



Quality of Life after Cochlear Implant in Children with Prelingual Hearing Loss: A Cross Sectional Study

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ABSTRACT

Background: Early diagnosis and intervention of hearing loss in children is important for the acquisition of hearing and speech, thereby contributing to the positive development and quality of life of this child. **Objective:** To describe the quality of life in children who had prelingual bilateral severe to intense sensorineural hearing impairment after receiving a cochlear implant. **Method:** This was done through a validated questionnaire directed to parents or caregivers of those children (up to 18 years old) included in the study and attended the audiology unit in the hospital of Benha University for evaluating hearing after cochlear implantation. **Results:** More than 90% reported high scores in domains of questionnaire and there was statistically difference ($p < 0.001$) between children who were implanted at earlier age (<24 months) have better quality of life especially in support, communication, self-confidence, well-being, and social relation sub scales. Also, this study found that children who had been using their implant for more than 10 years were superior to those who had been using it for less than 10 years in terms of communication, self-confidence, wellbeing, social relationships, and implantation services. **Conclusions:** Despite the fact that varied etiologic causes for hearing loss have led to a variety of results, cochlear implants typically increase communication, self-confidence, well-being, and social relation, which has a favorable impact on a person's quality of life. Additionally, a child's parents will notice a significant shift in their child's life after receiving a cochlear implant.

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INTRODUCTION

A partial or complete loss of hearing is known as hearing loss (HL). It may exist at birth or later in life. It may include one ear (unilateral HL) or both ears (bilateral).¹ Prelingual HL refers to HL that develops before speech and language skills (before the age of two) do.² Interpersonal communication, psychosocial well-being, economic independence, and quality of life (QoL) can all be adversely impacted by severe HL.³ However, the cochlear implant (CI) had changed this concept as it was proven that it is the ideal method for management of those individuals.⁴

According to statistics, bilateral severe or profound HL is present at birth in 3 out of 1000 people in industrialized nations and more than 6 out of 1000 in underdeveloped countries¹. In Egypt, HI

prevalence among children reported as 13.8% and 20.9%. Moreover, HI prevalence increases with increasing age.⁵ Early diagnosis and intervention of HL in infants is important for the acquisition of hearing, speech, and linguistic skills that contribute to the positive development of this child and allow those children to have equal opportunities in society as their normal peers.⁶

Children with HL score worse on QoL tests than their counterparts with normal hearing, according to previous studies.⁷ For kids with HL, a range of problems can affect their QoL.⁸ On the other hand, according to other research, these kids have a comparable QoL to their peers who are healthy.³

The concept of CI is the first line of management for children with prelingual severe to profound HL is

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Table 1: Relation between the time at implantation and the Parents' Perspective Questionnaire

	<24 months	24-48 months	>48 months	KW test	P value
	Median (Min.-Max)	Median (Min.-Max)	Median (Min.-Max)		
Decision for implantation	16 (12-35)	17.5 (14-24)	17 (15-22)	0.571	0.752
Process of implantation	16 (11-23)	16.5 (11-23)	19 (16-21)	8.832	0.012
Positive effect of implantation	10 (8-12)	9 (7-13)	12 (6-15)	6.149	0.046
Support	11 (9-11)	8 (5-14)	8 (6-10)	20.158	< 0.001
Communication	17 (9-24)	9.5 (8-22)	10 (9-15)	11.934	0.003
Self-confidence	17 (9-25)	15 (5-23)	11 (7-17)	10.537	0.005
Well-being	14 (12-15)	6.5 (5-8)	4 (3-9)	44.618	<0.001
Social relation	28 (25-30)	8.5 (6-12)	16 (6-25)	41.525	<0.001
Education	11 (9-16)	13 (7-17)	13 (9-17)	3.467	0.176
Services of implantation	10 (7-14)	9.5 (7-12)	9 (8-11)	0.286	0.867
General Functioning	8 (7-11)	8.5 (5-11)	8 (7-11)	0.918	0.632

not new, and it was not the scope of this study, but this study aimed to evaluate, by using a validated questionnaire, whether CI confers superior benefits than hearing aids (HA) do in patients with prelingual severe to intense HL.

METHODS

A cross sectional study was conducted in audiology unit of Benha University children from April till October 2022.

