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Research Article

A Comparative Study on the Development of Language Skills among the Children using Cochlear Implant and Hearing Aids

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ABSTRACT

The purpose of this study was to document the performance of a group of children with moderately severe to severe hearing loss who use hearing aids on a range of language (speech-language, phonology and cognition) and to compare these results to children with severe to profound hearing loss, who have learned language through cochlear implants. This study involved 40 children with bilateral sensorineural hearing impairment, aged 6-18 years. Twenty children had moderately severe/severe hearing loss and used hearing aids, and 20 with severe to profound hearing loss and using cochlear implants. Communication and scholastic skills were assessed using speech recognition Tests and standardized measures of speech production, language, phonology, and cognition. In the present study, three variables: speech-language, phonology/literacy, and cognition were taken into consideration. This study suggests that there is an improvement in the development of language skills (speech-language, phonology & cognition) by using cochlear implant as an assistive device, when compared with hearing aids. Further research is required to evaluate the benefits of hearing aids and cochlear implants in children with hearing loss who are diagnosed and received intervention within the early years of life and to analyze the physiological, medical, and psychological effects on Scholastic performance in children with hearing impaired.

Keywords: Hearing aids; Cochlear implants; Speech recognition tests; Scholastic skills

INTRODUCTION

Hearing impaired students, through their handicap, display different characteristics of emotions, that normally difficult to determine with certainty [1,2]. The teen years provide developmental challenges for all children. Both one's intimate attachment to parents and peers as well as belonging to social network is important in healthy development in adolescents. Support from parents and peers help to cope with stress and give emotional support. Self-identity depends on the knowledge that our own feelings and attitudes are similar to those of our peers. The inability of the deaf children to profit from language regarding their roles and interpersonal relationship may create serious problems in this area. The deaf may be somewhat self-centered because they lack communication through language.

Personality and self-esteem were among the most important intrinsic factors which affect the academic performances of students. The ability to care for one self and to act independently influences classroom behaviors as well as educational achievement and social relationship.

Cochlear implantation has dramatically changed outcomes for children with severe to profound hearing loss by providing them with auditory information not available through conventional hearing aid technology [3,4]. Outcomes in these children have been so encouraging that attention has also been directed to the implantation of children with less severe hearing loss [5-7]. While there is clear evidence for improved outcomes from cochlear implants compared to hearing aids for children with severe to profound hearing loss, there appears to be some difference in the interpretation of implant candidacy for children with significant residual hearing [5,8]. As noted by Geers (2006), the point at which a cochlear implant can provide more acoustic information than conventional hearing aids remains uncertain. For individuals with thresholds in the severe hearing loss range, conventional hearing aids can provide satisfactory access to the speech spectrum in the low to mid-frequencies but provide insufficient gain in the high-frequency range beyond about 3000 Hz [9]. Although adults with severe hearing losses in the 70-90 dB range commonly meet candidacy criteria for cochlear implantation, in children, these hearing loss ranges can present difficult decisions for both parents

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[10] and practitioners [11]. Studies suggest that practitioners are regularly faced with decision-making about improving access to sound through cochlear implantation for children who have substantial usable hearing and open-set speech recognition with conventional hearing aids [5,12,13]. In recent years, there appears to be considerable difference in the interpretation of cochlear implant candidacy for children in the audiologic borderline category. A recent nationwide survey of pediatric cochlear implant centers in Canada showed substantial variation in the definition of borderline candidacy for implantation [8].

The survey revealed that hearing loss definitions of borderline candidacy ranged from 70 to slightly better than 90 dB Pure-Tone Average (PTA). However, the overwhelming majority of centers also reported that evaluation of borderline candidates requires careful examination of several factors that extend well beyond the audiogram and speech recognition scores, such as social and school functioning. Age was a critical factor in decision making as 90% (10 of 11) of the implant centers indicated a reluctance to implant children under age 2 years who fell outside the typical candidacy criteria of a 90 dB HL or greater PTA. Recently, Wiley and Meinzen-Derr [13] also reported differences in agreement on candidacy decisions for children with borderline audiologic profiles.

Investigators have examined the question of benefits by attempting to establish an equivalent hearing level to describe the performance of children with cochlear implants. As early as 1994, Boothroyd and Eran [14,15] proposed that children with cochlear implants functioned like children with hearing loss of 88 dB PTA who used hearing aids. Based on speech recognition results, other investigators have confirmed that many children using cochlear implants have a hearing level equivalent to those in the severe hearing loss range [16,17]. Blamey et al. [18] concluded that children with implants and an average hearing loss of 106 dB HL performed on speech perception, production, and language measures such as children with hearing aids with an average hearing loss of 78 dB HL.

