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EFFECT OF COCHLEAR IMPLANTATION IN PRE-LINGUAL ADULTS ON SPEECH DEVELOPMENT

Original Research

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ABSTRACT

Background: Cochlear implants (CIs) have emerged as a transformative intervention for individuals with severe-to-profound sensorineural hearing loss. While extensive research has supported their effectiveness in post lingually deaf individuals, outcomes in prelingually deaf adults remain less explored. This population presents unique auditory and neurological challenges due to a lack of early sound exposure, which may affect speech and language development. Understanding the extent of benefits in this group is vital for evidence-based clinical decisions.

Objective: To evaluate the impact of cochlear implantation on speech comprehension, social interaction, and overall quality of life in adults with prelingual deafness.

Methods: A prospective cohort study was conducted over six months (July 2024 to December 2024) in the Department of Otorhinolaryngology. Seventy adults (n=70) with congenital or early-onset deafness who received cochlear implants were enrolled. Self-reported outcomes were assessed using the Abbreviated Profile of Hearing Aid Benefit (APHAB) and Short Form Health Survey (SF-36) both before and after implantation. Pre- and post-implantation data were statistically analyzed using paired tests, with significance set at $p<0.05$.

Results: Post-implantation, participants showed significant improvements across all domains: telephone communication (85.71%), music perception (78.57%), social engagement (92.86%), speech comprehension (88.57%), and perceived quality of life (82.86%). The APHAB scale revealed a 28.5% overall reduction in listening difficulties, including improvements in ease of communication ($p=0.001$), background noise ($p=0.003$), aversiveness ($p=0.020$), and reverberation ($p=0.010$). SF-36 scores showed enhanced physical functioning ($p<0.01$), decreased pain ($p<0.02$), increased vitality ($p<0.0001$), and better mental health ($p<0.01$).

Conclusion: Cochlear implants significantly enhance both objective hearing performance and subjective life quality in prelingually deaf adults. These findings support broader use of CIs in this population and emphasize the importance of early diagnosis and intervention.

Keywords: Cochlear Implants, Deafness, Hearing Aids, Hearing Loss, Quality of Life, Speech Perception, Treatment Outcome.

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INTRODUCTION

Cochlear implants (CIs) have revolutionized the management of severe to profound sensorineural hearing loss by directly stimulating the auditory nerve through electrical impulses delivered to the cochlea. This advancement allows individuals who previously relied on visual communication methods, such as lip reading or sign language, to perceive and produce speech with significantly improved outcomes (1,2). While cochlear implantation is well established as an effective intervention for post lingually deaf individuals—those who lost hearing after acquiring language—its application in prelingually deaf adults, who were born deaf or became deaf before language development, remains a subject of ongoing investigation. Research has consistently shown that post lingually deaf children benefit immensely from early implantation, demonstrating substantial gains in speech perception and language acquisition (3). However, outcomes for prelingually deaf adults have been more variable, partly due to the lack of early auditory stimulation during critical periods of neural development. The auditory deprivation experienced in early childhood often leads to underdeveloped cortical pathways essential for speech and language processing, which may restrict the full potential of cochlear implants in this group (4). Despite technological advancements, limited data exist regarding how prelingually deaf adults progress in terms of speech recognition, verbal production, and psychosocial integration after implantation (5). This has left significant knowledge gaps, particularly concerning long-term outcomes and quality of life (6,7).

Furthermore, much of the existing literature focuses primarily on speech recognition metrics while overlooking broader communicative and functional outcomes, such as emotional well-being, family dynamics, and vocational performance. There is also insufficient understanding of how patient-specific factors—such as age at implantation, duration of auditory deprivation, and prior use of hearing aids—affect post-implantation success (8,9). Addressing these gaps is crucial for guiding clinicians in making evidence-based recommendations tailored to the unique needs of prelingually deaf adults seeking cochlear implantation. Recent studies have emphasized the importance of holistic evaluations, incorporating both clinical and patient-reported outcomes to assess the comprehensive impact of cochlear implants (10). These findings support the need for further investigation into the psychosocial and functional domains affected by cochlear implantation, as well as the development of individualized rehabilitation strategies. The objective of this study is to evaluate how cochlear implants influence speech perception, speech production, and overall communication development in prelingually deaf adults. Additionally, it aims to examine the broader effects on quality of life, including physical functioning, emotional health, family relationships, and occupational performance, while analyzing the influence of implantation timing, duration of deafness, and hearing aid history on these outcomes.

