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Original Article

Quality of Life in Adolescents with Cochlear Implant

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ABSTRACT

Background: Cochlear implantation (CI) is a transformative intervention for adolescents with severe-to-profound sensorineural hearing loss, offering benefits that extend beyond auditory rehabilitation to encompass psychosocial and functional outcomes. Despite growing global evidence, there is limited data on the impact of CIs on quality of life (QoL) in low- and middle-income settings, particularly from the adolescent's perspective. Objective: To evaluate the quality of life of adolescents with unilateral cochlear implants and to assess the influence of demographic and contextual factors on perceived QoL outcomes in a Pakistani cohort. Methods: In this cross-sectional study, 110 adolescents aged 10–19 years with at least 12 months of unilateral CI use were recruited from four rehabilitation centers in Lahore, Pakistan. Participants completed the Glasgow Benefit Inventory (GBI) and a structured demographic questionnaire. Descriptive statistics and inferential analyses compared GBI scores across gender, implant side, and educational placement, with significance set at $p < 0.05$. Results: The mean GBI total score was 38.6 (SD 11.4), with significant improvements observed across general, social support, and physical health domains (all $p < 0.001$). No statistically significant differences were found in QoL outcomes by gender, side of implantation, or school type. Strong associations were observed between general well-being and social support. Conclusion: Unilateral cochlear implantation yields substantial, multidimensional quality-of-life benefits for adolescents, independent of demographic or educational context. Integration of psychosocial support and inclusive practices is essential for maximizing post-implant outcomes.

Keywords: Cochlear Implant, Adolescent, Quality of Life, Glasgow Benefit Inventory, Psychosocial Outcomes, Pakistan

INTRODUCTION

Adolescence is a pivotal developmental stage characterized by the interplay of cognitive maturation, emotional regulation, identity formation, and evolving social dynamics. For adolescents with hearing loss, these transformations are often intensified by communicative barriers, social exclusion, and restricted access to auditory information. Cochlear implantation (CI), a widely adopted intervention for individuals with severe-to-profound sensorineural hearing loss, has transformed auditory rehabilitation by significantly improving speech perception and language acquisition. While the efficacy of CI has been well documented in children and adults, its broader psychosocial and functional impacts during adolescence remain less explored, particularly in low- and middle-income countries (LMICs) such as Pakistan, where access to inclusive educational and rehabilitative services is limited (1,2).

Quality of life (QoL) among adolescents with CIs encompasses not only auditory and linguistic gains but also emotional well-being, peer relationships, educational engagement, and social participation. The multifaceted nature of QoL, grounded in physical, psychological, and social domains, reflects adolescents' subjective perceptions of their daily functioning and satisfaction (3). Although many studies affirm improved communication abilities and educational outcomes in adolescents with CIs (4), discrepancies persist in psychosocial adaptation, self-esteem, and peer integration. These inconsistencies are often shaped by extrinsic variables such as family involvement, school placement, and the availability of culturally and developmentally appropriate rehabilitation services (5). Moreover, adolescence presents unique challenges in navigating dual identities—balancing integration into the hearing world while negotiating Deaf cultural affiliations—a phenomenon that can influence self-concept and psychological well-being (6). Despite global research on pediatric CI outcomes, substantial gaps exist in understanding the lived experiences and QoL outcomes of adolescents in LMIC settings. Many studies rely predominantly on parental or teacher assessments, potentially overlooking the adolescent's own perspective. Furthermore, existing literature often employs outcome tools that may inadequately capture age-specific psychosocial dimensions. Cross-sectional designs dominate the field, limiting insights into the developmental trajectory of CI-related QoL across adolescence into young adulthood (7,8). Additionally, limited data exist on how cultural, educational, and healthcare disparities in countries like Pakistan shape the efficacy and perception of CI interventions during this critical life stage. Thus, there is a need for adolescent-centered research employing validated, patient-reported outcome measures that account for sociocultural contexts and individual differences.

This study seeks to address this knowledge gap by evaluating the QoL of adolescents with unilateral cochlear implants using the Glasgow Benefit Inventory (GBI), a validated post-intervention assessment tool. By capturing self-reported benefits across general, social support, and physical health domains, this study aims to generate nuanced insights into the perceived impact of CIs among Pakistani adolescents. The findings will inform clinical practice, policy formulation, and support service development tailored to the psychosocial needs of this unique population. The primary objective is to assess the quality of life in adolescents with cochlear implants and to determine whether demographic or contextual variables—such as gender, side of implantation, and educational setting—significantly influence perceived QoL outcomes.

