

International Encyclopedia of Rehabilitation

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This publication of the Center for International Rehabilitation Research Information and Exchange is supported by funds received from the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education under grant number H133A050008. The opinions contained in this publication are those of the authors and do not necessarily reflect those of CIRRIE or the Department of Education.

Quality of Life Among Cochlear Implant Recipients

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Acknowledgment

I wish to express gratitude to Dr. Janet Jamieson for her editorial help.

Introduction – Cochlear Implants

Cochlear implants are surgically implanted electronic devices that enable individuals with severe-to-profound hearing loss to regain or access some hearing. In sensorineural hearing loss (severe to profound nerve deafness) where there is damage to the tiny hair cells in the cochlea, sound cannot reach the auditory nerve. A cochlear implant is very different from a hearing aid. Hearing aids amplify sounds so they may be detected by damaged ears. A cochlear implant bypasses damaged portions of the ear and directly stimulates the auditory nerve. The cochlear implant does not result in "restored" or "cured" hearing. It does, however, allow for the perception of sound "sensation" and help a person with deafness to understand speech. Hearing through a cochlear implant is different from normal hearing and takes time to learn or relearn.

Today, surgical rehabilitation by cochlear implantation has become a widely accepted routine procedure in cases of severe deafness where conventional rehabilitation with acoustic stimulation is no longer helpful (Tange, Grolman, & Dreschler, 2009). According to data from the National Institute on Deafness and Other Communication Disorders and the Food and Drug Administration, as of April 2009, approximately 188,000 people worldwide have received cochlear implants. In the United States, roughly 41,500 adults and 25,500 children have received them (National Institute on Deafness and Other Communication Disorders, 2009).

The majority of research on the effects of cochlear implants among children has focused on speech and language outcomes. For example, numerous studies have demonstrated the positive benefits of cochlear implants for children's speech perception, speech production, language, and communication (Bat-Chava, Martin, & Kosciw, 2005; Blamey, Barry, Bow, Sarant, Paatsch, & Wales, 2001; Blamey, et al., 2001; Connor, Hieber, Arts, & Zwolen, 2000; Geers, Nicholas, & Sedey, 2003; Geers, 2004; Kluwin & Stewart, 2000; Svirsky, Robbins, Kirk, Pisoni, & Miyamoto, 2000). Recently, researchers also demonstrated benefits for children in terms of their social competence (Bat-Chava & Deignan, 2001; Bat-Chava & Martin, 2002; Bat-Chava et al., 2005; Christiansen & Leigh, 2002), reading ability (Tomblin, Spencer, & Gantz, 2000), and academic achievements (for review, see Fagan, Pisoni, Horn, & Dillon, 2007). In adult patients the majority of research has focused on speech and music perception and functional use of auditory skills such as telephone use (e.g., McDermott, 2004; Ramsden, 2002). In general, much

of the current literature has suggested that cochlear implants have a large positive impact on recipients' lives, especially for improving communication. However, great variability remains between individual outcomes (Bat-Chava et al., 2005; Geers, Brenner, & Davidson, 2003; Purdy, Chard, Moran, & Hodgson, 1995; Ray, Wright, Fielden, Cooper, Donaldson, & Proops, 2006; Sach & Whynes, 2005; Spencer, 2004; Spencer & Marschak, 2003; Svirsky et al., 2000; Wilson & Dorman, 2008). For example, while some cochlear implants recipients may obtain only an increased awareness of environmental sounds, others achieve open-set speech recognition, telephone use, and can integrate easily into the hearing world. This variability indicates that children and adults may continue to demonstrate hearing, communication, and psychological difficulties after cochlear implantation. Some factors that have been linked to variability in outcomes include age of implantation, duration of sensory deprivation, duration of implant use, mode of communication, prior to implantation the child's general developmental potential, the anatomy and physiology of the inner ear, technological and surgical factors, quality of rehabilitation, and availability of education and assistance. Nevertheless, there are no known definite pre-surgical predictors of post-surgical performance in cochlear implant recipients (Hamzavi, Baumgartner, Pok, Franz, & Gstoettner, 2003).

Quality of Life in Cochlear Implant Research

In recent years, there has been a growing interest in the inclusion of more holistic outcome measures, such as quality of life (QOL), in order to capture the influence of cochlear implants on children and adult recipients. The need for more holistic evaluations have emerged as traditional clinical outcomes, such as speech perception or economic evaluation, fail to capture the whole range of ways in which a cochlear implant may influence recipients' everyday experiences such as social interaction, school adjustment, employment and other constituents of QOL.