Studies directly comparing children with severe hearing loss and acoustic amplification to children with comparable hearing loss and cochlear implants have not been conducted. Likely, this is due to the relatively small number of children with severe hearing loss who have received cochlear implants. Furthermore, as recently noted by Moeller et al. [19], although outcomes of cochlear implantation have been extensively reported, there are relatively little current outcome data on children with hearing loss in the mild to severe range. Relatively few controlled studies have compared children with severe loss and hearing aids and children with cochlear implants across multiple dimensions of communication development. Blamey et al. [18] reported that on average, scores on speech perception, speech production, and language were very similar for a group of 40 children with a mean hearing loss of 78 dB HL who used hearing aids and 47 children with a mean loss of 106 dB HL who used cochlear implants. Overall, traditional cochlear implant evaluation protocols have tended to focus on speech recognition as the best proxy of cochlear implant benefit.

In light of the broadening of cochlear implant candidacy criteria and the trend toward the implantation of children with more residual hearing, it is essential to establish benchmarks for outcomes in children with less severe hearing loss and to compare their performance with children who have received a cochlear implant. Given that candidacy criteria for these borderline candidates extend beyond audiologic criteria and include such factors as academic functioning, it is important to conduct a comprehensive assessment. Since the overall goal of any hearing technology is to provide children with auditory and spoken communication skills that permits them to learn alongside their hearing peers, studies are required that document outcomes in multiple domains related to hearing including language, phonology, and literacy. Studies of children with delayed speech and language skills have shown that weak language skills are associated with deficits in literacy and academic development [20,21]. Long-term studies of children who received cochlear implants have concluded that literacy [22] and academic skills are important outcomes [23].

The present study was undertaken to document the performance of a group of children with severe hearing loss (≥ 65 dB HL) who use hearing aids on a range of speech recognition, speech–language, and literacy measures and to compare these results with children with severe to profound hearing loss, which have learned language using cochlear implants.

REVIEW OF LITERATURE

As early as 1994, Boothroyd and Eran [14] proposed that children with cochlear implants functioned like children with hearing loss of 88 dB PTA who used hearing aids. Based on speech recognition results, other investigators have confirmed that many children using cochlear implants have a hearing level equivalent to those in the severe hearing loss range [16,17]. Blamey et al. [18] concluded that children with implants and an average hearing loss of 106 dB HL performed on speech perception, production, and language measures such as children with hearing aids with an average hearing loss of 78 dB HL. Investigators have examined the question of benefits by attempting to establish an equivalent hearing level to describe the performance of children with cochlear implants.

Tait et al. [24] compared the preverbal conversational style of early-implanted children after 3 years of device use with similar children who were proficient hearing aid users (unaided thresholds 87 to 110 dB HL) and those who were poor hearing aid users (113 to 120 dB HL). The implant users and the proficient hearing aid users exhibited a preverbal conversational style that was typically vocal and auditory. In a later study, these preverbal behaviors were found to be associated with the development of linguistic communication proficiency [24].

Blamey et al. [18] reported that on average, scores on speech perception, speech production, and language were very similar for a group of 40 children with a mean hearing loss of 78 dB HL who used hearing aids and 47 children with a mean loss of 106 dB HL who used cochlear implants. Overall, traditional cochlear implant evaluation protocols have tended to focus on speech recognition as the best proxy of cochlear implant benefit.

Geers & Toby [25] and Geers et al. [26] respectively, reported that the impact of even a small amount of aided residual hearing on language development was apparent even before the advent of cochlear implants. Therefore, the dramatic increases in auditory speech perception afforded by the cochlear implant [27] should make achievement of optimum language skills easier for profoundly hearing-impaired children.

Svir-sky et al. [28] and Svir-sky et al. [29] reported that the literature on language development in children after cochlear implantation has established that children who use cochlear implants develop language at a faster rate than children with similar degrees of hearing loss who use hearing aids. Furthermore, children who obtain greater auditory benefit from their implant achieve more normal language levels than children who have poor speech perception post implant [30]. However, the amount of speech perception needed from any sensory aid for normal language development to occur has yet to be determined. The extent to which the language growth achieved resembles normal development and the amount of language delay exhibited by the deaf child after cochlear implantation continue to be examined. The role of communication modality in expediting language development post implant is also the focus of considerable investigation with conflicting findings that may be at least partially related to the techniques used to measure language.

As recently noted by Moeller et al. [19], although outcomes of cochlear implantation have been extensively reported, there are relatively little current outcome data on children with hearing loss in the mild to severe range.

Studies directly comparing children with severe hearing loss and acoustic amplification to children with comparable hearing loss and cochlear implants have not been conducted. Likely, this is due to the relatively small number of children with severe hearing loss who have received cochlear implants. Furthermore, relatively few controlled studies have compared children with severe loss and hearing aids and children with cochlear implants across multiple dimensions of communication development.

PURPOSE OF THE STUDY

The purpose of this study was to document the performance of a group of children with moderately severe to severe hearing loss who use hearing aids on a range of speech recognition, speech-language, and literacy measures and to compare these results to children with severe to profound hearing loss, who have learned language through cochlear implants.

