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A Comparative Study of language Skills between Students with Hearing Aid Users and Cochlear Implants

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ABSTRACT

The purpose of this study was to compare the language skills of students with hearing aid users and cochlear implants to understand how these assistive devices/technologies influence language development and communication. The language skills play a crucial role for cognition, academic success, peer relationships, and overall well-being, particularly for students with hearing impairments. The research involves combining quantitative assessments with qualitative insights. This study involved 60 bilateral sensorineural hearing-impaired students whose age range between 6-15 years. Thirty hearing impaired students had moderately severe/severe hearing loss with hearing aid users and 30 hearing impaired students severe to profound hearing loss with cochlear implants, drawn from special schools, inclusive schools and specialized clinics. Speech & Language skills were assessed using standardized test i.e. Linguistic Profile Test (LPT), focusing on assessing an individual's linguistic skills, specifically their abilities in phonology, syntax, and semantics, to identify potential language disorders or deficits. The findings suggest that students with cochlear implants demonstrate higher proficiency in phonology, syntax and semantics compared to their hearing aid-using counterparts, potentially due to enhanced auditory input and speech perception. However, students using hearing aids showed comparable performance in phonology but lots of problem faced in syntax and semantic parts of language. The study highlights the importance of tailored language skills training and support services to meet the unique needs of both groups. These insights can guide educators, therapists, and policymakers in developing inclusive educational strategies and interventions to enhance the language development of students with hearing impairments.

Keywords: Hearing aids, cochlear implants, hearing impairment, Language skills communication, etc.

INTRODUCTION

Hearing Impairment/Disability, particularly during childhood, can profoundly influence language development, communication abilities, and social engagement. Communication is fundamental to human interaction, fostering interpersonal relationships, emotional health, and overall quality of life. Students with hearing loss often exhibit unique emotional characteristics, which may be difficult to interpret or recognize with precision. Support from family members and peer

groups play a critical role in helping these individuals manage emotional stress and providing a sense of belonging and encouragement. Strong emotional bonds with caregivers and friends, along with active participation in social networks, are essential for the healthy psychological and social development of adolescents. An individual's self-concept is shaped by the alignment between their own feelings, attitudes, and those of their social peers. Personality traits and self-confidence are key internal factors that significantly influence academic outcomes. The capacity for independent functioning and self-care also impacts classroom behavior, academic success, and peer relationships. A typical auditory capacity supports optimal speech and language acquisition. Assistive listening devices, such as hearing aids (HAs) and cochlear implants (CIs), offer critical auditory support, enhancing sound perception, and facilitating both language proficiency and social participation. However, the degree to which these technologies improve hearing can vary depending on their design, efficiency, and the individual's adaptability to using them. Language competence spans various skills, including spoken and non-spoken communication, emotional understanding, social flexibility, and the ability to interact effectively across different social environments. Individuals with hearing challenges often face difficulties in these areas due to delays in language development, limited exposure to incidental learning opportunities, and potential social exclusion. Extensive research has examined the impact of hearing technologies like hearing aids and cochlear implants in mitigating these challenges and enhancing communicative and social functioning. Hearing impairment refers to a partial or complete loss of auditory perception, which may affect one or both ears and vary in severity from mild to profound (WHO, 2018). Hearing impairment is a condition in which the auditory system is impaired in detecting or processing sound, resulting in communication barriers (Ross, M., & Giolas, T. G. 1978). A disorder of the hearing system, hearing impairment reduces an individual's ability to detect or differentiate sounds, thereby affecting social and communicative interactions (Katz, J. 2002). Hearing impairment refers to any degree of loss in the ability to perceive auditory information, which can be congenital or acquired. (Northern, J. L., & Downs, M. P. 2002). Hearing impairment is a condition that limits the ability to perceive auditory stimuli, thereby influencing language learning, communication skills, and educational performance (Flexer, C. 1999).