QOL is conceptualized as a broad assessment of well-being across various domains. However, QOL is a broad concept and there seems to be no consensus on its definition nor measurement (Hallberg, Ringdahl, Holmes, & Carver, 2005; Moons, Budts, & De Geest, 2006; Skevington, Lotfy, & O'Connell, 2004). In essence, QOL is about the meaning that people attribute to and derive from the important aspects of their life; thus it is a social construction and highly individualized. The World Health Organization's definition of quality of life states that it reflects "an individual's perceptions of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns" (Williams, 2000). In the health literature, the concept of QOL is often used interchangeably with the term 'health related QOL' (HRQL). HRQL is generally understood as a multi-dimensional construct concerning an individual's perception of the impact of a health condition and related treatment on his/her health, well-being or functioning in relation to physical, psychological, and social aspects of life (Eiser & Morse, 2001; Varni & Burwinkle, 2005). HRQL provides a mechanism to evaluate the impact of a health-related condition such as hearing loss or cochlear implantation on children's and adults' daily life (Brouwer, Maille, Rovers, Grobbee, Sanders, & Schilder, 2005). It should be noted that although the term QOL is sometimes used interchangeably with HRQL, QOL is actually a broader construct that encompasses aspects of life which are not amenable to health care services. Thus, HRQL has emerged as the most appropriate term for QOL health dimensions which are within the scope of health care services (Food and Drug Administration, 2006).

Measurement of quality of life

According to all approaches to HRQL, the assessment of the individual concepts forming these dimensions can be done only by subjective measures. Evaluation of HRQL means asking a person directly, or if the person is unable to make a coherent response, then asking a relative, friend, or close observer (i.e., a proxy). The literature on HRQL includes both generic and condition-specific instruments. Generic instruments are designed to collect information on healthy as well as ill children/adults at the population level or in clinical practice, and allow for the comparison of HRQL across different conditions and settings and between healthy and ill children/adults (Bjornson & McLaughlin, 2001). Alternatively, condition-specific instruments are designed to be applicable to one group (i.e., individuals with a specific illness) that tends to be more sensitive to associated treatment-related changes (Bjornson, et al., 2001).

The aim of this chapter is to review the research examining the effect of cochlear implants on health-related QOL among three age groups of recipients: children, adults and the elderly. The review is limited to studies conducted within the last 10 years.

Children with cochlear implants HRQL

Research on the HRQL of children with cochlear implants is mostly focused on the following broad issues: (1) the effect of cochlear implants on improvement in children's HRQL; (2) HRQL of children with cochlear implants in comparison to their hearing peers; and (3) the factors that can explain variability in children's with HRQL, an examination of the association between HRQL and other relevant outcomes. These research questions also have implicit measurement considerations, including whose perspective should be assessed (parents or children) and whether a condition-specific or generic measure should be used. I will review the existing research, taking into account these research questions and measurement considerations.

Quality of life among children with cochlear implants: Condition-specific measures

Chmiel, Sutton, and Jenkins (2000) examined improvements in children's HRQL as a result of cochlear implantation. They assessed the HRQL via condition-specific items concerning the relative benefits and problems associated with implant use, the child's behavior, and social activities. Eleven parents and their children with cochlear implants (age range 6–20 yr) reported both significant improvements in the child's HRQL and minimal negative effects of the cochlear implant. When parents rated the items, the areas rated as having the greatest benefit were hearing environmental sounds, speech perception, and speech production. Overall communication skills, the child's sense of safety, self-esteem, vocabulary or language skills and relationship with family were all rated as a benefit for the child. In addition, child and parental responses were consistent. However, children rated making new friends more positively than parents, peer acceptance less positively than parents; and overall problems less positively than parents. All of the children reported that the implant helped them to 'feel happier.' Any child-reported displeasure associated with the implant was usually related to the awkwardness of managing the external equipment. Overall, parents and children found the implant to be 'a lot of help,' and the ability to hear environmental sounds was held to be the greatest benefit by both groups.

Chmiel et al.'s questionnaire was also used in a recent study (Schorr, Roth, & Fox, 2009). Similar to Chmiel et al.'s findings, children indicated significant improvement in HRQL in terms of their improved ability to hear and to communicate, to handle social interaction, and in their ability to participate in extracurricular activities. They experienced some problems with regard to loud environmental sounds and from conflict with their parents over when to use the cochlear implant. When examining variability in HRQL, it was found that the HRQL was higher when children were younger at the time of implantation and used the device for a longer period. Interestingly, children's perception of their HRQL was not associated with their speech perception performance, but at the same time was related to their ability to identify positive and negative emotions based on affective sound information.