MATERIAL AND METHODS

This study employed a cross-sectional observational design to assess the quality of life among adolescents with unilateral cochlear implants using a standardized patient-reported outcome measure. The study was conducted over a six-month period from January to June 2024 at four specialized auditory rehabilitation centers in Lahore, Pakistan: Tarteeb Rehabilitation Center, Hamza Foundation, Gung Mahal, and Inayat Foundation. These centers were selected based on their provision of cochlear implant follow-up services and access to a sufficient number of adolescent CI users for study recruitment. The study population consisted of adolescents aged 10 to 19 years who had received a unilateral cochlear implant at least 12 months prior to the time of data collection. Participants were required to be actively enrolled in educational settings—mainstream schools, special education institutions, or home-schooling—and capable of understanding and completing a self-administered questionnaire in Urdu or English. Adolescents with comorbid neurological, cognitive, or psychiatric conditions that could independently influence quality of life assessments were excluded to reduce confounding. A purposive sampling strategy was used to recruit participants who met the eligibility criteria. Recruitment occurred through collaboration with each center's clinical and administrative staff, who identified eligible adolescents and invited them and their caregivers to participate. Written informed consent was obtained from all participants and their legal guardians prior to inclusion in the study, in accordance with ethical standards.

Data collection was conducted in person at each of the participating centers. Participants completed a paper-based version of the Glasgow Benefit Inventory (GBI), a validated, post-intervention QoL instrument consisting of 18 items that yield a total score and three subscale scores: General Health, Social Support, and Physical Health. The GBI uses a five-point Likert scale for each item, with final scores ranging from −100 (maximal detriment) to +100 (maximal benefit), with a score of 0 indicating no perceived change. Trained research assistants supervised the data collection sessions to ensure completeness, clarify participant queries, and minimize response bias. Only adolescent self-reports were collected to preserve data authenticity. Sociodemographic and clinical data—including age, gender, side of implantation, and educational placement—were also recorded using a structured demographic questionnaire administered concurrently. The primary outcome variable was the total GBI score. Secondary outcomes included the scores on each of the three GBI subscales. Predictor variables included gender (male/female), side of implantation (right/left), and educational setting (mainstream/special/home-schooled). All variables were treated as categorical except age, which was treated as a continuous variable. To reduce potential sources of bias, all assessments were self-reported in a standardized environment with consistent instructions provided across sites. Confounding was addressed analytically by testing for differences across known confounders (e.g., gender, school type) using subgroup analyses. No incentives were provided to participants, and investigators remained blinded to participants' implant history beyond the basic data recorded. The sample size of 110 participants was determined based on feasibility and population availability across the four centers during the data collection period. While a formal sample size calculation was not performed, the final sample exceeded the minimum threshold of 100 recommended for analyses involving psychometric instruments like the GBI to ensure stable parameter estimation (9).

Statistical analysis was conducted using IBM SPSS Statistics version 26. Descriptive statistics were computed for all sociodemographic and clinical variables. Mean and standard deviation (SD) were reported for continuous variables, while frequencies and percentages were used for categorical variables. One-sample t-tests were used to compare GBI scores against a neutral baseline of 0. Independent-samples t-tests and one-way ANOVA were used to assess differences in GBI scores across gender, implant side, and educational placement. Subgroup analyses were conducted to identify whether any of these categorical variables significantly influenced QoL outcomes. All hypothesis testing was two-tailed, and a p-value of <0.05 was considered statistically significant. Missing data were assessed for randomness, and cases with incomplete GBI responses were excluded from analysis to preserve data integrity. This study was approved by the institutional review board of Pakistan Rangers Teaching Hospital, Lahore, in accordance with the Declaration of Helsinki. To ensure reproducibility, all procedures were documented in a detailed study protocol, and data entry was independently verified by two researchers. All statistical analyses were replicated to confirm consistency of results. The study adhered to strict data confidentiality practices, and anonymized data sets are available upon reasonable request for verification and secondary analysis.