The primary auditory assistive devices—hearing aids (HAs) and cochlear implants (CIs)—provide differing degrees of hearing restoration. Whereas hearing aids function by amplifying external sounds, cochlear implants circumvent damaged auditory pathways to deliver direct electrical stimulation to the auditory nerve. This essential divergence in mechanism may significantly impact the development of social competencies among users of each technology. This review explores the comparative social abilities of individuals using HAs and CIs, taking into account variables such as speech comprehension, peer engagement, and psychosocial well-being. Children with profound sensorineural hearing loss (SNHL) often experience delays in language development, which adversely affect their communication capabilities and social integration. Prior to the advent of cochlear implants, hearing aids were the sole technological option available for sound access among children with hearing impairments—both in developed and developing nations.

The introduction of cochlear implants marked a transformative advancement, dramatically improving the auditory and linguistic outcomes for these children. Today, cochlear implants have substantially enhanced speech and language acquisition in children affected by sensorineural hearing loss. Numerous investigations have

examined the various dimensions of language development, speech perception, and spoken language proficiency in recipients of cochlear implants. While it is now widely acknowledged that cochlear implants offer a level of hearing that approaches normal auditory function, an equally critical objective is the enhancement of social interaction in implanted children. Strengthening social communication skills can significantly mitigate feelings of isolation, representing a major benefit of cochlear implantation. Hearing aids are technological instruments intended to boost auditory signals and enhance hearing for individuals with auditory deficits. According to Katz (2002), Hearing Aids are electronic devices that elevate sound intensity to facilitate communication for those with hearing challenges. Dillon (2012) describes a hearing aid as a compact electronic apparatus designed to assist individuals with hearing loss by amplifying ambient sounds for everyday communication. The World Health Organization (2018) characterizes hearing aids as sound-enhancement tools that provide improved auditory access, thereby fostering better social interaction. Similarly, Lloyd & Kaplan (1978) define a hearing aid as an electroacoustic system that processes sound inputs to improve hearing for users with auditory impairments.

A cochlear implant is a biomedical electronic device that bypasses the damaged parts of the inner ear and directly stimulates the auditory nerve to provide sound perception to individuals with severe-to-profound hearing loss. (Clark, G. M. 2003). Cochlear implants are neuroprosthetic devices that convert sound into electrical signals to stimulate the auditory nerve, enabling individuals with severe hearing loss to perceive sound. (Zeng, F. G., Rebscher, S., Harrison, W., Sun, X., & Feng, H. 2008). Cochlear implants are electronic medical devices that provide a sense of sound to individuals with severe-to-profound sensor neural hearing loss by directly stimulating the auditory nerve. (Wilson, B. S., & Dorman, M. F. 2008). A cochlear implant is a prosthetic device that replaces the function of the damaged cochlea by converting sound into electrical impulses sent directly to the auditory nerve. (NIH Consensus Statement, 1995).

LITERATURE REVIEW

Hearing aids amplify sounds and facilitate access to auditory input, thereby supporting speech understanding and communication. However, studies indicate that students who rely on hearing aids may face social challenges due to issues like interference from background noise, difficulty with speech discrimination, and reliance on visual cues such as lip reading (Moeller, 2000). In contrast, cochlear implants (CIs) deliver direct electrical stimulation to the auditory nerve, offering more comprehensive auditory access than conventional hearing aids. Research shows that children with CIs frequently demonstrate superior speech perception, more advanced language development, and more positive social engagement compared to their peers using hearing aids (Geers et al., 2013). CIs have also been linked to improved linguistic abilities and better reading comprehension (Vijetha, P., 2014). Nonetheless, variables such as the age at which the implant is received, the length of device usage, and the availability of rehabilitative services play a crucial role in shaping social skill development (Spencer & Marschark, 2003). Numerous comparative studies have explored differences in language abilities between students with hearing aids and those with cochlear implants. For instance, Boerrigter et al. (2023) found that children with cochlear implants outperformed those with hearing aids in speech perception, language acquisition, and executive functioning. These findings contribute valuable insight to the ongoing discourse surrounding cochlear implant eligibility. Notably, both groups—children with CIs and those with HAs—achieved high scores in speech perception during conversational scenarios.