JUSTIFICATION

Children received rehabilitation services in the audiology program throughout their preschool years and subsequently accessed therapy services through their local school program at school age. The following criteria were applied to select the participants with hearing aids. It is immensely more logical to follow a different route to attain a different aim under different circumstances that to follow the same route to attain a different aim under different circumstances and that was precisely a reason for thinking about a comparison to the children using cochlear implant and hearing aids. Recently the trends in special education is changing it is also necessary to find out an excellent method for the development of academic skill of the person with intellectual disability. So I selected this research issue.

OPERATIONAL DEFINITIONS

Comparative study on language skills (Speech-language, phonology & cognition)

Speech-language: All speech and language measures were commonly used tests with established psychometric properties. An experienced language therapist or psychometrist, who was not providing therapy services, administered the test measures, typically during two individual test sessions. All these tests have normative data with a standardized score of 100 and a Standard Deviation (SD) of 15. The measures consisted of the Peabody Picture Vocabulary Test (PPVT-III), a widely used measure of receptive vocabulary [31] and the Clinical Evaluations of Language Fundamentals test (CELF-4), a commonly used test to evaluate multiple dimensions of receptive and expressive language [32].

Phonology/literacy: Phonological analysis, phonological memory, and rapid naming. Word-reading skills were assessed using the Wechsler Individual Achievement Test (WIAT-II): word-reading and psuedoword subtests [33]. The spelling subtest of the Peabody Individual Achievement Test-Revised (PIAT-R) [34] was also administered. Finally, the Gray Silent Reading Test (GRST) [35] was used to measure silent reading comprehension for children over 6 years of age.

Cognition: For children aged 6-16 years of age, the Wechsler Intelligence Scale for Children (WISC-IV) [36] was administered to assess the child's general intellectual functioning. Scores for the Perceptual Reasoning Index (PRI) are reported in this paper as a non-verbal measure of cognitive abilities. Participants over the age of 16 years were tested using the Wechsler adult intelligence scale [33].

Cochlear implant: A Cochlear Implant (CI) is a surgically implanted electronic device that provides a sense of sound to a person who is profoundly deaf or severely hard of hearing.

Hearing aids: A hearing aid is an electro acoustic device which is designed to amplify sound for the wearer, usually with the aim of making speech more intelligible, and to correct impaired hearing as measured by audiometry.

Statement of the problem

A comparative study on the development of language skills among the children using cochlear implant and hearing aids.

OBJECTIVES OF THE STUDY

- To find out the effect of speech-language, phonology and cognitive skills of children using cochlear implants.
- To find out the effect of speech-language, phonology and cognitive skills of children using hearing aids.
- To compare the speech-language, phonology and cognitive skills of children using hearing aids and cochlear implants.

HYPOTHESIS

- There is a significant difference in the speech-language, phonology and cognitive skills of children using cochlear implants.
- There is a significant difference in the speech-language, phonology and cognitive skills of children using hearing aids.
- There is a significant difference in the speech-language, phonology and cognitive skills of children using hearing aids and cochlear implants.

RESEARCH DESIGN

This study employed a retrospective cohort design to examine outcomes in multiple domains of communication and learning in school-aged children who used either hearing aids or a cochlear implant. Two groups of children were enrolled in this study and were defined based on exposure and language learning primarily through hearing aids or a unilateral cochlear implant.

TOOLS

The measures consisted of the Peabody Picture Vocabulary Test (PPVT-III), a widely used measure of receptive vocabulary [31] and the Clinical Evaluations of Language Fundamentals test (CELF-4), a commonly used test to evaluate multiple dimensions of receptive and expressive language [32]. For this study, a core language score was computed to compare overall spoken language ability with a normative sample. Speech production was assessed using the sounds in words subtest of the Goldman-Fristoe Test of Articulation (GFTA-2) [37].

DISCRIMINATION OF THE TOOL

The measures consisted of the Peabody Picture Vocabulary Test (PPVT-III), a widely used measure of receptive vocabulary [31] and the Clinical Evaluations of Language Fundamentals test (CELF-4), a commonly used test to evaluate multiple dimensions of receptive and expressive language [32].

The Wechsler Individual Achievement Test (WIAT-II): word-reading and pseudo word subtests [36]. The spelling subtest of the Peabody Individual Achievement Test-Revised (PIAT-R) [34] was also administered. Finally, the Gray Silent Reading Test (GRST) [35] was used to measure silent reading comprehension for children over 6 years of age.

The Wechsler Intelligence Scale for Children (WISC-IV) [36] was administered to assess the child's general intellectual functioning. Scores for the Perceptual Reasoning Index (PRI) are reported in this paper as a non-verbal measure of cognitive abilities. Participants over the age of 16 years were tested using the Wechsler adult intelligence scale [33].

VARIABLES

Dependent variables

Development of language skills (speech-language, phonology & cognition).

