

## CLINICAL STUDY

# Quality of life after cochlear implantation in children in Slovakia

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**ABSTRACT**

**BACKGROUND:** Cochlear implantation (CI) is the method of choice for treating severe and profound hearing loss in children.

**OBJECTIVE:** To obtain and evaluate the quality of life of children after cochlear implantation and to compare the results with those of a normal-hearing (NH) control group.

**METHODS:** Cross-sectional, observational design in a university-based ambulatory paediatric otolaryngology clinic. Participants included 40 subjects (21 parents of children after CI, 11 children after CI, 21 parents of normal-hearing children and 23 normal-hearing children). The children were between 3 and 17 years of age. Those participants who could not be contacted by telephone, did not provide all of the data in the database, did not answer the questionnaires completely or had an explantation of the cochlear implant in their anamnesis were excluded. A questionnaire aimed at the generic quality of life was sent to all participants, including children with implants and their parents, as well as normal-hearing children and their parents. The statistical analysis was performed using the IBM SPSS program.

**RESULTS:** The questionnaires were anonymous. The only statistically significant differences within the subscales were seen in the group of parents of children aged 7–13 years. The parents of children with implants scored significantly higher in the 'Family' domain than the parents of the normal-hearing children ( $p = .003$ ), suggesting that from the parental point of view, the situation at home is considered better in families of a child with an implant, as the family is a safe place for them, and the implant is considered a normal component of their life.

**CONCLUSION:** The total quality of life score did not significantly differ between the group with cochlear implants and the normal-hearing group. Therefore, the analysis demonstrates that the hearing quality does not seem to negatively influence the quality of life in children with cochlear implants (Tab. 5, Fig. 2, Ref. 9). Text in PDF [www.elis.sk](http://www.elis.sk)

**KEY WORDS:** cochlear implantation in children, quality of life, KINDLR, SSQ12, Slovakia.

**Introduction**

Cochlear implantation is the method of choice for treating severe and profound hearing loss in children. The first working cochlear implant was invented by the physician André Djourno and otologist Charles Eyriès in 1957 and was composed of a single implanted electrode (1). In 1990, the Food and Drug Administration (FDA) in the USA approved the use of cochlear implantation methods in children (2).

Quality of life (QoL) is a term which is hard to define in a single sentence, but generally one can say that the most important factors influencing QoL are a person's constitution, self-esteem and satisfaction with life, relationships in social surroundings as well as the ability to cope with everyday life tasks (3). Childhood

is one of the most important life phases when it comes to personality and self-esteem development.

Many studies have proved that CI brings a great benefit when it comes to hearing and language improvement and therefore also to better communication (4) but not as many studies have evaluated QoL after cochlear implantation in children. In 1994, prof. Monika Bullinger developed a device for measuring the quality of life of children and adolescents – the KINDLR questionnaires for children and adolescents. The questionnaire was revised by prof. Ulrike Ravens-Sieberer and Monika Bullinger in 1998. The aim was to generate a short, flexible, and methodically adequate instrument for children as well as their parents (5).

**Material and methods**

Cross-sectional, observational design in a university-based ambulatory paediatric otolaryngology clinic. The study was approved by the local ethical committee.

*Participants*

The study subjects (CI group) were recruited from a population of patients after cochlear implantation (CI) performed at the

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Department of Paediatric Otorhinolaryngology MF CU and NICD in Bratislava, Slovakia, who were born between 11/2006 and 11/2017. Informed consent was obtained prior to their participation in the study. Those participants who could not be contacted by telephone, did not provide all of the data in the database, who did not answer the questionnaires completely or had an explanation of the cochlear implant in their anamnesis were excluded.

Healthy normal-hearing subjects (NH group) aged 3–17 years (born between 11/2006 and 11/2017) were also recruited to participate in the study. Participants with a previously diagnosed hearing loss were excluded. These issues were screened by asking the parents about the results of their newborn’s hearing screening tests (normal OAE), other previous hearing tests, use of hearing aids, ear surgery and speech therapy sessions. The group included children from Slovakia and Germany.