METHODS

This prospective cohort study was conducted in the Department of Otorhinolaryngology at a tertiary care center over a period of one year, from January 2024 to December 2024. The study enrolled 70 adult participants (37 males and 33 females) with congenital, prelingual deafness who underwent cochlear implantation at the institution. The mean age of participants was 37.5 years, with an age range of 30 to 45 years. The study was approved by the institutional ethics review committee, and all participants provided written informed consent in accordance with the ethical standards of the Declaration of Helsinki. Inclusion criteria comprised adults with early-onset deafness who were able to communicate using oral language, had consistently used hearing aids prior to implantation, and consented to participate in the study. Individuals were excluded if they failed to attend follow-up appointments or had limited access to post-operative care due to geographical constraints. Seven participants were excluded on these grounds (11).

All participants underwent comprehensive preoperative assessments that included pure-tone audiometry and aided speech recognition testing. To assess speech comprehension while minimizing visual cue influence, lip-reading was effectively blocked using an opaque barrier between the speaker and the patient during testing. High-resolution computed tomography (CT) scans of the temporal bone and magnetic resonance imaging (MRI) of the brain and inner auditory pathways were performed to evaluate inner ear anatomy and confirm candidacy for implantation. Following cochlear implantation, audiological and speech perception evaluations were conducted using standardized equipment. Pure-tone thresholds were measured, and speech perception at conversational volume was assessed by a speech-language pathologist to determine functional auditory improvement. Two structured and validated survey tools were employed to assess patient-reported outcomes. The first questionnaire gathered subjective data on pre- and post-implant hearing experiences and their

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influence on social and occupational functioning. The second, the Abbreviated Profile of Hearing Aid Benefit (APHAB), evaluated how effectively participants managed everyday listening environments. In addition, the Short Form Health Survey (SF-36) was used to assess overall quality of life, focusing on physical, emotional, and social domains (12). Patient outcomes were compared with normative data from individuals with normal hearing and those with untreated hearing loss. The analysis also explored the relationship between patient-specific variables—such as age at initial hearing aid use, duration of deafness, and baseline auditory function—and post-implant speech perception results. All participants were followed for a duration of one-year post-implantation. Data were analyzed using SPSS software version 23. The Shapiro-Wilk W test was used to examine the normality of continuous variables. Non-normally distributed data were analyzed using the Wilcoxon matched-pairs signed-ranks test, while categorical data were evaluated using McNemar's chi-squared test. Statistical significance was set at $p < 0.05$.

RESULTS

The findings demonstrated substantial improvements in communication abilities and quality of life following cochlear implantation in prelingually deafened adults. Notably, the ability to engage in telephone conversations improved from 42.86% pre-implantation to 85.71% post-implantation. Music perception rose from 35.71% to 78.57%, and enhanced social interaction was reported by 92.86% of patients compared to 50.00% prior to surgery. Speech comprehension improved from 40.00% to 88.57%, while overall perceived quality of life increased markedly from 28.57% to 82.86%. On the APHAB (Abbreviated Profile of Hearing Aid Benefit) scale, statistically significant improvements were observed across all measured domains. The greatest benefit was found in the "ease of communication" domain, where mean scores decreased from 60.5 to 35.2 ($p = 0.001$), indicating enhanced speech understanding. Background noise interference scores were significantly reduced from 72.3 to 45.6 ($p = 0.003$), suggesting improved hearing clarity in noisy environments. Aversiveness scores dropped from 50.8 to 40.3 ($p = 0.020$), reflecting greater tolerance to loud sounds, while reverberation scores improved from 65.1 to 50.2 ($p = 0.010$), indicating better sound clarity in echo-prone settings.