MATERIALS & METHODS

Objective of the Study:

The primary objective of this study is to compare the language skills—specifically receptive, expressive, and pragmatic language abilities—between students who use hearing aids and those who use cochlear implants.

- Examine the differences in language development outcomes between the two groups.
- Identify the strengths and challenges associated with each hearing device in relation to language acquisition.
- Explore the impact of age at intervention, duration of device use, and access to speech-language therapy on language proficiency.
- Provide insights that can inform educators, therapists, and parents in selecting and supporting effective communication interventions.

Hypotheses of the study

- There is a significant difference in the Receptive & Expressive Language skills of Children using Hearing Aids and Cochlear Implants.
- There is a significant difference in the Receptive Language skills of Children using Hearing Aids and Cochlear Implants.
- There is a significant difference in the Expressive Language skills of Children using Hearing Aids and Cochlear Implants.

Sample

This study involved 60 children with bilateral sensor neural hearing impairment, aged 6-15 years. 30 children with moderately severe/ severe hearing loss using hearing aids as assistive device, and 30 children with severe to profound hearing loss using cochlear implants as assistive devices.

Tool Used

The Linguistic Profile Test (LPT)- Hindi, developed by Ali Yavar Jung National Institution for the Hearing Handicapped (AYJNIHH), is a well-known tool for assessing Language competencies. This task was undertaken as a joint collaborative project entitled "Development and Standardization of Language and Articulation Tests in Indian Languages" funded by UNICEF. This linguistic profile test is the final product of three years of work.

PROCEDURE

Children's hearing devices, including hearing aids and cochlear implant speech processors, were provided and overseen by the audiology team. At the time, standard clinical practice involved fitting bilateral hearing aids or a single (unilateral) cochlear implant. All participants received audiological services throughout the study period. Each child used their hearing device at the prescribed settings determined by their clinical audiologist. Listening checks were carried out prior to each testing session. The Linguistic Profile Test (LPT) served as the primary tool for evaluating speech recognition. In addition, standardized assessments of speech and language abilities, literacy skills, and cognitive functioning were administered to both groups of children. Test selection was based on established psychometric strength, frequent use in existing research and clinical contexts, and suitability for efficient administration to school-aged children. The assessments were categorized into three main outcome areas: speech recognition, language and phonological skills, and literacy-related measures. The study also gathered data on both receptive and expressive language abilities to provide a fuller picture of the children's verbal development. All assessment outcomes, apart from speech recognition, are reported using standardized scores, allowing for comparisons across children of varying ages by referencing age-matched normative data from typically hearing populations. Speech recognition scores, in contrast, are presented as a percentage of correct responses.

STATISTICAL ANALYSIS

The "t" test was used to determine the significance of mean differences.

RESULT & DISCUSSION

The results of present study are presented table wise.

Hypothesis – 1: There is a significant difference in the Receptive and Expressive Language skills of Children using Hearing Aids and Cochlear Implants.

Groups	Subject (N)	Mean	SD	SED	t-value	Significant level
Children using Hearing Aids	30	81.9	4.68			
Children using Cochlear Implants	30	91.53	3.24	1.05	9.10	P<0.01
N = 60						