Moving away from purely quantitative studies that examined the outcomes of cochlear implantation via closed questionnaires, qualitative studies focus on the subjective perceptions of quality of life and other psychological issues through open-question interviews. In their qualitative study, Wheeler, Archbold, Gregory & Skipp (2007) interviewed a group of 29 young people aged 13–16 years about the impact of cochlear implantation on their lives. They concluded that the young people in this group felt positive toward their cochlear implants and that they were happy to recommend the procedure to others. The majority felt that the cochlear implant helped them learn at school, but at the same time reported some negative school-related experiences. Many of the youth were found to have a flexible attitude to communication modes and an identity that was not fixed in terms of conventional descriptors. The advantages of the cochlear implants to the young people were many and varied.

Another widely used approach to gain understanding of children's HRQL is to ask their parents. Sach and Whynes (2005) interviewed 216 families of children who received cochlear implants. One of the topics parents were interviewed about was their perceptions of the consequence of the procedure in terms of the impact on their child's quality of life. Findings indicated that improved hearing was the most-commonly cited outcome of the procedure; this was noted in 93% of the interviews. Most of the parents (86%) voiced the opinion that improved hearing had led to improved personal safety. Beyond hearing improvements, parents commented extensively on the positive psychosocial development of their child. Moreover, many (41%) felt that the cochlear implant had improved their child's ability to communicate with and relate to other people. In addition, parents (31%) felt that their children's confidence and independence increased. Parents also perceived that increases in confidence facilitated fuller integration into social groups. Negative aspects identified included: children becoming distressed following device failure and the implantation as a potential source of manipulation. Some parents believed that the improvement in hearing, which the child experienced, created in the child an awareness of disability.

In another qualitative work, Archbold et al., (2002) explored parental perceptions of their child's outcomes following cochlear implantation and the implantation process. In this study, improvement in children's HRQL was reflected in an increase in the children's confidence and communication ability. Based on their qualitative work, Archbold et al. developed the Parents Views and Experiences with Pediatric cochlear implantation questionnaire (PVEIQ). The PVEIQ is a closed-format questionnaire containing 10 domains that broadly capture parental perceptions of their child and the implantation process. The PVEIQ was designed to be a measure of parental

perceptions and not a direct measure of HRQL, including only five of the instrument's domains relevant to pediatric HRQL including: communication, general functioning, self-reliance, well-being and happiness, and social relationships (Lin & Niparko, 2006). Other studies, in which the PVEIQ was used, included samples from diverse countries (i.e., UK, Turkey, Finland). Findings indicated that, overall, parents were largely satisfied with the outcomes (Archbold, Sach, O' Neill, Lutman, Gregory, 2008; Huttunen et al., 2009; Incesulu, Vural, & Erkam, 2003; Nicholas & Geers, 2003). In these studies, parents reported improved communication in the family, and also indicated that their children developed greater confidence, were more independent, and greatly developed their spoken language. Moreover, parents stated that their children did not need greater parental support than prior to implantation and the support parents were now giving was more productive. With parental reports of significant changes in confidence, the majority of children were considered as independent as most children of the same age, being able to amuse themselves. However, parents continued to report on existing concerns, such as their children's future education, children's ongoing frustrations, the pace of their child's progress, and the need for parents to adjust their expectations for outcomes following implantation. The results of these studies reflect parents who, on the whole, reported improvement in children's HRQL specifically in terms of children gaining benefit in communication, social relationships, and self-confidence.

Examination of the association between children's HRQL on the PVEIQ total score and other outcome measures indicated that parents' ratings of their views and experiences regarding cochlear implantation were significantly positively related to outcome scores in speech perception, speech production, oral language and total language, and reading. Huttunen et al. (2009) found associations between speech recognition and PVEIQ social relations scale, but no other correlations were found between PVEIQ sub-scales and speech perception or functional hearing in everyday life scores.