Independent variables

Children using cochlear implant and hearing aids. A comparison of the latency and amplitude values of the auditory P300 components (Table 1). The mean amplitude of auditory P300 after hearing aid use was higher than the mean amplitude.

SAMPLE

This study involved 40 children with bilateral sensorineural hearing impairment, aged 6-18 years. 20 children with moderately severe/severe hearing loss using hearing aids an assistive device, and 20 children with severe to profound hearing loss using cochlear implants as assistive devices.

Table 1: Independent sample t-test on acquisition of speech language in development of language skills.

Users	n	Mean	S.D	t-value	Significance
Cochlear Implant	20	32.3500	1.89945	10.684	0.000
Hearing Aid	20	24.7500	2.55209		

PROCEDURE

Children's hearing aids or cochlear implant speech processors were fit and managed through the audiology program. Standard clinical procedures at the time were bilateral hearing aids and unilateral cochlear implants. All children will receive audiologic care at the time of the study. The child's hearing technology was worn at user settings as prescribed by the clinical audiologist. Listening checks were conducted prior to the test session.

A battery of speech recognition measures as well as standardized speech-language and literacy, and cognitive measures will be administered to both groups of children. The test battery will be selected on the basis of the psychometric properties of the tests, their common use in the literature, clinical practice, and the need for a test protocol that could be administered to a school age population in a reasonable period of time.

The tests, described below, are divided into three categories of outcome measures: speech recognition, speech-language and phonology/literacy measures. Cognitive measures were also collected during this Study and are reported here to describe the children non-verbal functioning. All test results, with the exception of speech recognition, are reported as standardized scores. This permits a comparison of scores for children assessed at different ages since they are compared with large normative samples of their normal hearing peers of the same age. The speech recognition measures are scored as percent correct.

DATA ANALYSIS

Differences between patient characteristics for the two groups (hearing aids and cochlear implants) were analyzed descriptively. The primary outcomes analyzed for the study were communication and literacy skills. All analyses were completed using IBM SPSS version 20.0. Differences in the main speech and language outcomes between the two groups (hearing aids vs. cochlear implant) were compared using independent samples Student's t tests when data were normally distributed. Non-parametric tests (Mann-Whitney U test) were applied for scores that were not normally distributed. Outcomes are reported as percentage correct for the speech recognition tests and as standard scores for all other tests.

Statistical significance was accepted at the 5% level and all p values are two-tailed. Ninety-five percent confidence intervals (95% CI) were also calculated where appropriate. Spearman correlations were conducted to examine the relationship between speech recognition scores and outcomes in speech production (GFTA-2), receptive vocabulary (PPVT-III), and language (CELF-4) will be used for data analysis & interpretation.

CONCLUSION BASED ON THE FINDINGS OF THE STUDY

The present study was undertaken to analyze and compare the

language development in the children with severe to profound hearing loss using cochlear implants as assistive device are performed well but it shows as follows:

This concludes that both males and females in development of language skills by using cochlear implant vary. This implies that it shows that there is 't' difference in development of language skills (speech-language, phonology & cognitive) by using cochlear implant. Males are showing more improvement in cognitive and in phonology but in speech-language the females are more significant when compared with the males.

This concludes that both males and females in development of language skills by using hearing aids also vary. This shows that there is a difference in development of language skills (speech-language, phonology & cognitive) by using hearing aids. Females are showing more improvement when compared with the males in speech-language and in cognitive but in phonology the males showed more improvement when compared with the females.

This concludes that the development of language skills by using hearing aids and cochlear implants also varies. This shows that there is a difference in development of Language skills (speech-language, phonology & cognitive) by using hearing aids and cochlear implant.

The purpose of the present study was to assess the language development skills in the children of hearing impairment by using the assistive devices. The purpose of this study was to document the performance of a group of children with moderately severe to severe hearing loss who use hearing aids on a range of speech recognition, speech-language, and literacy measures and to compare these results to children with severe to profound hearing loss, who have learned language through cochlear implants.

The following criteria were applied to select the participants with hearing aids:

(1) Age 6-18 years; (2) Bilateral sensorineural hearing loss, with a three frequency (500, 1000, and 2000 Hz) or high-frequency (2000 and 4000 Hz) PTA of 65 dB HL or greater in the better ear; (3) Known or presumed early onset of hearing loss before age 3 years; based on medical chart documentation; (4) Telugu as the primary language of education; (5) Consistent use of amplification and enrolled in a rehabilitation program focused on oral communication; and (6) Non-verbal intelligence in the average range.

Children with other documented disabilities that would interfere with oral language development were excluded from the study. Children in the cochlear implant group were a subset of children who participated in a separate study investigating.

A battery of speech recognition measures as well as standardized speech-language and literacy, and cognitive measures will be administered to both groups of children. The test battery will be selected on the basis of the psychometric properties of the tests, their common use in the literature, clinical practice, and the need for a test protocol that could be administered to a school age population in a reasonable period of time.