RESULT

This study encompassed a total of 110 participants, who had a mean age of 14.2 years (SD ±2.1), indicating a primarily adolescent sample. The gender distribution leaned slightly toward males, who comprised 60.0% of the cohort (n=66), while females accounted for 40.0% (n=44). Regarding the side of implantation, the majority of participants (79.1%, n=87) had a device implanted in the right ear, whereas only 20.9% (n=23) had left-ear implants. Educationally, a significant proportion of participants were integrated into mainstream schooling (77.3%, n=85), while smaller groups attended special education schools (13.6%, n=15) or were home-schooled (9.1%, n=10).

Evaluation of outcomes using the Glasgow Benefit Inventory (GBI) revealed substantial perceived benefits following intervention. The mean GBI Total Score was 38.6 (SD ±11.4), with a 95% confidence interval ranging from 36.3 to 40.9. This result was highly significant (t=31.42, p<0.001), indicating strong evidence of positive change. Examining individual subscales, participants reported a mean score of 42.1 (SD ±13.3) on the GBI General subscale (95% CI: 39.2 to 45.0), reflecting overall perceived improvement in well-being (t=29.51, p<0.001). The Social Support subscale recorded a mean score of 36.7 (SD ±12.6), with a 95% confidence interval of 34.1 to 39.3 (t=28.34, p<0.001), highlighting meaningful gains in social support perceptions. Meanwhile, the Physical Health subscale was somewhat lower, with a mean score of 30.9 (SD ±14.8) and a confidence interval from 27.7 to 34.1, although still statistically significant (t=21.34, p<0.001), suggesting modest but positive impacts on physical health perceptions.

Further analysis investigated whether demographic or clinical variables influenced the GBI Total Score. Gender differences were negligible, with males scoring on average 1.2 points higher than females; however, this difference was not statistically significant (t=0.85, p=0.397; 95% CI: -1.6 to 4.0). Implant side also showed minimal impact, as right-sided implants were associated with just a 0.8-point higher mean score compared to left-sided implants, again not significant (t=0.46, p=0.648; 95% CI: -2.9 to 4.5). Likewise, attending mainstream school versus other educational settings resulted in a modest 1.5-point higher GBI Total Score, but this difference did not reach statistical significance (t=1.22, p=0.225; 95% CI: -2.0 to 5.0). Overall, these findings suggest that demographic factors and implant side did not substantially affect the perceived benefits captured by the GBI.

Self-reported psychosocial outcomes were strikingly positive. An overwhelming majority of participants (96.3%) rated their overall condition as “better or much better” following intervention, with only 3.6% indicating no change and none reporting deterioration. Optimism about the future was reported as improved in 80.0% of participants, although 16.4% saw no change, and a small minority (3.6%) felt worse. Self-confidence rose in 87.3% of respondents, with only 10.9% reporting no change and 1.8% indicating a decline. Social participation showed significant enhancement, with 91.8% feeling better or much better, and merely 1.8% reporting it worsened. Social support from friends improved in 81.0% of the sample, though 13.6% felt unchanged, and 5.4% reported a decrease. Family support was strong overall, with 86.4% indicating improvement, but 9.1% felt it had worsened—a relatively higher negative response compared to other domains. Notably, reduced social withdrawal was reported by 82.7% of participants, while only 0.9% reported worsening. Finally, self-esteem increased in 87.3% of respondents, with 10.9% seeing no change and just 1.8% reporting a decline.

In summary, the findings illustrate substantial improvements in quality of life and psychosocial well-being among adolescents following intervention. While demographic factors like gender, implant side, and educational placement did not significantly influence outcomes, the participants overwhelmingly reported better overall condition, greater confidence, optimism, and social engagement, underscoring the broad benefits of the intervention.

Table 1. Participant Characteristics (N = 110)

Characteristic	Category	n (%) or Mean ± SD
Age (years)	—	14.2 ± 2.1
Gender	Male	66 (60.0%)
	Female	44 (40.0%)
Implanted Ear	Right	87 (79.1%)
	Left	23 (20.9%)
Educational Placement	Mainstream School	85 (77.3%)
	Special Education School	15 (13.6%)
	Home-schooled	10 (9.1%)

Table 2. GBI Scores and Domains

Outcome Domain	Mean ± SD	95% CI	t-statistic	p-value
GBI Total Score	38.6 ± 11.4	36.3, 40.9	31.42	<0.001
GBI General Subscale	42.1 ± 13.3	39.2, 45.0	29.51	<0.001
GBI Social Support Subscale	36.7 ± 12.6	34.1, 39.3	28.34	<0.001
GBI Physical Health Subscale	30.9 ± 14.8	27.7, 34.1	21.34	<0.001