Using parents as the reporters, Beadle, Shores, & Wood (2000) examined parental perceptions of quality of life within the family during and after the cochlear implant process. In a self-constructed questionnaire, they asked parents of implant recipients to rate the current quality of life of their child as reflected in independence, communication, happiness and satisfaction, and also asked questions about their own satisfaction and that of the family as a whole. On a scale from 1 to 10, with the higher number reflecting greater satisfaction, the mean ratings were 7.9 for the child, 7.8 for the parents, and 7.1 for the family, reflecting a generally positive view of current quality of life in these three areas.

Recently, several researchers have examined the implant's implications for HRQL among children with both hearing loss and additional disabilities such as Ushers Syndrome (Damen, Pennings, Snik & Mylanus, 2006) or Autism Spectrum Disorder (Donaldson, Heavner, & Zwolan, 2004). Damen and colleagues (2006), using two proxy condition-specific quality of life measures (i.e., the Nijmegen Cochlear Implant Questionnaire (NCIQ) and the Ushers Lifestyle Questionnaire (ULS)) reported that implanted children with Ushers Syndrome Type I (N = 7) showed improved auditory and social functioning as reported via the NCIQ, as compared with children with Ushers Syndrome who did not receive cochlear implants (N = 2). However, the results of the ULS were similar between groups and more difficult to interpret because of the small sample size. Donaldson et al. (2004) examined speech and language outcomes before and after cochlear implantation for six deaf children with Autism, as well their parents' subjective

impressions of the benefits of cochlear implants. Survey results suggested gains in responsiveness to sound, interest in music, vocalization, and eye contact following implantation. Five of the six families indicated that they would recommend a cochlear implant to other families in a similar situation. Through interviews with parents of children with additional special needs, Wiley, Jahnke, Meinzen-Derr, & Choo (2005) found that although not all of the children gained excellent speech and language outcomes, all children broadened their communication skills and interaction inside the family.

Quality of life among children with cochlear implants: Generic measures

In order to compare the HRQL of children with cochlear implants to the HRQL of their hearing counterparts, there is a need to use generic measures. A group of studies compared the HRQL of children with cochlear implants to that of their typical-hearing peers, and also examined whether parents and children have similar perceptions of the children's HRQL. In all three studies the KINDLR, a generic HRQL questionnaire, suitable for children between the ages of four and sixteen years, and a corresponding parental questionnaire served as assessment tools.

In the first study, Huber (2005) found that children (8 - 12 yr) reported significantly lower HRQL in comparison to their parents and lower scores than their hearing peers. In contrast, adolescents scored similarly to their parents and hearing peers on all subscales and total overall HRQL scores. Moreover, as children had higher capability to hear and understand spoken language they also experienced higher HRQL. At the same time, no associations were found between parents' assessment of HRQL and children's capability to hear and to understand, age at implantation, duration of implant experience, and children's chronological age. Among adolescents, parents' ratings of HRQL were positively associated with age of implantation, and adolescent self-rating was positively associated with years of deafness.

In the second study, Loy, Warner-Czyz, Tong, Tobey, & Roland (2010) found that children's and adolescents' evaluations of their overall HRQL did not differ from that of their hearing peers. However, examination of individual subscales revealed that 8- to 11-year-old children with cochlear implants rated their HRQL on the family sub-scale less positively in comparison to children with normal hearing. Moreover, adolescents with cochlear implants tended to rate their HRQL less positively than did their hearing peers on the friends and the school sub-scales. Moreover, younger cochlear implants recipients rated their overall HRQL more positively than did adolescents with cochlear implants. With regard to the concurrent HRQL evaluation between parents and children, findings demonstrated that parents and children with cochlear implants of both age groups agree on overall QOL. At the same time, parents of 12- to 16-year-old children with cochlear implants overestimated their adolescent's success in school relative to their children's self-assessment. In addition, only among the adolescent group, earlier age of implantation and longer cochlear implant use were associated with higher quality of life scores.

In the third study, young children (4 to 7 yr old) rated their overall HRQL more positively than their parents, but similarly to children with normal hearing (Warner-Czyz, Loy, Roland, Tong, Tobey, 2009). It was also found that the younger the children and the shorter the duration of cochlear implant experience, the higher they tended to rate higher their quality of life.

Using a different generic parental survey that focuses on children's social well-being related to kindergarten/school, Percy-Smith, Caye-Thomasen, Gudman, Jensen, & Thomsen (2008) found that children with cochlear implants were rated significantly higher on questions about well-being in kindergarten/school and that boys with cochlear implants appeared to manage school work better than typical-hearing boys, according to their parents' perceptions. Moreover, children with cochlear implants were rated as more active and less likely to bully other children than their normal-hearing peers, whereas no difference existed in terms of being bullied by other children. The two groups of children scored similarly on being confident, independent, social, not worried, and happy.