The tests, described below, are divided into three categories of outcome measures: Speech-language and phonology/literacy measures and cognitive measures were also collected during this study and are reported here to describe the children's non-verbal functioning. All test results, with the exception of speech recognition, are reported as standardized scores. This permits a comparison of scores for children assessed at different ages since they are compared with large normative samples of their normal hearing peers of the same age. The speech recognition measures are scored as percent correct.

The marks obtained by each student for the test administered were collected for the purpose of the study. The collected data were consolidated, analyzed and interpreted for the realization of the objectives of the study which are restated below.

OBJECTIVE WISE ANALYSIS

The data collected were analyzed employing appropriate statistical procedures and the results and interpretations are presented under the following heads.

- To find out the effect of speech-language, phonology and cognitive skills of children using cochlear implants.
- To find out the effect of speech-language, phonology and cognitive skills of children using hearing aids.
- To compare the speech-language, phonology and cognitive skills of children using hearing aids and cochlear implants.

Interpretation of the data

To examine whether there is any significant difference in the speech language in language developmental skills in between the cochlear implant and hearing aid users. The data was subjected to independent sample t-test and the results of the test are given in the above Table 1.

It can be observed from the above table that the mean value is found more significant (32.3500) and (24.7500). This indicates that there is a significant difference in mean values of the cochlear implant and hearing aid users. The mean value of cochlear implants is found to be greater than the hearing aid user's value. This implies that it shows that there is a significant difference in speech language level in the development of language skills.

Interpretation of the data

To examine whether there is any significant difference in the phonology in language developmental skills in between the cochlear implant and hearing aid users. The data was subjected to independent sample t-test and the results of the test are given in the above Table 2.

It can be observed from that the mean value is found more significant (33.1000) and (22.5000). This indicates that there is a significant difference in mean values of the cochlear implant and hearing aid users. The mean value of cochlear implants is found to be greater than the hearing aid user's value. This implies that it shows that there is a significant difference in phonological level in the development of language skills.

Interpretation of the data

To examine whether there is any significant difference in the cognitive level in development of language skills in between the cochlear implant and hearing aid users. The data was subjected to

independent sample t-test and the results of the test are given in the Table 3.

It can be observed that the mean value is found more significant (44.2500) and (37.0500). This indicates that there is a significant difference in mean values of the cochlear implant and hearing aid users. The mean value of cochlear implants is found to be greater than the hearing aid user's value. This implies that it shows that there is a significant difference in cognitive level also in the development of language skills.

Interpretation of the data

To examine whether there is any significant difference in both male and female development of language skills (speech-language, phonology & cognitive) in cochlear implant users. The data was subjected to independent sample t-test and the results of the test are given in Table 4 and in Figure 1.

It can be observed from the Table 4 and in Figure 1, that the mean values are found more significant (32.0000) and (32.7000) in females when compared with the males in speech-language. The mean values are found more significant (33.3000) and (32.9000) in males when compared with the females in phonology, and the mean values are found more significant (44.4000) and (44.1000) in males when compared with the females in cognitive. This indicates that there is a significant difference in mean values of both males and females in development of language skills by using cochlear implant varies. This implies that it shows that there is a significant difference in development of language skills (Speech-Language, Phonology, & Cognitive) by using cochlear implant. Males are showing more significant in cognitive and in phonology but in speech-language the females are more significant when compared with the males.

Interpretation of the data

To examine whether there is any significant difference in both male and female development of language skills (Speech-Language, Phonology & Cognitive) in hearing aid users. The data was subjected to independent sample t-test and the results of the test are given in Table 5 and Figure 2.

Table 2: Independent sample t-test on acquisition of phonology in development of language skills.

Users	n	Mean	S.D	t-value	Significance
Cochlear Implant	20	33.1000	1.25237	30.205	0.000
Hearing Aid	20	22.5000	0.94591		

Table 3: Independent sample t-test on acquisition of cognition in development of language skills.

Users	n	Mean	S.D	t-value	Significance
Cochlear Implant	20	44.2500	1.44641	6.763	0.000
Hearing Aid	20	37.0500	4.53611		

Table 4: Gender wise independent sample t-test on the development of language skills in cochlear implant users.