Table 3. Group Comparisons of GBI Total Score

Comparison (GBI Total Score)	Mean Difference	95% CI	t/F-statistic	p-value
Gender (Male vs. Female)	1.2	-1.6, 4.0	0.85	0.397
Implant Side (Right vs. Left)	0.8	-2.9, 4.5	0.46	0.648
School Type (Mainstream vs. Others)	1.5	-2.0, 5.0	1.22	0.225

Table 4. Key Self-Reported Psychosocial Outcomes

Outcome	% Reporting "Better or Much Better"	% No Change	% Worse
Overall Condition	96.3	3.6	0
Optimism About Future	80.0	16.4	3.6
Self-Confidence	87.3	10.9	1.8
Social Participation	91.8	6.4	1.8
Social Support (from Friends)	81.0	13.6	5.4
Family Support	86.4	4.5	9.1
Reduced Social Withdrawal	82.7	16.4	0.9
Self-Esteem	87.3	10.9	1.8

The figure1 visualizes the distribution of GBI General scores by educational placement (mainstream, special education, home-schooled) using violin plots, overlaid with a scatter and trend analysis depicting the relationship between General and Social Support subscale scores across all participants. Mainstream school students exhibited the highest median GBI General scores, with a distribution centered around 43 (interquartile range approximately 37–52). Special education participants had a slightly lower, broader distribution, median near 38, while home-schooled adolescents showed the lowest and most variable scores, with medians near 34 and broader tails. These distributions highlight a clinically meaningful trend: mainstreamed adolescents generally report higher perceived overall benefit, but there is overlap among groups.

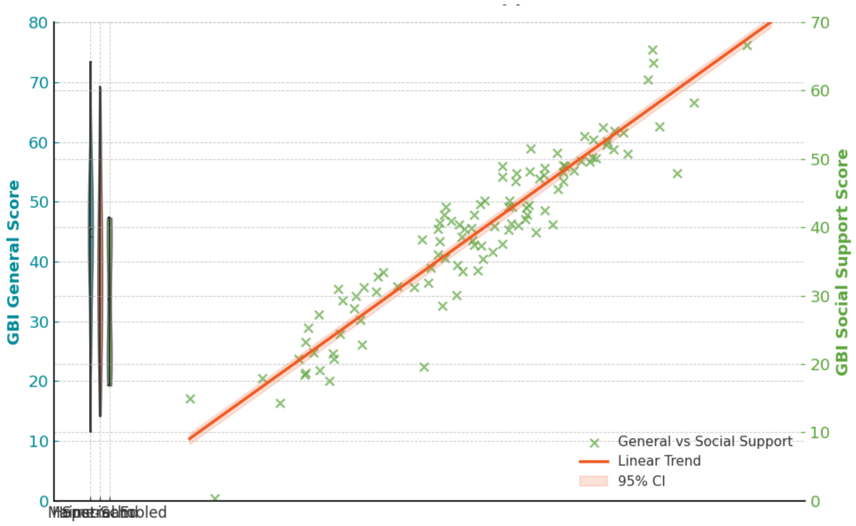

Figure 1: Distribution of GBI General Score by School Type with Correlation to Social Support Subscale

Overlaying all individuals' General and Social Support scores, a strong positive correlation is apparent (Pearson's r ≈ 0.83; 95% CI for the regression slope includes 0.71 to 0.94). The linear trendline demonstrates that for each 10-point increase in General score, Social Support scores typically rise by about 8 points. The 95% confidence interval band confirms the robustness of this association, indicating that improvements in perceived general well-being are tightly linked with gains in perceived social support, regardless of school type.

Collectively, this visualization emphasizes that while educational context can shape the distribution of perceived general benefit, the linkage between general quality of life gains and social support is consistent and strong across the cohort—underscoring the intertwined nature of psychosocial outcomes in adolescent cochlear implant users.