In summary, research on the HRQL of children with cochlear implants indicates improvements in children's quality of life with minimal negative effects. Consistent with the HRQL definition, children experienced improvement in relation to physical, psychological, and social aspects of life. Specifically, children and their parents across studies reported improvement in hearing, speech and communication skills, in children's social relationships, personal safety, and self-confidence. In addition, comparing the HRQL of children with cochlear implants to their hearing peers indicated inconsistent results across different age groups. However, overall children with cochlear implants tend to have similar rating of HRQL to their hearing peers. Based on the review, I have outlined some suggested recommendations for clinicians/professionals working with children with cochlear implants and their families:

- The existing inconsistency in the association between speech perceptions and production and children's HRQL emphasizes the importance of measuring a broad range of outcomes following cochlear implantation beyond objective audiological outcomes.
- The review draws attention to both similarities and differences between parent proxy reports and children's self-reports on HRQL. Parents may underestimate children's quality of life in relation to their psychosocial functioning but have a more precise estimation with regard to their physical well-being. This points to the importance of considering both perspectives in the evaluation of HRQL, at least from the time children reach school age and are able to provide self-reports.
- Although HRQL generic measures have the benefits of comparing children to their hearing peers, condition-specific measures may be more responsive to clinical changes during rehabilitation. However, both types of measures as well as qualitative approaches can assist clinicians and professionals to focus on the child and family's subjective experience, rather than the condition itself, and can support treatment, planning, and clinical decision making.
- It should be noted that more psychometric work is needed in the area of cochlear implant HRQL measurement. For example, more work is needed to identify the dimensions of functioning that are relevant for children and adolescents with cochlear implants and the development of measures that would take into account developmental changes that occur in children (in other words, developing measures that would have age-related versions).

Adults with Cochlear Implants: HRQL

Research on HRQL among adults with cochlear implants, similar to the research among children with cochlear implants, stems from the need to examine the broader implications of cochlear implants beyond their audiological benefits, which are mostly determined in clinical settings. However, few substantial differences exist between these two bodies of research. First, in contrast to research on children, the literature on adults' HRQL has the advantage of including a comparison group of either adults with hearing aids with the same hearing levels and/or adults who are on the waiting list for cochlear implantation. Second, research on adults often makes the important distinction between cochlear implant recipients who are prelingually deafened adults (i.e., they have never experienced auditory input) and ones who are postlingually deafened adults (i.e., where hearing loss is adventitious and develops after the acquisition of speech and language). This group distinction is important as it has been reported that prelingually deafened adult who use cochlear implants have poorer outcomes than postlingually deafened adult recipients (e.g., Waltzman, Cohen, & Shapiro, 1992; Zwolan, Kileny, & Telian, 1996). Hence, it might be that their daily subjective and contextual experiences are different as well. Finally, the literature on children mostly relied on proxy accounts from parents in HRQL assessment and hence the children's own views are generally underrepresented. In contrast, adults have the ability to self-report on their own subjective experience, which has been considered the standard for measuring perceptions of HRQL. Finally, research on adults with cochlear implants has mainly focused on speech perception, as representing an objective clinical outcome. Studies on HRQL have the contribution of focusing on speech perception outcomes in conjunction with the subjective experience of the recipients themselves.

One of the frequently used 'disease-specific' questionnaires that has been used to specifically address HRQL in cochlear implant adult recipients is the Nijmegen Cochlear Implant Questionnaire (NCIQ) developed by Hinderink, Krabbe, & Van Den Broek (2000). The NCIQ addresses three general domains: physical (as related to communication), social, and psychological functioning. The physical domain has three sub-domains including basic sound perception, advanced sound perception and speech production. The social domain consists of two sub-domains including activities and social functioning and the psychological functioning domain addresses only self-esteem.

Hinderink et al. (2000) compared ratings of postlingually deafened adults with cochlear implants (n=46) to those who were on the waiting list for cochlear implants (n=45). It was found that cochlear implant recipients scored better than non-implantees in the basic and advanced sound perception sub-domains. In addition, differences in the other four sub-domains were smaller, but still significant. Similar findings were also reported by Cohen, Labadie, Dietrich, & Haynes (2004) who found greater HRQL benefits in cochlear implants users than hearing aids users across the physical, psychological, and social sub-domain. When ratings were compared pre- to post-intervention both hearing aid users and cochlear implant users improved HRQL, however, the change in HRQL was greater in the cochlear implants recipients; they had twice as much improvement in their overall HRQL scores.