The study comprised parents and caretakers of kids (up to 18 years old) who underwent cochlear implantation because of prelingual bilateral severe to profound SNHL and received binaural hearing aid fittings for more than 6 months with frequent conversation sessions with no or limited language skill development. Parents or caregivers of those children receiving thorough information about the study and then they approved it.

A convenience sampling technique was assumed. Parents or caregivers of involved children were interviewed by one of the authors during their visit to the audiology unit to fill out a questionnaire.

Sample size calculation was done using G*power 3.1.9.7 assuming effect size $d=1.01$ α error prob at

0.05 and power of study 80%. The minimal calculated sample size was 44 participants that was increased up to 60 to compensate for missing data. *Study tools:* Parents or caregivers of involved children were invited to complete an interview questionnaire that included two parts; socio-demographic characteristics (age, sex, age of child at implantation, duration of implant use, family history of HL or positive consanguinity, and place of implantation whether private or public), the Parents Perspective Questionnaire (PPQ), developed by the Nottingham Pediatric Cochlear Implant Program at Nottingham University Hospital in Nottingham, United Kingdom, is a validated parent survey that measures children's QoL following cochlear implantation.⁹⁻¹³ The total number of questions in the PPQ was 58, divided into 11 domains, that includes, Decision for implantation domain (7 questions), Process of implantation domain (8 questions), Positive effect of implantation (5 questions), Supporting the child by his family domain (5 questions), Communication domain (5 questions), Self-confidence domain (5 questions),

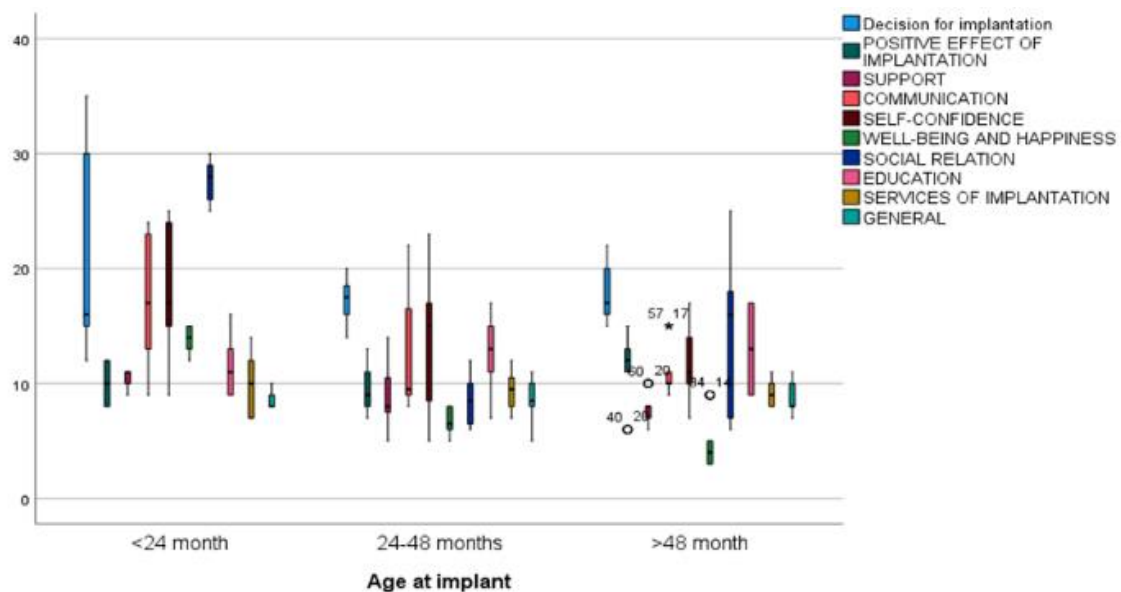


Figure 1: Relation between the age at implantation on Parents' Perspective Questionnaire

Wellbeing and happiness domain (3 questions), Social relationship subscale (6 questions), Education domain (4 questions), Services of the implantation center (6 questions), General functioning domain (4 questions), responses of questionnaire were on 5-point Likert scale, definitely agree, agree, neither agree nor disagree, disagree, and definitely disagree.