Assessment of general health outcomes using the SF-36 survey also revealed significant gains post-implantation. Physical functioning scores improved from 45.2 ± 10.1 to 60.4 ± 9.8 ($p = 0.001$), and bodily pain scores increased from 50.8 ± 9.5 to 65.1 ± 8.9 ($p = 0.001$), suggesting better physical well-being. Role physical scores rose from 40.5 ± 12.3 to 55.3 ± 11.7 ($p = 0.001$), and general health improved from 42.1 ± 11.2 to 55.7 ± 10.5 ($p = 0.001$). Vitality scores increased from 38.7 ± 13.4 to 52.9 ± 12.7 ($p = 0.001$), while social functioning improved from 36.2 ± 10.7 to 50.1 ± 9.8 ($p = 0.001$). Similarly, role emotional scores increased from 41.5 ± 9.9 to 56.2 ± 9.5 ($p = 0.001$), and mental health scores rose from 39.8 ± 12.1 to 53.4 ± 11.3 ($p = 0.001$), reflecting enhanced emotional and psychological well-being.

Subgroup analysis revealed that participants above 40 years of age achieved slightly higher speech comprehension scores (90.0%) and quality of life ratings (85.0%) compared to those under 35 years (85.0% and 80.0%, respectively). Similarly, individuals with more than 35 years of deafness demonstrated slightly improved social interaction (94.0%) and quality of life (85.5%) compared to those deaf for a shorter duration. A positive trend was also observed in individuals who had used hearing aids for 10 or more years prior to implantation, with speech comprehension and quality of life reaching 90.2% and 86.0%, respectively. Correlative analysis supported these findings, with weak to moderate positive associations observed between longer duration of hearing aid use and improved post-implantation outcomes. Specifically, Spearman correlation coefficients indicated positive correlations between hearing aid use duration and both speech comprehension ($\rho = 0.28$) and quality of life ($\rho = 0.31$). Age at implantation and total duration of deafness showed weaker correlations with outcome measures, suggesting that pre-implant auditory stimulation through hearing aids may play a more influential role in predicting cochlear implant benefits.

Table 1: Evaluation of Subjective Improvement

Subjective Benefits	Before implant (YES) %	Before Implant (NO) %	After Implant (YES) %	After Implant (NO) %
Ability to have telephone conversations	42.86%	57.14%	85.71%	14.29%
Perception of music	35.71%	64.29%	78.57%	21.43%
Improved social interactions	50.00%	50.00%	92.86%	7.14%

Subjective Benefits	Before implant (YES) %	Before Implant (NO) %	After Implant (YES) %	After Implant (NO) %
Enhanced speech comprehension	40.00%	60.00%	88.57%	11.43%
Improved quality of life	**28.57%**	**71.43%**	**82.86%**	**17.14%**

Table 2: APHAB Scales before and after Cochlear Implantation

APHAB Domain	Pre-Implant Mean Score	Post-Implant Mean Score	Mean Difference	P-Value
Ease of Communication	60.5	35.2	25.3	0.001
Background Noise	72.3	45.6	26.7	0.003
Aversiveness	50.8	40.3	10.5	0.020
Reverberation	**65.1**	**50.2**	**14.9**	**0.010**

Table 3: Pre and Post Implantation comparison of SF36 Norm based scores in prelingually deaf patients

