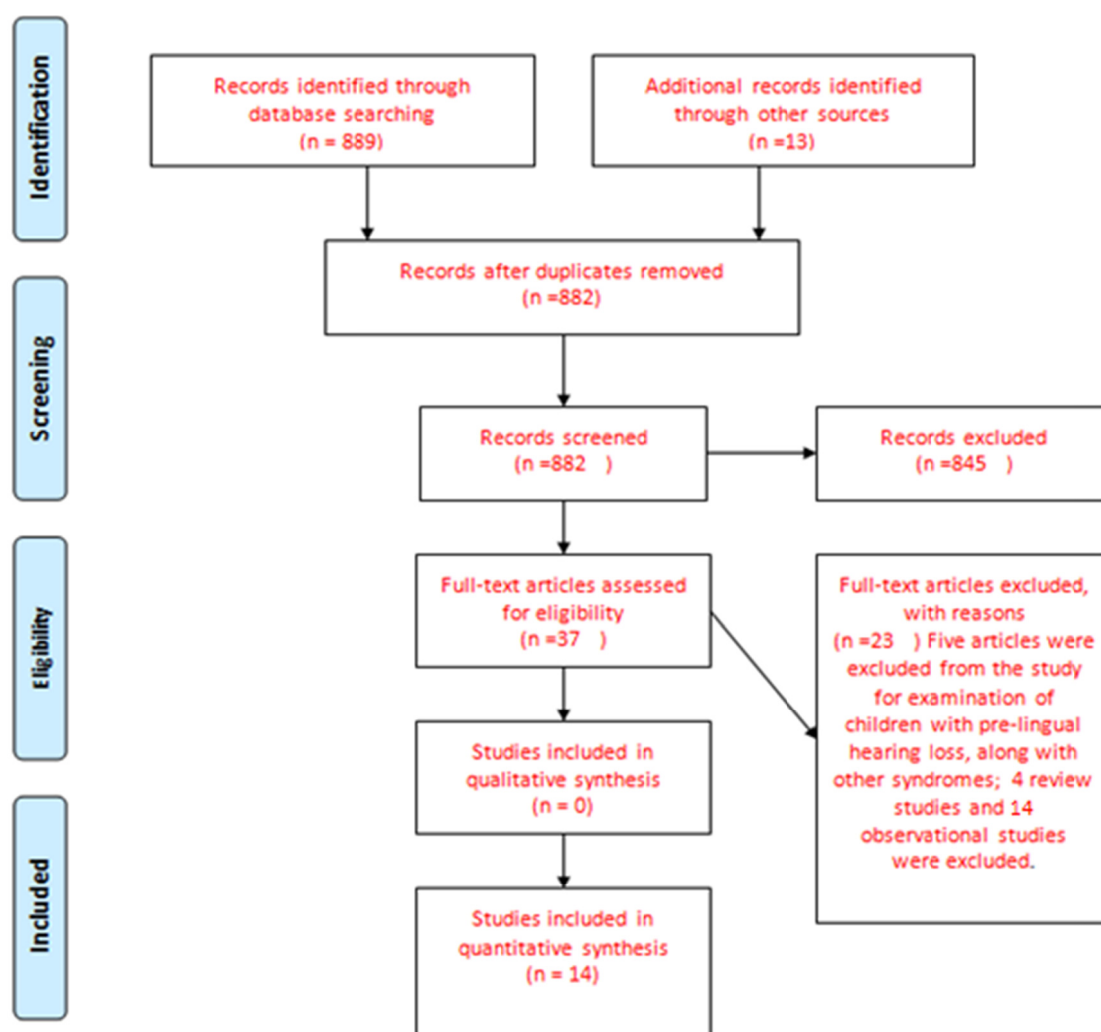


Fig. 1. PRISMA flowchart for selecting study articles

The study of Cochrane, Lalasaso, and Eden (2008) on hearing-impaired children showed that those who were exposed to cued speech training scored higher on phonological awareness and reading ability compared to the group undergoing oral instruction (29).