Validation of study tool: The Parents Perspective Questionnaire was translated into Arabic using the suggested standards by Guillemin et al. (1993). There were three translators involved: two certified translators with a background in medicine, as well as one of the authors. The back translation was done by two distinct professional translators and another author. The translators were given instructions stressing the significance of carefully and exactly translating the activity stated in the original questionnaire while utilizing literal, understandable Arabic language across all Arabic cultures.¹⁴

Statistical analysis: Using SPSS version 21, data management and statistical analysis were conducted. (IBM, United States, Armonk, New York). Numbers and percentages are used to represent Qualitative data. The median and range were used to define quantitative parameters. For the analysis of continuous dependent variables, the Kruskal-Wallis test was used. The Mann Whitney test was used in several comparisons. Statistical significance was defined as $p < 0.05$.

RESULTS

The study included 60 children (33 males and 27 females) with cochlear implants. The median age of

the studied group was 10 (6-14) for males and 6 (4-11) for female with their age of implantation ranged between 18 months and 56 months with a median= 31.5. Of the studied group, there were 30% participant with positive family history and consanguinity, 10% had other pathological conditions. Three-fourths of the children were in primary school when the study was done, while the remaining children were still in preschool and enrolled in kindergarten with normally growing peers. Children who went to school had stronger social and communication skills than those who did not ($p > 0.05$), but the difference was not statistically significant. 40% of the kids had cochlear devices implants, and 60% of the kids were utilizing MeDEL devices.

A descriptive statistical analysis was performed on the PPQ domains. Additionally, scores of PPQ domains were examined in relation to the age of implantation and the period since implantation. In the comparative analysis between the age at implantation and PPQ, there was a statistically significant difference in the process of implantation, positive effect of implantation, support, communication, self-confidence, well-being, and social relation subscales ($p < 0.001$). (Table 1, Fig. 1) No statistically significant difference was found in the other subscales. Mann Whitney test revealed that there was statistically difference between children who were implanted at earlier age (<24 months) have better QoL especially in support, communication, self-confidence, well-being and social relation sub scales.

The study revealed a statistically significant difference ($p < 0.001$) the implantation process, the positive effect of implantation, communication, self-confidence, well-being, social relations, education, and services of implantation subscales when the relationship between the duration of implant use and PPQ was analyzed. (Table 2, fig. 2). According to the Mann-Whitney test, children who had been using their implant for more than 10 years were superior to those who had been using it for less than 10 years in terms of communication, self-

confidence, wellbeing, social relationships, and implantation services.

Decision for implantation: The study demonstrated that 85% of respondents to the questions pertaining to the decision of implantation subscale stated that they experienced stress in the weeks immediately preceding and following surgery. Additionally, nearly all parents said that when their kids first responded to their voice, it brought them great relief.

Table 2: Relation between the duration of using the implant on the parents' perspective questionnaire

	<6 years	6-10 years	>10 years		
	Median (Min.-Max)	Median (Min.-Max)	Median (Min.-Max)	KW test	P value
Decision for implantation	17 (14-22)	16 (15-19)	18 (12-35)	2.339	0.311
Process of implantation	17 (12-21)	16 (11-19)	17 (13-23)	7.994	0.018
Positive effect of implantation	8 (6-15)	11 (9-13)	10 (8-13)	7.401	0.025
Support	8 (5-14)	8 (6-11)	10 (8-11)	5.542	0.063
Communication	9 (8-11)	15 (10+-17)	21 (14-24)	46.897	<0.001
Self-confidence	10 (5-16)	15 (9-17)	21.5 (17-25)	40.756	<0.001
Well-being and happiness	6 (3-13)	5 (3-15)	12.5 (7-15)	11.881	0.003
Social relation	9 (6-26)	18 (6-29)	26.5 (6-30)	7.974	0.019
Education	13 (7-17)	11 (9-13)	10 (9-17)	7.761	0.021
Services of implantation	9 (7-12)	8 (7-11)	10.5 (10-14)	19.390	<0.001
General Functioning	8 (5-11)	8 (7-11)	8 (8-10)	0.230	0.891

Implantation process: Regarding the impact of implantation, 80% of parents felt that speaking with other families who had children with cochlear implants was helpful. Additionally, 80% of parents said that all of their children used cochlear implants regularly.

Positive effect of implantation: Ninety percent of the parents who responded to the study thought that having implantation will improve the future of their kids.

Support: 85% of parents reported that it is easier to communicate with their child by speaking than by signing.

Communication: 65% of the parents reported that their children fared better than they had anticipated post the cochlear implant procedure. Sixty percent of parents who had cochlear implants said they could communicate with their kids even though they couldn't see them.