Demographic data were collected, KINDLR and SSQ12 results were obtained and the questionnaires were transformed into electronic form (Google questionnaire).

**Materials and equipment**

The KINDLR questionnaire is a standardized generic QoL questionnaire. It consists of a 24-item Likert scale subdivided into the following 6 dimensions (sub-scales): physical well-being (pw), psychological/emotional well-being (ew), self-esteem (se), family (fa), friends (fr) and school (sc). The 6 sub-scales are summarized to obtain a total score, and each sub-scale score is calculated individually. For each question, the respondents are asked to choose a number denoting rate of occurrence as follows: 1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = all the time (6). They were divided into four groups as follows: children aged 4–6 and 7–13 years, and parents of children aged 3–6 and 7–13 years. The questionnaires were answered anonymously. There was no Slovak version available among the official versions of the questionnaire; therefore, it was translated from English into Slovak by a native-speaking Slovak translator. One of the official versions was in German. The KINDLR questionnaire comes with a specified evaluation method which is defined in the official KINDLR manual (6), using the IBM SPSS programme. The internal consistency of the questionnaire was evaluated by calculating the Cronbach’s alpha value for the entire questionnaire as well as for the individual subscales in each group. Within each group, the alpha values were calculated for the whole cohort (NH and CI) combined as well as separately for the NH control group and CI group. Considering the rather small sample group in this study, the nonparametric Mann–Whitney U test was used to determine statistically significant

differences between the CI and NH groups. This type of test is used to determine whether the central tendencies of two independent samples (NH control group and CI group) are diverse. Additionally, the ‘effect size’ (*d*) is calculated for the total group and each subscale. Furthermore, since it was questionable whether the subscales within the CI group showed statistically significant different scores, the Friedman test for dependent samples was used. If statistically significant *p* were found, a ‘post hoc analysis’ was done to recognise the affected subscales. In both cases, the zero hypothesis is that the answers of the groups and subscales would not differ.

The SSQ12 (Speech, Spatial and Qualities of Hearing scale) directly evaluated the subjective quality of hearing of the patients as well as of the control group. It was meant to serve as an additional measure to determine any difference in hearing between these two groups. The questionnaire was completed by the children themselves (except for the three-year-old children whose parents completed the questionnaire on the behalf of their children). The Cronbach’s alpha for internal consistency was calculated for the entire questionnaire for each of ‘NH’ and ‘CI’ groups, as well as for both combined. To evaluate the central tendencies of the two groups, the Mann–Whitney U test was used.

**Statistical analysis**

The aim was to evaluate the QoL questionnaires that were completed by the participants in the patient group (CI) and normal-hearing group (NH) and to compare the results of both groups.

**Tab. 1. Results of the group of children aged 7–13 years.**

| NH    |  | n  | Items | Mean   | Median | SD     | Minimum | Maximum |
|-------|--|----|-------|--------|--------|--------|---------|---------|
| total |  | 13 | 22    | 76.748 | 76.136 | 8.637  | 62.50   | 93.18   |
| pw    |  | 13 | 4     | 81.250 | 87.500 | 16.137 | 50.00   | 100.00  |
| ew    |  | 13 | 4     | 74.519 | 75.000 | 11.256 | 50.00   | 93.75   |
| se    |  | 13 | 4     | 70.192 | 75.000 | 16.369 | 43.75   | 100.00  |
| fa    |  | 13 | 3     | 75.000 | 75.000 | 14.027 | 50.00   | 91.67   |
| fr    |  | 13 | 3     | 83.974 | 83.333 | 15.761 | 50.00   | 100.00  |
| sc    |  | 13 | 4     | 76.923 | 81.250 | 15.601 | 50.00   | 100.00  |
| CI    |  | n  | Items | Mean   | Median | SD     | Minimum | Maximum |
| total |  | 9  | 22    | 74.182 | 73.864 | 14.548 | 52.27   | 95.45   |
| pw    |  | 9  | 4     | 78.472 | 87.500 | 19.543 | 43.75   | 100.00  |
| ew    |  | 9  | 4     | 73.611 | 68.750 | 19.460 | 37.50   | 100.00  |
| se    |  | 9  | 4     | 68.056 | 68.750 | 17.524 | 37.50   | 93.75   |
| fa    |  | 9  | 3     | 80.556 | 83.333 | 15.590 | 58.33   | 100.00  |
| fr    |  | 9  | 3     | 76.852 | 75.000 | 15.466 | 50.00   | 100.00  |
| sc    |  | 9  | 4     | 69.676 | 68.750 | 22.051 | 31.25   | 100.00  |