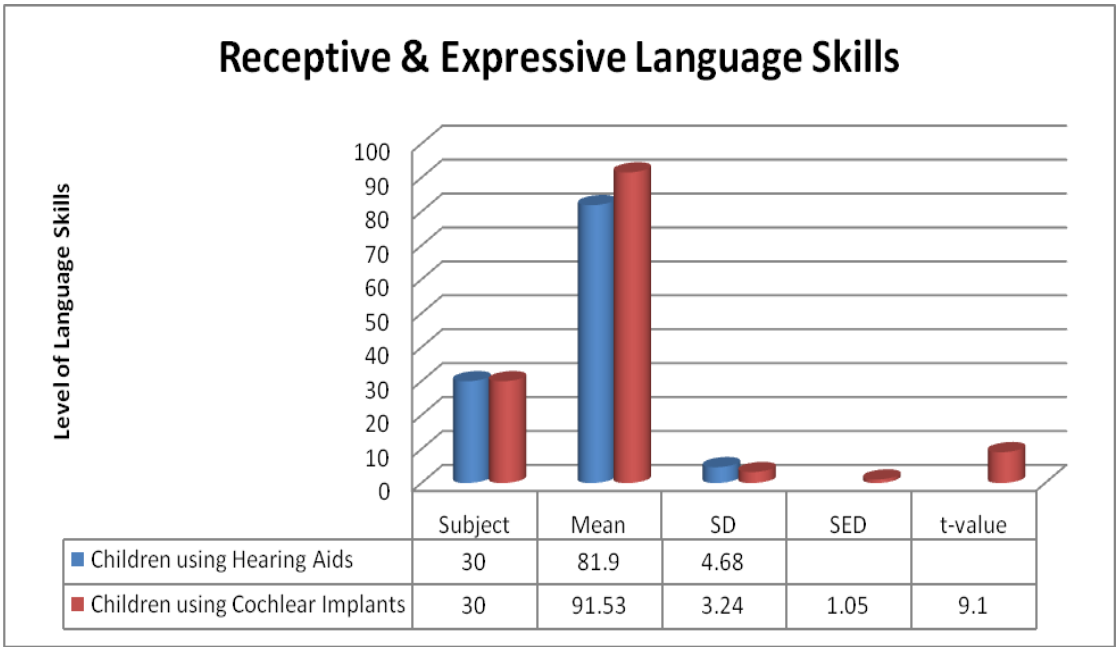

Figure No. – 1: Difference in the language skills of Children using Hearing Aids and Children using Cochlear Implants.

The table and figure number – 1 reveals that the mean value of Language skills of Children using Hearing Aids is 81.9 and SD value is 4.68, whereas mean value of language skills of Children using Cochlear Implants is 91.53 and SD value is 3.24. The t-value between the mean of Children using Hearing Aids and Children using Cochlear Implants is 9.1, which shows significant difference at 0.01 levels. That means there is significant difference between the Receptive and Expressive Language skills of Children using Hearing Aids and Children using Cochlear Implants. But when we compare mean value the language skills of Children using Cochlear Implants is better as compared to Children using Hearing Aids. Children using Cochlear Implants have high level of language skills than the Children using Hearing Aids. The probable reason the Children using Cochlear implants directly stimulate the auditory nerve, allowing for better sound clarity and speech perception. This advantage contributes to improve spoken language, which can positively impact on language development.

Hypothesis – 2: There is a significant difference in the Receptive Language skills of Children using Hearing Aids and Cochlear Implants.

Groups	Subject (N)	Mean	SD	SED	t-value	Significant level
Children using Hearing Aids	30	41.6	2.96			
Children using Cochlear Implants	30	48.66	1.67	0.63	11.17	P<0.01
N = 60						