Self-confidence: In regard to questions about self-confidence, 75% of parents said that their kids' self-

confidence grew following implantation. While 69% of parents stated that their children were independent like their peers following implantation. *Well-being:* Regarding the wellbeing subscale, 60% of parents stated that their children became less frustrated after implantation. Additionally, 60.1% of parents reported that following implantation, their kids really loved watching TV, playing, and listening to music.

Social relationships: Before the cochlear implant, 60% of parents reported that their children were socially gathering; however, more than tree fourths of the parents observed that their children became more talkative, more socially active and attend family gathering after implantation.

Education: 80% of the parents said that their children were able to keep up with their peers at school following getting a cochlear implant.

Service of the implant center: All parents reported that the implant center provided them with sufficient information about the implant and about surgery.

General Functioning: Of the parents who answered the questionnaire, 90% of parents said their kids never stopped wearing their implanted device after getting used to it. More than 75% stated that they can let their child play outside since they can hear the traffic. All parents reported that their child can hear them when they call out to them.

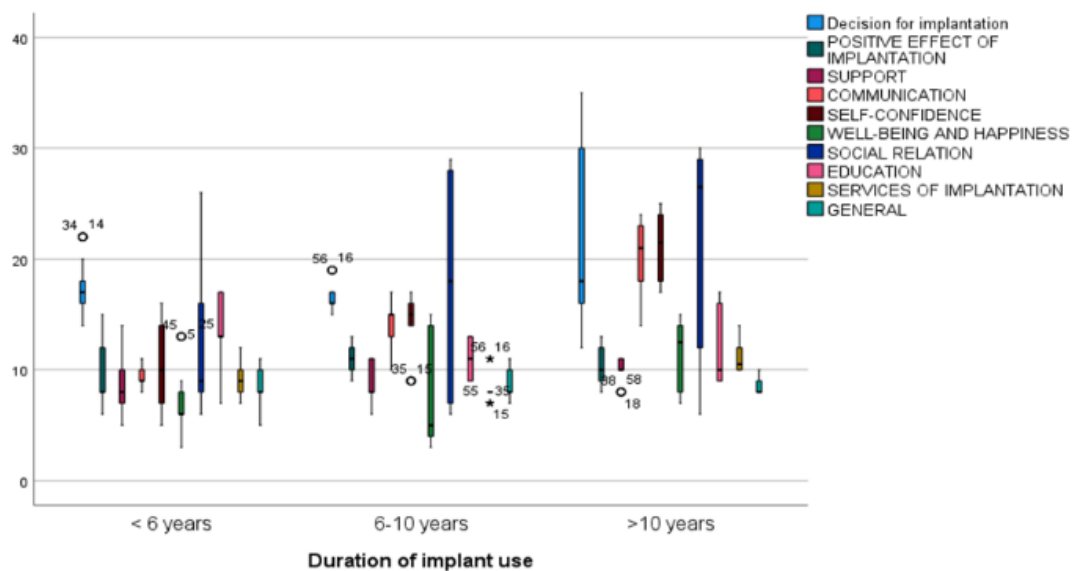


Figure 2: Relation between duration of using the implant on the parents' perspective questionnaire Domains of PPQ

DISCUSSION

The World Health Organization defines QoL as a person's perception of their place in life within the context of the culture and value systems in which they live. Complex relationships exist between a person's physical and mental health, psychological state, personal beliefs, social relationships, and their relationship to salient environmental features.¹⁵ CI has a significant impact on life quality.¹⁶⁻²⁰ Children with severe to profound SNHL who attend mainstream schools after receiving CI achieve social and academic outcomes comparable to those of their classmates with normal hearing.^{21, 22}

This study used the questionnaire from the perspective of parents, As it has the advantage of offering a method relevant to kids of all ages based

on the accounts of persons participating in the process and CI results. Additionally, parents can give details about a range of situations to which their kids are exposed, like school, everyday activities, and the relationship with their families, allowing a description of CI outcomes in kids using a single instrument.^{11,12}

The present study was done in the audiology unit of the hospital of Benha University, where there is no CI center, but patients with CI come to the audiology unit for evaluation of hearing after implantation, and this had the advantage of providing the study with subjects from different centers of CI and not limited to a certain center or hospital. Also, this study included all children with CI due to prelingual bilateral severe to profound SNHL and came to audiology unit during 2022 without any exclusion

criteria for including children with different variables and pathologies one of those children was autistic and other one had metabolic disorder.