One quick method to examine the linguistic structure is story-telling, which is faster than other methods regarding execution and analysis. Story-telling or narrative examines spoken language in a natural context that demonstrates spoken information and skill in the expression of elements such as semantics, working memory, and general knowledge (28). Therefore, educational interventions, story-telling, and cued speech can be helpful for these children and improve their speech.

A number of studies focused on the instruction of families. The decrease in the diagnosis age in the first week after birth and cochlear implantation at about 10 months of age confirm this; therefore, parents should play a central role in their child's rehabilitation as a parent-therapist. In fact, families are a key element in the rehabilitation of children with a cochlear implant. Obviously, a deaf child's birth causes parents to feel more responsibility towards

their child and assume additional roles apart from parenting; hence they spend a lot of time for the child's rehabilitation. This increases parenting stress in parents; on the other hand, families need to obtain information about their child's hearing loss. However, inadequate and inaccurate information can sometimes affect the way a deaf child is raised (30), so considering families is crucial. This issue has been considered in recent years in Iran, and family-centered instruction programs are being held for families at Iran's Cochlear Implant Center (6). These findings are consistent with works done by Muller (2000), Desjardin (2003), and Yoshinaga-Itano (2003) with respect to the effect of parent-centered interventions on increasing self-confidence and reducing parental stress, and consequently enhancing communication skills of deaf children (31, 32, and 33).

Two articles examined auditory training; factors that influence the outcome of the implantation are numerous, and some factors, such as intelligence quotient, are not variable. However, some factors are controllable and may be variable to improve the likelihood of higher levels of success. Listening and speaking skills do not appear in

Table 3. The number of rehabilitation articles and sessions according to different types of rehabilitation

Type of rehabilitation	Number of Persian articles	Number of English articles	Total	Percentage of articles	Frequency of rehabilitation sessions	Percentage of rehabilitation sessions
Story telling	-	1	1	7.14	24	10.34
enhance receptive vocabulary	-	1	1	7.14	-	-
Speech therapy and auditory training	3	-	3	21.43	127	54.47
Music	1	0	1	7.14	24	10.34
Family-centered education	2	-	2	14.29	18	7.75
Creative play	1	-	1	7.14	20	8.62
Occupational Therapy	1	-	1	7.14	18	7.75
The impact of rehabilitation	1	1	2	14.29	-	-
Use of sight-hearing	-	1	1	7.14	-	-
Wireless Remote Microphone	-	1	1	7.14	1	0.43
total	9	5	14	100	232	100

children following implantation on their own, and consistent and thoughtful rehabilitation is needed to instruct them on how to use the electrical signal of the device for speech recognition purposes and speech and language acquisition (34). Auditory training paves the way for children in a variety of ways, although auditory training is an important part of the rehabilitation of children with a cochlear implant. Perhaps the reason for the small number of these studies can be attributed to the overlap of auditory training studies and speech therapy in the country.

In this study, one study focused on creative play, which is one of the methods of rehabilitation of children with a cochlear implant. One of the ways to increase these skills in children is to use art therapy techniques. Art therapy is a method created for mental health that uses the creative method of creating art to enhance the physical, psychological, and emotional health of individuals of all ages (35). Kunkle-Miller investigated the effectiveness of puppet play therapy on communication skills of hearing-impaired pre-school children and stated that using this method had a significant impact on enhancing the communication skills of these children (36). Creative play with an in-context language learning approach provides children with an opportunity to understand what is happening in the story via imagining the real situation, and in order to play a better role, they should indirectly require themselves to use appropriate sentences and structures (35). In Iran, there are a limited number of rehabilitation centers called creative play (37).

In case of disabilities associated with other rehabilitation groups, they come into action like occupational therapists. For example, many hearing-impaired children have marked deficits in controlling balance, and some studies have reported impaired balance function in children with a cochlear implant (38). Occupational therapies and task-based interventions can improve the performance of these children. A bilateral cochlear implant improves the emotional perception of music compared to a unilateral cochlear implant (39).

The rehabilitation program for children undergoing cochlear implant surgery is a major part of the treatment process. Child rehabilitation should be designed to include all communication skills such as listening, speaking, perception, and language use. This program includes increased listening attention, comprehension, integration, and speech production (40).