SF36 Domain	Pre-Implant Mean Score (± SD)	Post-Implant Mean Score (± SD)	P-value (Paired t-test)
Physical Functioning	45.2 ± 10.1	60.4 ± 9.8	0.001
Role Physical	40.5 ± 12.3	55.3 ± 11.7	0.001
Bodily Pain	50.8 ± 9.5	65.1 ± 8.9	0.001
General Health	42.1 ± 11.2	55.7 ± 10.5	0.001
Vitality	38.7 ± 13.4	52.9 ± 12.7	0.001
Social Functioning	36.2 ± 10.7	50.1 ± 9.8	0.001
Role Emotional	41.5 ± 9.9	56.2 ± 9.5	0.001
Mental Health	**39.8 ± 12.1**	**53.4 ± 11.3**	**0.001**

Table 4: Subgroup Analysis Table

Subgroup	Speech Comprehension (%)	Social Interaction (%)	Quality of Life (%)
<35 yrs. (n=22)	85	90.9	80
35-40 yrs. (n=26)	88	92.3	84.5
>40 yrs. (n=22)	90	95	85
Deaf <35 yrs. (n=25)	87.5	91.5	83
Deaf ≥ 35 yrs. (n=45)	89	94	85.5
HA use <10 yrs. (n=30)	86.7	91	81.5
HA use ≥ 10 yrs. (n=40)	90.2	94.2	86

Table 5: Correlation Outcomes Table

	Speech Comprehension (%)	Quality of Life (%)
Age at Implantation	0.091	0.051
Duration of Deafness	-0.039	0.010
Hearing Aid Use (Years)	-0.304	0.179