This study designed to assess QoL in children with prelingual severe to profound SNHL after cochlear implantation using a questionnaire with multiple domains. Cochlear implants and QoL have been the topic of several studies worldwide. For example, a study conducted in Saudi Arabia using the Paediatric QoL Inventory 4.0 - Generic core scale (PedsQLTM 4.0 - GCS) to compare the QoL of Saudi toddlers and young CI recipients with normal children. According to the study's findings, Saudi children with CI have a similar QoL as healthy kids. Gender, birth order, and distance from the CI centre, however, were found to have distinct effects on the QoL dimensions.²³ in children with CI. This judgement is supported by the present research.

Another study done in Scotland by *Fraser and his colleagues* hat children with severe needs and those without had comparable long-term QoL scores. In this group, there were more challenges and a higher likelihood of continuing medical issues after an early implantation, which could impede progress. The Glasgow Children's Benefit Inventory (GCBI), a validated questionnaire appropriate for the retrospective assessment of health related QoL following paediatric surgical operations including CI, was used to measure QoL.²⁴ This study confirmed routine evaluation of QoL in patients with special needs and cochlear implant.

Parents of 123 children with CIs (mean age, 40 to 45 months; mean CI implantation age, 24.74 months; mean device experience, 16.34 months) were included in the Zhao et al. study. After using CI for 0, 1, 2, 3, 6, and 12 months, follow-up was conducted. A HRQoL questionnaire was used to assess the children's QoL. All HRQoL parts received favourable feedback from parents. Over the first three months of CI use, almost all areas showed rapid development, with education advancing more slowly. This study assessed the value of language rehabilitation by showing that enhancing language rehabilitation may be a successful strategy for raising children with CI's HRQoL. This study also supports CI's crucial advantage.²⁵

In Turkey, a similar study to ours was done using the same questionnaire but selecting children with HL due to auditory neuropathy only. This study concluded that cochlear implantation not only improves hearing but also fosters the growth of

speech and language abilities, improving the patient's QoL. Cochlear implantation in children with auditory neuropathy, from the perspective of parents and enhances QoL in numerous ways. The staff in implant centers should consider the perspective of parents because it can provide a multifaceted appraisal regarding the child's progress.²⁶

A specific study's objective was to assess how CI affected the QoL of kids with profound and multiple learning impairments (PMLD). Due to their typical poor speech and hearing outcomes, this group of kids has previously been seen as a poor candidate for CI. All kids implanted between July 1996 and July 2015 were looked up in the prospectively held database of the Irish National Cochlear Implant Programme. A retrospective analysis of all 381 children's charts revealed that 16 of them fit the requirements for PMLD. The Glasgow Children's Benefit Inventory scores as well as speech and hearing abilities for this patient cohort were retrospectively assessed. Categories of Auditory Performance (CAP) and Speech Intelligibility Rating (SIR) scores, which measure speech and hearing outcomes, showed little to no improvement from pre-implantation to a 3-year interval after surgery. However, 11 out of 16 parents reported an improvement in their child's QoL after implantation, with 3 out of 16 reporting no improvement. This study demonstrates that, despite their poor performance on conventional outcome measures like the CAP and SIR, children with PMLD may experience an increase in their QoL after receiving CI. It also validated the significance of CI for QoL in all children with severe or persistent PMLD.²⁷

Although some studies reported little benefit from CI, all previous studies, other studies, and our study cannot neglect the great effect of CI on language improvement in children with prelingual bilateral severe to profound SNHL and hence improve the QoL for those children.

Limitations: There was some limitation of the study as it was cross section not a prospective follow up study, the study was done at only Benha university hospital instead it was better to choose more than one center. Also, convenience non-probability sampling technique that interfere with generalization of the results.

CONCLUSIONS

Even though varied etiologic causes for hearing loss have led to a variety of results, cochlear implants typically increase communication, self-confidence, wellbeing and social relation, which has a favorable impact on a person's QoL. Additionally, a child's parents will notice a significant shift in their child's life after receiving a cochlear implant. However, many parents are often hesitant while making the decision to implant. Regarding the issues, the implant center staff should undertake a lot of work and accept accountability for giving the child and parents additional help.

Ethical Approval: This study was performed in line with the principles of the declaration of Helsinki. Approval of study was obtained from the ethical committee of Benha Faculty of medicine (No.9-12-2021). Informed consent was obtained from all individuals (parents and/or legal guardian of children for study participation) prior to the interview.

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