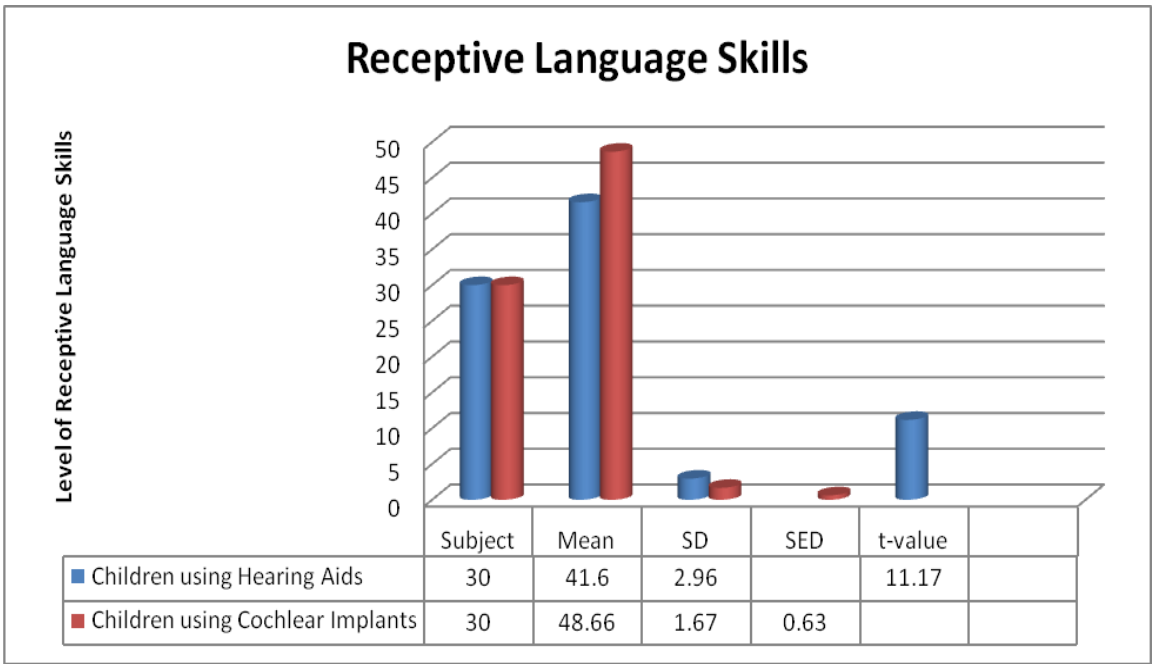

Figure No. – 2: Difference in the Receptive Language skills of Children using Hearing Aids and Children using Cochlear Implants.

The table and figure number – 2 reveals that the mean value of Receptive Language skills of Children using Hearing Aids is 41.6 and SD value is 2.96, whereas mean value of language skills of Children using Cochlear Implants is 48.66 and SD value is 1.67. The t-value between the mean of Children using Hearing Aids and Children using Cochlear Implants is 11.17, which shows significant difference at 0.01 levels. That means there is significant difference between the Receptive Language skills of Children using Hearing Aids and Children using Cochlear Implants. But when we compare mean value the receptive language skills of Children using Cochlear Implants is better as compared to Children using Hearing Aids. Children using Cochlear Implants have high level of reception of environmental sound than the Children using Hearing Aids. So children using cochlear implant can hear better sound clarity. This advantage contributes to improve receptive language, which can positively impact on cognitive and language development.

Hypothesis – 3: There is a significant difference in the Expressive Language skills of Children using Hearing Aids and Cochlear Implants.

Groups	Subject (N)	Mean	SD	SED	t-value	Significant level
Children using Hearing Aids	30	40.3	4.53			
Children using Cochlear Implants	30	42.86	2.09	0.92	2.76	P<0.01
N = 60						