Language Developmental Skills	Gender	n	Mean	S.D	t-value	Significance
Speech language	Male	10	32	1.41421	0.817	0.427
	Female	10	32.7	2.31181		
Phonology	Male	10	33.3	1.05935	0.705	0.491
	Female	10	32.9	1.44914		
Cognitive	Male	10	44.4	1.50555	0.454	0.655
	Female	10	44.1	1.44914		

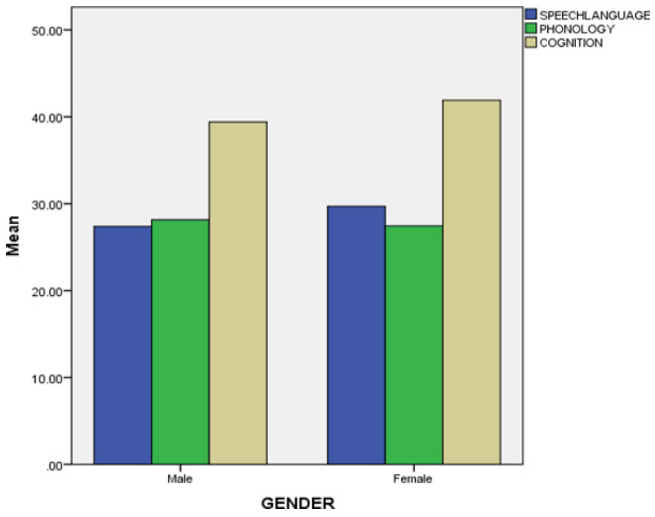

Figure 1: Graphical representation of the results of the means of gender-wise independent sample t-test on the development of language skills in cochlear implant users.

It can be observed from the Table 5 and Figure 2, that the mean values are found more significant (22.8000) and (26.7000) in females when compared with the males in speech-language. The mean values are found more significant (23.0000) and (22.0000) in males when compared with the females in phonology, and the mean values are found more significant (34.4000) and (39.7000) in females when compared with the males in cognitive levels of development of language skills. This indicates that there is a significant difference in mean values of both males and females in development of language skills by using hearing aids also varies. This implies that it shows that there is a significant difference in development of language skills (speech-language, phonology & cognitive) by using hearing aids. Females are showing more significant when compared with the males in speech-language and in cognitive but in phonology the males are more significant when compared with the females.

The Figure 3 represents the mean values of speech & language, phonology and cognition of the cochlear implant users when taken into consideration in the percentage when compared with the hearing aid users. This implies that it shows that there is a significant difference in the development of language skills when the children are using hearing aids and cochlear implant.

The Figure 4 represents the mean values of speech & language, phonology and cognition of the hearing aid users when taken into consideration in the percentage when compared with the cochlear implant users. This implies that it shows that there is a significant difference in the development of language skills when the children are using hearing aids and cochlear implant.

TENABILITY OF HYPOTHESES

- There is a significant difference in the speech-language, phonology and cognitive skills of children using cochlear implants.
- There is a significant difference in the speech-language, phonology and cognitive skills of children using hearing aids.
- There is a significant difference in the speech-language, phonology and cognitive skills of children using hearing aids and cochlear implants.

SUGGESTIONS BASED ON THE STUDY

This study suggests that there is an improvement in the development of language skills (speech-language, phonology & cognition) by using cochlear implant as an assistive device, when compared with hearing aids.

SUGGESTIONS FOR FURTHER RESEARCH

In this the investigator found two things that which has to be carried over for the further research:

A cross study on the variations showing by the males and females in

Table 5: Gender wise independent sample t-test on the development of language skills in hearing aid users.

Language Developmental Skills	Gender	n	Mean	S.D	t-value	Significance
Speech language	Male	10	22.8000	0.78881	5.357	0.000
	Female	10	26.7000	2.16282		
Phonology	Male	10	23.0000	1.15470	2.739	0.023
	Female	10	22.0000	0.00000		
Cognitive	Male	10	34.4000	3.16930	3.177	0.006
	Female	10	39.7000	4.21769		

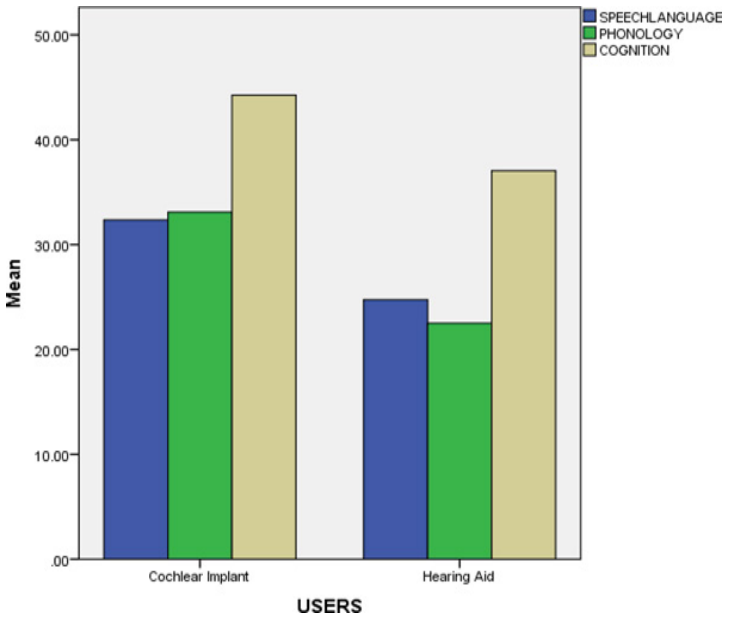

Figure 2: Graphical representation of the results of the means of development of language skills (Speech-Language, Phonology & Cognition) had drawn by independent sample t-test for the both cochlear implant and hearing aids users.