In other studies, the NCIQ was administered retrospectively in a pre and post format, or over time pre- and post-implantation. Hirschfelder, Gabel, & Olze (2008) examined retrospectively the change in HRQL among 56 postlingually deafened adult with cochlear implants. Results

showed significant improvements in both the total scores of the NCIQ and the subdomain mean scores. Findings also demonstrated that the NCIQ was significantly positively correlated with recipients' speech perception and speech production scores, and with duration of having the implant. Akin to the Hirschfelder et al. (2008) study, Klop, Boermans, Ferrier, van den Hout, Stiggelbout, & Ferrier (2008) also compared postlingually deafened adults with cochlear implants preoperatively, 4 months preoperatively, and 12 months preoperatively, using the NCIQ in conjunction with a generic health status measure. Findings demonstrated clinically relevant HRQL benefits, with differences pre- to post-implant being significant in all NCIQ sub-domains and in most recipients on the sensation domain of the health status measure. In addition, improvements in speech perception performance were also reported. Constant benefits over time were also reported in a long-term follow-up study of postlingually deafened adults with and without cochlear implants using the NCIQ (Damen, Beynon, Krabbe, Mulder, & Mylanus, 2007). Beneficial effects were also reflected on generic quality of life measurements, specifically the Medical Outcome Study Short Form (SF36) and the Health Utility Index (HUI3). In addition, similar to Klop et al., (2008), cochlear implant recipients also demonstrated improvements over time in their speech perception performance.

Klop, Briare, Stiggelbout, & Frijns (2007) also used the NCIQ to study QOL outcomes in prelingually deafened adult cochlear implants recipients. In their study, they looked at the effects that cochlear implants had on the speech perception and HRQOL of eight prelingually deafened adults. QOL scores were evaluated pre- and post-implantation at periods of 4 to 5 months, 12 months, and 30 months following implantation. It was found that while speech perception scores among participants differed over time for the NCIQ, there were significant improvements for the basic sound perception sub-domain, advanced sound perception, and social interaction sub-domains.

In sum, the result of the studies cited above suggest that cochlear implants can have a significant positive impact on HRQL for physical, psychological, and social functioning in both postlingually and prelingually deafened adults over time and in comparison to deaf adults who are using hearing aids. Improvements in HRQL were consistent with speech perception outcomes; however, benefits are still reported even when speech perception outcomes are varied.

Using another condition-specific questionnaire, Castro, et al. (2005) asked 30 cochlear implants recipients to complete a "specific questionnaire" that evaluated six different aspects relating to cochlear implants: verbal discrimination, social relationships, use of the telephone, self-confidence, family life, and satisfaction. Respondents were asked to retrospectively rate the situation for one month before surgery and then post-implant. It was found that benefits obtained from the implant allowed cochlear implant recipients to undertake certain tasks such as telephone conversations and to participate in social activities with greater comfort. In addition, respondents completed the Glasgow Benefit Inventory (GBI), which evaluated the changes that cochlear implants produced in different aspects of life, including: general, social, and physical. For the GBI, the average overall HRQL benefit from pre- to post-implant was greatest for the general subcategory, followed by social and physical.

Chee, Goldring, Shipp, & Chen (2004) also used an open-ended questionnaire to investigate perceptions of benefits and shortcomings of cochlear implants among 30 early-deafened adult

recipients. Findings indicated that the majority of patients used their cochlear implants throughout all their waking hours, and continued to depend on lip-reading and hearing as their main modes of communication. Patients reported greater independence, a greater sense of safety in their environment, and an improved social life following implantation. Moreover, the majority of recipients (96.7%) said that they were satisfied with their implant and that the cochlear implant had had a positive effect on their quality of life. Importantly, family and peer support, prior auditory-verbal therapy, and a positive attitude were considered important factors in maximizing this benefit.

Although some researchers who examined the effect of cochlear implantation on HRQL assessed employment status (e.g., Chee et al., 2004), they did not specifically look at how cochlear implantation affects the employment experience and career-related perceptions of the recipients. This is surprising in light of the fact that in adulthood everyday experiences such as employment and social interaction in the work place have a major impact on peoples' quality of life. In one study that examined the effect of cochlear implantation on adults' employment (Fazel & Gray, 2007) participants reported an overall improvement in employment life, increased job satisfaction, more confidence in the workplace, and greater chances of promotion or career advancement. On the other hand, around 50% of the participants felt that they had either missed out on a promotion or suffered a career setback prior to the cochlear implantation.