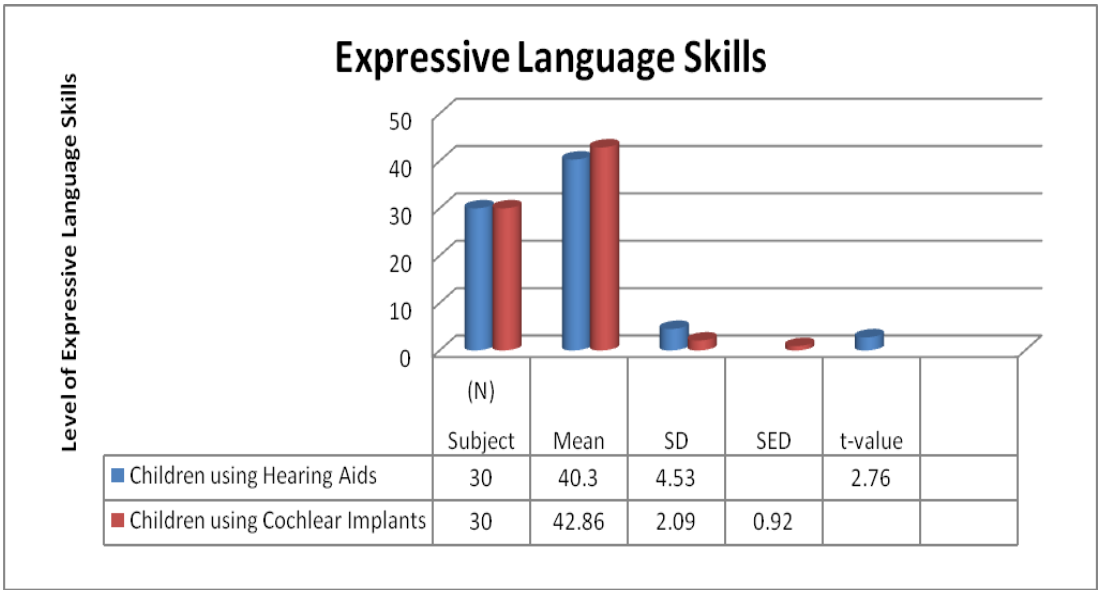

Figure No. – 3: Difference in the Expressive Language skills of Children using Hearing Aids and Children using Cochlear Implants.

The table and figure number – 2 reveals that the mean value of Receptive Language skills of Children using Hearing Aids is 41.6 and SD value is 2.96, whereas mean value of language skills of Children using Cochlear Implants is 48.66 and SD value is 1.67. The t-value between the mean of Children using Hearing Aids and Children using Cochlear Implants is 11.17, which shows significant difference at 0.01 levels. That means there is significant difference between the Receptive Language skills of Children using Hearing Aids and Children using Cochlear Implants. But when we compare mean value the receptive language skills of Children using Cochlear Implants is better as compared to Children using Hearing Aids. Children using Cochlear Implants have high level of reception of environmental sound than the Children using Hearing Aids. So, children using cochlear implant can hear better sound clarity. This advantage contributes to improve receptive language, which can positively impact on cognitive and language development.

CONCLUSION

The study emphasizes that although students using cochlear implants often exhibit stronger verbal communication abilities, those who rely on hearing aids tend to cultivate different methods for social adaptation. Programs focused on enhancing social skills, promoting inclusive educational environments, and initiating early intervention are crucial to helping both groups interact effectively in social settings. Further investigations could examine the long-term effects of diverse rehabilitation strategies on the social growth and emotional health of students with hearing loss.

EDUCATIONAL IMPLICATIONS

A comparative analysis of language proficiency among students using hearing aids (HAs) versus cochlear implants (CIs) reveals significant educational considerations for cultivating inclusive learning settings. Learners with CIs frequently demonstrate more advanced spoken language abilities compared to their peers with HAs, highlighting the need for differentiated instructional approaches. Educational institutions should adopt personalized support frameworks, initiate early intervention initiatives, and provide consistent speech-language therapy to bolster communication development. Inclusive teaching practices—such as peer sensitization programs, use of assistive

auditory technologies, and collaborative learning activities—can foster both linguistic growth and social inclusion. It is essential that educators receive professional development on adaptive communication strategies and tools such as real-time captioning and speech recognition software. Furthermore, active family engagement and broader community involvement are vital in supporting language acquisition beyond school settings. By embracing these methods, schools can ensure a fair and supportive educational environment that nurtures both the language and academic progress of students with hearing loss.

Declaration by Authors

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