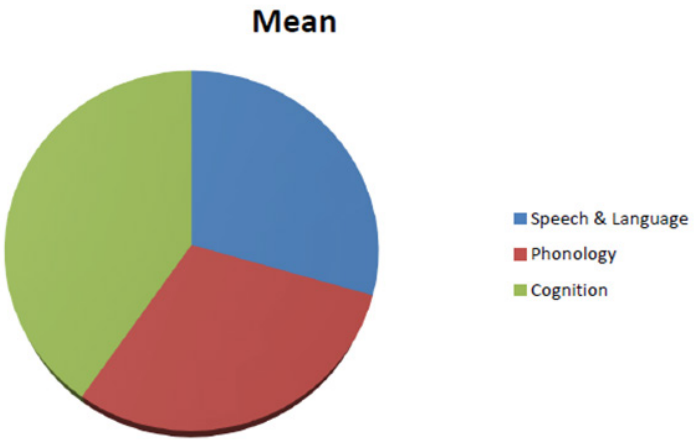

Figure 3: Graphical representation in the pie diagram of the results of the means of development of language skills (Speech-Language, Phonology & Cognition) had drawn by independent sample t-test for the cochlear implant users.

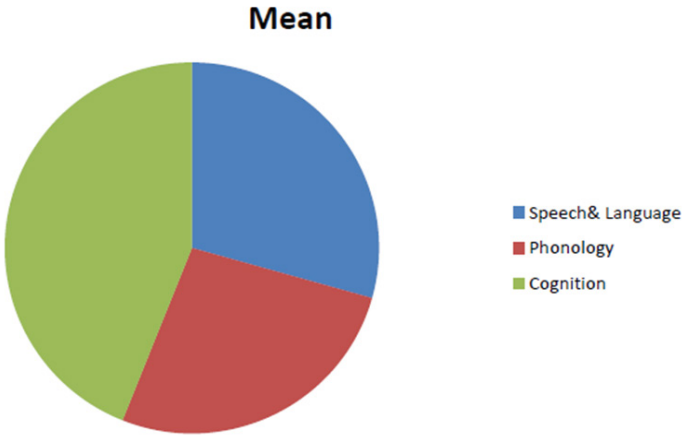

Figure 4: Graphical representation in the pie diagram of the results of the means of development of language skills (speech-language, phonology & cognition) had drawn by independent sample t-test for the hearing aid users.

development of language skills especially in the areas of cognition & speech-language by using cochlear implant as an assistive device.

A cross study on the variations showing by the males and females in development of language skills especially in the areas of cognition & speech-language by using hearing aids as an assistive device.

REFERENCES

1. Barbalet JM. Emotion, Social Theory, and Social Structure: A Macro sociological Approach. Cambridge: Cambridge University Press. 1998.
2. Barbalet JM. William James: Pragmatism, Social Psychology and Emotions. European Journal of Social Theory. 2004;7:337-353.
3. Boothroyd A, Geers AE, Moog JS. Practical implications of cochlear implants in children. Ear Hear. 1991;12:81S-89S.
4. Moog JS, Geers AE. Speech and language acquisition in young children after cochlear implantation, Otolaryngologic Clinics of North America. 1999;32:1127-1141.
5. Dettman SJ, Pinder D, Briggs RJ, Dowell RC, Leigh JR. Communication development in children who receive the cochlear implant younger than 12 months: Risks versus benefits. Ear Hear. 2007;28:11S-18S.
6. Eisenberg LS, Kirk KI, Martinez AS, Ying EA, Miyamoto RT. Communication abilities of children with aided residual hearing. Comparison with cochlear implant users. Archives of Otolaryngology-Head & Neck Surgery. 2004;130:563-569.
7. Fitzpatrick E, Brewster L. Pediatric cochlear implantation in Canada: Results of a survey. Can J Speech Lang Pathol Audiol. 2008;32:29-35.
8. Fitzpatrick E, Olds J, Durieux-Smith A, McCrae R, Schramm D. Pediatric cochlear implantation: How much hearing is too much? Int J Audiol. 2009;48:101-107.
9. Boothroyd A. The acoustic speech signal. In: JR Madell, C Flexer, eds. Pediatric Audiology: Diagnosis, Technology, and Management. New York: Thieme Medical Publishers, Inc. 2008:159-167.
10. Hyde M, Punch R, Komesaroff L. Coming to a decision about cochlear implantation: Parents making a decision for their deaf children. J Deaf Studies Deaf Educ. 2010;15:162-178.
11. Hayes H, Geers A, Treiman R, Moog J. Receptive vocabulary development in deaf children with cochlear implants: Achievement in an intensive auditory-oral educational setting. Ear and Hearing. 2009;30:128-135.
12. Geers AE, Moog J. Early speech perception test battery. Central Institute for the Deaf; St. Louis 1990.
13. Wiley S, Meinzen-Derr J. Access to cochlear implant candidacy evaluations: Who is not making it to the team evaluations? International Journal of Audiology. 2009;48:74-79.
14. Boothroyd A. Speech perception tests and hearing impaired children. In: G Plant. KE Spens., eds. Profound Deafness and Speech Communication, London: Whurr. 1995;345-371.