Using more generic questionnaires, Hogan et al. (2001) compared the effect of cochlear implants on the social, psychological, physical, emotional and hearing handicap levels between 148 implantees and 54 non-implantees with similar levels of hearing loss. Hogan et al. used two questionnaires: the Assessment of Quality of Life instrument (AQoL), which is a generic measure of quality of life that addresses broad aspects of quality of life (including aspects of independent living, social relationships, physical senses, and psychological wellbeing) and the Participation Scale (PS), which was derived from the Glasgow Health Status Inventory (Gatehouse, 1997, as cited in Gatehouse (2001) and addresses psychological and social wellbeing, emotional factors, and hearing handicap. The comparison between implantees and non-implantees for the PS showed that cochlear implants recipients overall scored better. In addition, cochlear implant recipients scored higher in the areas of self-esteem and social interaction, and scored lower for hearing handicap. However, for the AQoL the only significant difference was in the physical senses domain.

In contrast to studies that looked at the effect of cochlear implantation on HRQL by means of questionnaires, a limited number of studies used a qualitative method. This qualitative work aimed to originate a complete understanding of how deaf adults with cochlear implants view the effect of these devices on their lives, with an interest in capturing the subjective meaning and experiences of living with a cochlear implant.

Hallberg & Ringdahl (2004) conducted a grounded theory qualitative study in which they interviewed 17 participants, aged 29–78 yr, who had received a cochlear implant, where the majority of participants were postlingually deaf. Their interview protocol concerned the life situation before the cochlear implantation, the decision to undergo surgery, what living with a cochlear implant means, and the present life situation and thoughts about the future. Six categories emerged from the analysis, forming a conceptual model showing the process and the

subjective meaning of living with a cochlear implant. Overall, findings support the notion that cochlear implants provide substantial improvement in the quality of life. The core meaning of getting a cochlear implant referred to psychological and existential dimensions rather than to speech perception and communication benefits only. The participants reported that having a cochlear implant means being able to leave the world of silence and be a part of the living world. Sound awareness and hearing background sounds contribute to feelings of being involved and integrated in everyday social life and to related feelings of social connectedness. When the cochlear implant was finally connected to the processor and participants were involved in an intensive training process, they reported feeling excited about being connected with the surrounding world developing psychological security and strength. It was evident that the cochlear implant contributes to increasing confidence, higher self-esteem, a greater sense of self-worth, a stronger sense of connection to the living world, and more involvement in social life.

In a recent descriptive qualitative study, Rembar, Lind, Arnesen, & Helvik (2009) used an open-ended questionnaire that focused on psychological well-being as the definition of quality of life. In addition, they examined the general benefits and shortcomings of cochlear implants. Overall, recipients perceived improvements in their psychological well-being. Approximately 76% of the subjects stated that the implant had only positive effects on their psychological well-being and an additional 13.5% indicated both positive and negative effects. Recipients indicated that they had acquired ‘a new life’ with the implant, which indicates a global effect of the cochlear implant. Specific issues that influenced this global effect of ‘a new life’ included changes in recipients’ interactions with the world around them, their experience of themselves, their ability to hear the world around them and certain device-related issues. In general, the reported shortcomings and negative effects on psychological well-being in most cases were issues that were not directly affected by the cochlear implant (i.e. areas that the implant had made bad or worse).

In sum, most commonly, it has been found that cochlear implants improve the HRQL among both prelingually and postlingually deafened adult recipients. Based on cochlear implant user subjective reports, it seems that cochlear implants provide better sound perception; facilitate greater communication abilities; and improve psychological aspects including increased safety, increased social participation, confidence, independence, and better opportunities in the work place. However, it should be noted that there is much variability between individuals, and the impact of cochlear implants on the daily lives of adult recipients is yet to be fully explored.