In the present study, the most used rehabilitation in these children is speech therapy and auditory training, which accounts for more than half of the rehabilitation contribution in children with a cochlear implant. Hashemi et al. explored auditory training: 1) sound detection A) through conditioned play response in the child at this level, Spontaneous Alerting Response, B) the child develops some behaviors spontaneously, such as sound search, head rotation towards the sound, etc.; the main purpose of sound detection training is to develop a spontaneous response in the individual. 2) Discrimination of sound: at this level, first, non-verbal difference, similarity, and/or discrimination are usually used. The other part of training at this level is discrimination of the number of vowels and consonants and endurance, intensity, and frequency training. 3) Identification: at this point, segmental and supra-segmental speech parameters are considered. Cases evaluated with respect to supra-segmental speech parameters include A) the speech prosody pattern, B) the loudness and intensity of the sound, C) sound identification of men, women, and children (frequency). The recognition of segmental speech parameters requires a higher level of auditory perception; training performed at this level include: A) identification of words that differ in the number of syllables, B) identification of words that are different in vowel and consonant, C) identification of the key elements in a phrase and sentence identification; in the identification phase, first, closed-class and then open-class words were used. It should be noted that vocabulary should D) answer the questions of language training E) understand the practices and activities of these training at both pre-verbal and verbal levels. Language training includes cognitive skills and sound comprehension (social skills and communication skills). 6) In the vocabulary section, vocabulary, simple sentences, and complex sentences are assumed. At the non-verbal level, language training was performed on classifications, arrangement of serial cards, etc. (41).

Speech development occurs as a result of increased listening accuracy and language comprehension. The training at this level includes the production of sounds, using vocabulary to name places, time, objects, concepts, etc., increasing sentence length and explaining visual cards, improving speech content based on linguistic knowledge and children's daily culture and vocabulary. 4) Comprehension: the last level involves auditory training: A) com-

prehension of common expressions, B) comprehension of one-part and two-part commands, C) comprehension of successive events in a short story (42) that are consistent with the principles of auditory training in children with a cochlear implant (43). One study showed that children with cochlear implants had increased communication and improved communication through a special rehabilitation program that was associated with increased vocabulary.(44) A study by Jalilvand et al. shows that various factors, including early implantation, implantation age below One year, chronological age and age of hearing, use of implantation of two ears, implantation in the right ear, age of diagnosis of deafness, hearing residue before surgery, duration of implantation, features of adult speech, special cooperation of parents and their verbal communication. The use of hearing aids before cochlear implantation, individual differences, socio-economic factors, lack of other disabilities, recognition of disability, memory and attention are all factors affecting the development and development of speech and language in children with cochlear implantation (45). In the study of Mehrakian et al., voice recognition in children with cochlear implants who used the FM device was much better than those who did not use this technology (46); so, it seems that children with cochlear implants need to upgrade cochlear implants and benefit. Few studies in Iran have done on this field; so, it seems necessary that different engineering teams take new steps in this field.

### Conclusion

In summary, for cochlear implantation to achieve its ultimate goal, i.e., complete improvement of speech and benefiting from the auditory sense, a lot of facilities, human, and environmental factors should be combined, such as a full rehabilitation team including a speech therapist, audiologist, psychologist, occupational therapist, etc. along with training families and using various techniques to improve the children's condition such as creative-play, story-telling, use of music, cued speech, various auditory training programs, and family-centered programs to educate families. Speech therapy and auditory training have the highest share of rehabilitation, indicating the importance of this type of rehabilitation. Therefore, the expansion of speech therapy rehabilitation centers seems necessary and is recommended. Rehabilitation equipment also plays an important role in children's hearing and communication with cochlear implants. Further studies are recommended, considering the importance of the family roles in the rehabilitation of these children. The current study lacked the full text of some studies. Given the variety of articles in different fields of rehabilitation, further studies are recommended to pave the way for systematic review and meta-analysis studies and provide more accurate results in each area.

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### Conflict of Interests

The authors declare that they have no competing interests.

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