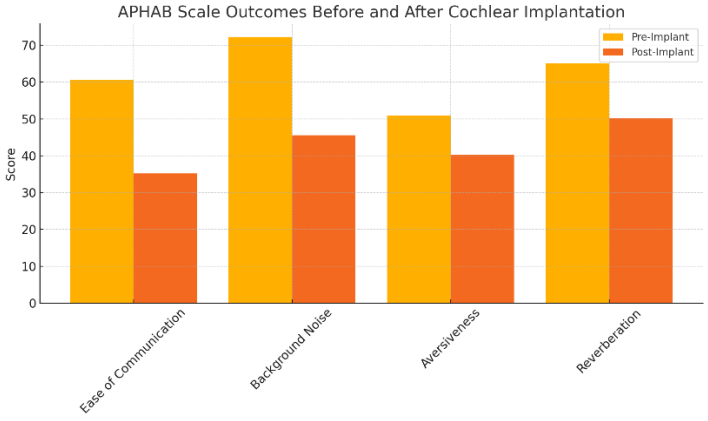

Figure 1 APHAB Scale Outcomes Before and After Cochlear Implantation

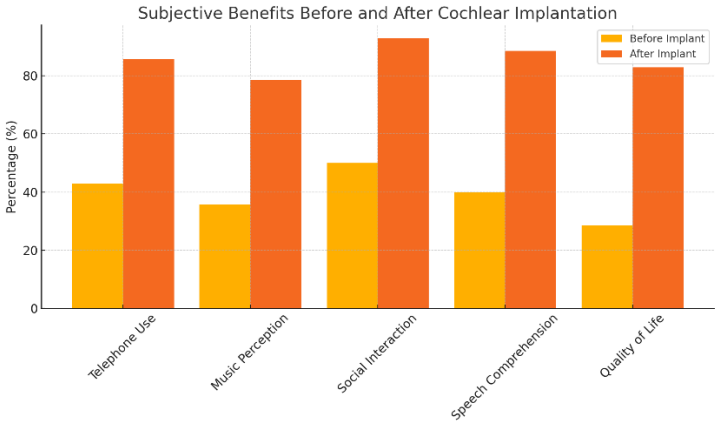

Figure 2 Subjective Benefits Before and After Cochlear Implatation

DISCUSSION

The present study reinforces the growing body of evidence supporting the benefits of cochlear implantation in prelingually deafened adults, demonstrating statistically and clinically significant improvements in speech comprehension, music perception, telephone communication, social interactions, and overall quality of life. These findings align closely with earlier research reporting enhanced auditory performance and psychosocial outcomes following cochlear implantation (13). Subjective assessments, supported by objective measures, confirmed that participants experienced substantial gains across all evaluated domains, confirming the functional advantages of the intervention in daily life. Improvements in telephone conversation skills and music appreciation observed in this study mirror earlier findings that highlighted increased auditory clarity and perception post-implantation (14,15). Music perception, which is traditionally more challenging for cochlear implant users due to limited pitch resolution, showed marked improvement in this cohort, underscoring the value of auditory rehabilitation and prolonged device use. Enhanced social participation and speech understanding, particularly in challenging listening environments, were also consistent with previous reports indicating better communicative engagement and reduced listening effort following implantation (16,17).

Quality of life, assessed through the SF-36 scale, showed statistically significant gains in both physical and psychological domains. These findings support prior studies suggesting that cochlear implants contribute not only to auditory improvements but also to broader well-being, including physical functioning, reduced pain perception, and improved emotional health (18). The APHAB outcomes further validated these improvements, with decreased difficulty in communication, reduced aversiveness to loud sounds, and enhanced performance in noisy and reverberant environments. These results corroborate existing literature that has emphasized the reduced listening burden and improved clarity of auditory signals with cochlear implant use (19,20). The study's strengths include a clearly defined prelingual adult population, comprehensive pre- and post-implant assessments using validated tools, and a structured follow-up period. The integration of both subjective and objective outcome measures enhances the reliability and clinical relevance of the findings. Additionally, subgroup and correlation analyses provided nuanced insights into how patient-specific variables, such as age at implantation, duration of deafness, and hearing aid use, influence post-implant outcomes. These analyses contribute valuable information for individualizing cochlear implant candidacy assessments and optimizing postoperative expectations.

However, certain limitations must be acknowledged. The absence of a control group limits comparative interpretation and generalizability. Although the sample size was adequate for primary analysis, larger multicenter studies would improve external validity and allow for more robust subgroup comparisons. Longitudinal follow-up beyond one year is needed to determine the durability of the observed benefits and to assess the trajectory of auditory and psychosocial outcomes over time. Future research should prioritize longitudinal designs with larger, diverse populations and include neurocognitive and linguistic assessments to explore the full impact of cochlear implantation in prelingually deaf adults. Investigations into rehabilitation protocols, device programming strategies, and patient counseling models could further refine treatment efficacy. Moreover, exploring the interaction between cognitive plasticity and auditory training may offer deeper understanding of individual variability in outcomes. Overall, this study substantiates the considerable communicative and quality-of-life improvements associated with cochlear implantation in prelingually deafened adults and highlights the importance of early hearing intervention and consistent pre-implant auditory stimulation in achieving favorable outcomes.

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CONCLUSION

This study concludes that cochlear implantation offers significant benefits to prelingually deafened adults by enhancing their speech perception, communication skills, social interaction, and overall quality of life. The results affirm the practical value of cochlear implants not only in improving auditory performance but also in supporting meaningful psychosocial integration. These findings contribute to the growing evidence base advocating for the use of cochlear implants in adults with early-onset deafness, emphasizing the importance of timely intervention and consistent pre-implant auditory stimulation. Continued research is essential to evaluate the long-term effectiveness of cochlear implants and to explore how tailored rehabilitation strategies can further optimize patient outcomes.