Elderly Persons with Cochlear Implants: QOL/HRQOL

Whereas 0.3% people age 16-60 years old experience severe to profound hearing loss, 2.3% of people 61-80 years old and 17% of people over 81 years old experience severe to profound hearing loss (Davis, 1995), increasing the demand for cochlear implants among older adults. Implant programs are gradually required to provide services for more and more elderly individuals as potential implant recipients, in light of the changing life expectancy in the developed world, coupled with the fact that the prevalence of hearing loss increases with age. At the same time, over the last two decades, much of the cochlear implant research has little reference to cochlear implantation outcomes in the elderly. It is importance to note that the age definition of the “elderly group” varies across different studies, as does the measurement approach. In addition, it appears that changes in HRQL following cochlear implantation were not

expected to include improvement in general physical health and/or other domains that do not have ontological relevance.

Studies examining HRQL of elderly cochlear implant recipients most commonly compare this group's HRQL with either a younger adult implants recipients group or their own HRQL before and after the cochlear implantation. Djalilian, Smith, King, & Levine (2002) developed a condition-specific HRQL questionnaire that assesses implant use, communication, and HRQL. When compared with younger adult patients, cochlear implant recipients older than 60 years showed no difference in hours per day of implant usage, in their ability to discriminate environmental sounds from human voices, or in their ability to communicate via the telephone. In addition, the majority of elderly recipients reported improved social life, confidence, and overall HRQL after cochlear implantation. In a more recent study, using validated HRQL questionnaires for hearing loss, Vermeire, Brokx, Wuyts, Cochet, Hofkens, & Van de Heyning (2005) compared the quality of life of 64 younger adult recipients with 25 patients implanted at age 70 years or older, all of whom were postlingually deaf. HRQL assessment included the Hearing Handicap Inventory for Adults (HHIA), the Glasgow Benefit Inventory (GBI), and the scale for the prediction of hearing disability with sensorineural hearing loss. Results indicated that even though the postoperative audiologic performance of the geriatric population was significantly lower than for the younger age groups (although it still led to useful hearing) the HRQL outcomes on all measures were similar across the groups. Furthermore, elderly recipients reported a significant improvement in the HHIA total score before and after implantation, as well as in the emotional and situational subscales before and after implantation. Using the GBI, which assesses the intervention effects on the health status of the patient, the total score, as well as the general and the social subscales, showed a significant benefit of cochlear implants. However, the physical subscale, which assesses general medical problems, did not show an influence due to cochlear implantation. In sum, the results of this study prove that cochlear implantation in the elderly provides improvements in HRQL similar to those found in younger adult cochlear implant recipients. Similarly, Orabi, Mawman, Al-Zoubi, Saeed, & Ramsden (2006) in a retrospective comparative study, found improvements in the quality of life among a group of 34 cochlear implant recipients aged 65 years and over using the Glasgow Health Status Inventory (GHSI) and Glasgow Benefit Inventory (GBI) as Vermeire, et al. (2005) used. Specifically, there were significant improvements in all aspects of HRQL except in the physical health aspect. Furthermore, elderly recipients had realistic expectations for their cochlear implants, and a majority of them were completely satisfied with their outcomes.

When the relationship between HRQL and other speech measures was examined, it was found that improvements in speech perception were predictive of gains in HRQL and associated with emotional benefits after cochlear implantation (Francis, Chee, Yeagle, Cheng, & Niparko, 2002). However, Vermeire et al. (2005) found unclear patterns of correlations between speech recognition and the HRQL measures. These findings highlight that subjective and more objective measures can provide different perspectives.

In conclusion, the above mentioned studies indicate that overall, cochlear implants improve elderly patients' HRQL, and these improvements are comparable to the benefits that younger adult recipients experience. It seems that despite age-related changes in the auditory system and

prolonged duration of deafness, cochlear implantation for individuals in the over 65 years of age group present HRQL benefits.

Overall Summary

The current reviews support the notion that cochlear implants have been highly successful for those with severe to profound hearing losses and tend to result in improved HRQL. At the same time, adults, children, and elderly adults who received cochlear implants demonstrate wide variability in their outcomes; they have to participate in rehabilitation, and might face challenges in their daily lives as related to their hearing loss. It is important to remain objective and realistic when providing information to potential recipients and their families. Despite significant research, outcomes are varied and still there is no reliable and accurate pre-surgical predictor of post-surgical performance in cochlear implant recipients that would allow clinicians to confidently predict how prospective candidates how will do with the implant (Zeng, 2004). It is important to incorporate an evaluation or framework of quality of life in cochlear implant rehabilitation centers, as quality of life is a multi-faceted construct that provides rich information about the recipients' personal experiences in their in daily life across various domains of functioning. As such, information about quality of life can provide useful information to professionals in order to support children and adults who undergo cochlear implantation and their families.

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