15. Boothroyd A, Eran O. Auditory speech perception capacity of child implant users expressed as equivalent hearing loss. Volta Review (Monograph). 1994;96: 151-168.

16. Nakisa R, Plunkett K, Hahn U. Single- and dual-route models of inflectional morphology. In P. Broeder & J. Murre (Eds.), Models of language acquisition: Inductive and deductive approaches. Oxford Linguistics, Oxford: Oxford University Press, 2001.

17. Snik AF, Makhdoum MJ, Vermeulen AM, Brokx JP, Broek P. The relation between age at the time of cochlear implantation and long-term speech perception abilities in congenitally deaf subjects. International Journal of Pediatric Otorhinolaryngology. 1997;41:121-131.

18. Blamey PJ, Sarant JZ, Paatsch LE, Barry JG, Bow CP, WalesRJ, et al. Relationships Among speech perception, production, language, hearing loss, and age in children with impaired hearing. Journal of Speech, Language, and Hearing Research. 2001;44:264-285.

19. Moeller MP, Hoover B, Putman C, Arbataitis K, Bohnenkamp G, Peterson B, et al. Vocalizations of infants with hearing loss compared with infants with normal hearing: Part II--transition to words, Ear Hear. 2007;28:628-42.

20. Nathan L, Stackhouse J, Goulandris N, Snowling MJ. The development of early literacy skills among children with speech difficulties: a test of the critical age hypothesis. Journal of Speech, Language, and Hearing Research. 2004;47: 377-391.

21. Scarborough H. Index of productive syntax. Applied Psycholinguistics. 1990;11:1-22.

22. Geers A, Nicholas J, Moog J. Estimating the influence of cochlear implantation on language development in children. Audiological Medicine. 2007;5:262-273.

23. Uziel AS, Sillon M, Vieu A, Artieres F, Piron JP, Daures JP, et al. Ten-year follow-up of a consecutive series of children with multichannel cochlear implants. 2007;28:615-628.

24. Tait M, De Raeve L, Nikolopoulos TP. Deaf children with cochlear implants before the age of 1 year: Comparison of preverbal communication with normally hearing children. Int J Pediatr Otorhinolaryngol. 2007; 71: 1605-1611.

25. Geers AE, Toby E. Effects of cochlear implants and tactile aids on the development of speech production skills in children with profound hearing impairment. The Volta Review. 1992;94:135-163.

26. Geers AE, Nicholas JG, Sedey AL. Language skills of children with early cochlear implantation. Ear and Hearing. 2003;24:s46-s58.

27. Geers AE. Language Skills of Children with Early Cochlear Implantation. Missouri, USA, Central Institute for the Deaf. 2003.

28. Svirsky MA, Robbins AM, Kirk KI, Pisoni DB, Miyamoto RT. Language development in profoundly deaf children with cochlear implants. Psychological Science. 2000;11:153-158.

29. Svirsky MA, Teoh SW, Neuburger H. Development of language and speech perception in congenitally, profoundly deaf children as a function of age at cochlear implantation. Audiol Neurootol. 2004;9:224-233.

30. Crosson J, Geers A. Structural analysis of narratives produced by a group of young cochlear implant users. Annals of Otology, Rhinology & Laryngology. 2000;109:118-119.

31. Dunn L. Peabody Picture Vocabulary Test-III (3rd ed). Circle Pines, MN: American Guidance. 1997.

32. Semel-Mintz E, Wiig E, Secord W. Clinical Evaluation of Language Fundamentals (4th ed). San Antonio,TX: sychological Corporation. 2003.

33. Wechsler D. Wechsler intelligence scale for children, 3rd Edition. San Antonio: Psychological Corp. Harcourt Brace. 1991.

34. Markwardt F. Peabody Individual Achievement Test-Revised: Normative Update. Minneapolis, MN: Pearson Assessments. 1998.

35. Holt RF, Svirsky MA. An exploratory look at pediatric cochlear implantation: Is earliest always best? Ear and Hearing. 2008;29:492-511.

36. Wechsler D. Wechsler Intelligence Scale for Children (4th ed.) San Antonio, TX: The Psychological Corporation. 2003.

37. Goldman R, Fristoe M. Goldman Fristoe Test of Articulation-Second Edition. Circle Pines, MN: AGS. 2000.