Author Contribution

Author	**Contribution**
Affaf Yousaf*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Umair Adeel	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Nida Anjum Ghouri	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Tariqullah	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hassan Rasheed	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hummaira Maheen	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Laiba Gul	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Morris DJ, Van De Velde D. Hearing Loss and Cochlear Implants. The Handbook of Language and Speech Disorders. 2021 Mar 1:53-80.
2. Lloyd S, Tremblay A. No hearing without signals: imagining and reimagining transductions through the history of the cochlear implant. The Senses and Society. 2021 Sep 2;16(3):259-77.
3. Gupta D. The Sound Seeker's Handbook: Unbiased Reviews and Insights for Cochlear Implant Selection. Blue Rose Publishers; 2023 Aug 2.
4. Makhamra, A., & Hzazah, M. (2024). AHolisticInitiativeforImprovingHearing CareinInfantswithCochlearImplants(Doctoral dissertation).
5. Burdo S. Cochlear Implants-Basic Textbook. Youcanprint; 2023 Oct 26.
6. Peters JP, van Heteren JA, Wendrich AW, van Zanten GA, Grolman W, Stokroos RJ, Smit AL. Short-term outcomes of cochlear implantation for single-sided deafness compared to bone conduction devices and contralateral routing of sound hearing aids—Results of a randomised controlled trial (CINGLE-trial). PLoS One. 2021 Oct 13;16(10):e0257447.

7. Kempfle JS, Jung DH. Experimental drugs for the prevention or treatment of sensorineural hearing loss. Expert Opinion on Investigational Drugs. 2023 Jul 3;32(7):643-54.
8. Paisa R, Cavdir D, Ganis F, Williams P, Percy-Smith LM, Serafin S. Design and evaluation of a multisensory concert for cochlear implant users. InArts 2023 Jul 10 (Vol. 12, No. 4, p. 149). MDPI.
9. Stach BA, Ramachandran V. Clinical audiology: An introduction. Plural Publishing; 2021 Mar 11.
10. De Jongh, N. K. (2020). Patient journey from hearing aids to cochlear implant: a retrospective study.
11. Lambinon C, le Roux T, Eikelboom RH, Bennett RJ. Impact of adult cochlear implantation on the partner relationship: a conceptual framework informed by cochlear implant recipient and partner perceptions. Disability and Rehabilitation. 2024 Sep 2:1-5.
12. Borel S, Dupré S, de Bergh M, Sterkers O, Mosnier I, Ferrary E. Rehabilitation of telephone communication in cochlear-implanted adults. European Annals of Otorhinolaryngology, Head and Neck Diseases. 2020 Nov 1;137(5):381-6.
13. Völter C, Schirmer C, Hinsen D, Roeber M, Dazert S, Bilda K. Therapist-guided telerehabilitation for adult cochlear implant users: developmental and feasibility study. JMIR Rehabilitation and Assistive Technologies. 2020 May 28;7(1):e15843.
14. Bekele Okuba T, Lystad RP, Boisvert I, McMaugh A, Moore RC, Walsan R, Mitchell RJ. Cochlear implantation impact on health service utilisation and social outcomes: a systematic review. BMC health services research. 2023 Aug 30;23(1):929.
15. O'Neill ER, Basile JD, Nelson P. Individual hearing outcomes in cochlear implant users influence social engagement and listening behavior in everyday life. Journal of Speech, Language, and Hearing Research. 2021 Dec 13;64(12):4982-99.
16. McRackan TR, Hand BN, Chidarala S, Dubno JR. Understanding patient expectations before implantation using the Cochlear Implant Quality of Life–Expectations Instrument. JAMA Otolaryngology–Head & Neck Surgery. 2022 Sep 1;148(9):870-8.
17. Dornhoffer JR, Meyer TA, Dubno JR, McRackan TR. Assessment of hearing aid benefit using patient-reported outcomes and audiologic measures. Audiology and Neurotology. 2020 Jul 17;25(4):215-23.
18. Lailach S, Lenz A, Zahnert T, Neudert M. Value of patient-reported outcome measures for evaluating the benefit of speech processor upgrading in patients with cochlear implants. Hno. 2024 Jan;72(Suppl 1):25-32.
19. Müller L, Graham P, Kaur J, Wyss J, Greenham P, James CJ. Factors contributing to clinically important health utility gains in cochlear implant recipients. European Archives of Oto-Rhino-Laryngology. 2021 Dec 1:1-9.
20. Andries E. Outcomes of cochlear implantation and implementation of the ICF model in adults with acquired sensorineural hearing loss. University of Antwerp; 2023.