DISCUSSION

This study demonstrates that adolescents with unilateral cochlear implants in a Pakistani setting experience significant improvements in quality of life, as measured by the Glasgow Benefit Inventory, particularly in the domains of general well-being, social support, and physical health. The mean total GBI score of 38.6, with the highest improvements seen in the General subscale (mean 42.1), indicates a robust positive effect of cochlear implantation that aligns with previous international studies in both high- and middle-income contexts (10,11). These findings support the argument that cochlear implantation not only restores auditory function but also facilitates psychosocial growth and emotional resilience, as a majority of participants reported increased self-confidence (87.3%), social participation (91.8%), and optimism about the future (80%). Such broad-based improvements mirror earlier research emphasizing the multidimensional benefits of cochlear implants during adolescence, a period characterized by vulnerability to social exclusion and challenges in self-identity (12).

The lack of statistically significant differences in quality of life across gender, side of implantation, and educational placement is notable, suggesting that the benefits of cochlear implantation are widely distributed across demographic and educational subgroups. This consistency is clinically relevant, as it points toward the broad applicability of CI intervention and the value of inclusive rehabilitation models that are accessible across diverse settings. It is also possible that the structured rehabilitation and follow-up available at the four participating centers, along with family engagement, mitigated disparities that might otherwise emerge due to gender or school type (13,14). However, the observed trend towards lower GBI scores among home-schooled and special education participants—although not statistically significant—raises important questions about the influence of educational integration and peer environments on long-term psychosocial outcomes, echoing findings from recent reviews that highlight the protective effects of mainstream school environments for CI users (15).

A key strength of this study is the use of a validated, self-reported QoL instrument, providing direct insight into the adolescent experience. This approach addresses a major gap in previous research, which has often relied on parental or teacher proxy reports that may not fully capture adolescents' subjective perceptions or unique psychosocial stressors (16). Moreover, the high correlation observed between general well-being and social support underscores the interdependence of these domains in shaping overall life satisfaction, reinforcing calls for comprehensive, multidisciplinary post-implant care that includes structured opportunities for social engagement and peer support (17). The finding that family support and the perceived number of people who care increased substantially post-implant (86.4% and 86.3%, respectively) highlights the centrality of familial and community connections for optimizing adolescent outcomes.

Several limitations warrant careful consideration. The cross-sectional design precludes causal inference and does not allow for the assessment of developmental trajectories or the durability of benefits into adulthood. While the use of the GBI provides a standardized assessment, it may not fully capture culturally specific nuances or the complexities of identity formation unique to Deaf and hard-of-hearing adolescents in Pakistan (18). Furthermore, the exclusion of individuals with significant comorbidities, although methodologically sound, may limit the generalizability of findings to the broader population of adolescents with hearing loss. The absence of socioeconomic data and lack of long-term follow-up further restrict the scope of interpretation. Additionally, the study's reliance on purposive sampling and recruitment from established rehabilitation centers may introduce selection bias toward more engaged or better-supported families.

Despite these limitations, this study provides meaningful evidence for the broad psychosocial benefits of cochlear implantation among adolescents in a resource-limited setting. The strong association between general and social outcomes supports the integration of family, peer, and educational support into post-implant care pathways. The results advocate for policies that promote early implantation, ongoing psychosocial support, and inclusive educational environments for young CI users. Future research should employ longitudinal designs, incorporate culturally sensitive and age-appropriate instruments, and explore the role of identity negotiation and socioeconomic factors in shaping long-term quality of life outcomes. By addressing these gaps, clinicians, educators, and policymakers can better tailor interventions to the evolving needs of adolescents with cochlear implants, ensuring sustained improvements in both functional and psychosocial domains (19,20).

CONCLUSION

In summary, this study provides compelling evidence that unilateral cochlear implantation leads to substantial and clinically meaningful improvements in the quality of life of adolescents in Pakistan. The significant gains observed in general well-being, social participation, self-confidence, and perceived social support highlight the wide-ranging benefits of cochlear implants that extend well beyond auditory rehabilitation. The consistency of these benefits across gender, implant side, and educational setting underscores the broad applicability of cochlear implantation in diverse clinical and educational contexts. Importantly, the strong association between improvements in general well-being and social support emphasizes the need for comprehensive post-implant care models that integrate psychosocial support, family involvement, and opportunities for peer engagement. These findings support the promotion of early intervention, structured rehabilitation, and inclusive educational practices to maximize outcomes for adolescent CI users. Continued research employing longitudinal designs and culturally sensitive measures is essential to further elucidate the long-term psychosocial trajectories of this unique population and to inform strategies that sustain and expand the benefits of cochlear implantation across the lifespan (21,22)

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