NH: normal hearing; CI: cochlear implant; SD: standard deviation; pw: physical well-being; ew: emotional well-being; se: self-esteem; fa: family; fr: friends; sc: school

**Tab. 2. Mann-Whitney U test for the subgroup of children aged 7–13 years.**

| n = 22         | total  | pw     | ew     | se     | fa     | fr     | sc     |
|----------------|--------|--------|--------|--------|--------|--------|--------|
| U-value        | 50.000 | 53.500 | 57.500 | 54.000 | 44.500 | 37.000 | 48.000 |
| Mean rank ‘NH’ | 12.15  | 11.88  | 11.58  | 11.85  | 10.42  | 13.15  | 12.31  |
| Mean rank ‘CI’ | 10–56  | 10.94  | 11.39  | 11     | 13.06  | 9.11   | 10.33  |
| Z              | –0.568 | –0.338 | –0.069 | –0.303 | –0.954 | –1.474 | –0.705 |
| p              | .570   | .736   | .945   | .762   | .340   | .140   | .481   |
| Effect size d  | 0.12   | 0.07   | 0.01   | 0.06   | 0.2    | 0.31   | 0.15   |

NH: normal hearing; CI: cochlear implant; pw: physical well-being; ew: emotional well-being; se: self-esteem; fa: family; fr: friends; sc: school

The data were analysed using SPSS Statistics for Mac, Version 26.0. Armonk, NY: IBM Corp.

## Results

The enrolled cohort consisted of 40 subjects (21 parents of children after CI, 11 children after CI, 21 parents of normal-hearing children and 23 normal-hearing children). The children were between 3 and 17 years of age.

### KINDLR HRQoL

The first calculation of the reliability of answers of the four subgroups was reviewed: (KINDLR children aged 4–6 years:  $n(\text{CI}) = 2$ ,  $n(\text{NH}) = 10$ , children aged 7–13 years:  $n(\text{CI}) = 9$ ,  $n(\text{NH}) = 13$ , parents of children aged 3–6 years:  $n(\text{CI}) = 7$ ,  $n(\text{NH}) = 8$ , parents of children aged 7–17 years:  $n(\text{CI}) = 14$ ,  $n(\text{NH}) = 13$ ), and CI and NH combined.

#### Group of children aged 4–6 years

The 'CI group had a higher total score ( $M = 88.89$ ) than the NH group ( $M = 83.182$ ) which could be explained by the fact that only two children in the CI group answered the questionnaire. Since the calculated reliability, Cronbach's alpha value, was 0.203 and showed an extremely low internal consistency, it was not evaluated further.

#### Group of children aged 7–13 years

The NH control group had a higher total life quality score ( $M = 76.748$ ) than the CI group ( $M = 74.182$ ) (Tab. 1). The subscale scores were mainly higher for the NH group with the biggest differences seen in the 'friends' and 'school' subscales. As for the 'family' subscale, the 'CI' group yielded a higher score ( $M = 80.556$ ) compared to the 'NH' group ( $M = 75.0$ ). The internal consistency of the entire questionnaire ('total') showed a good Cronbach's alpha value for the whole group of Children aged 7–13 years ( $\alpha = 0.856$ ) as well as for the separated NH ( $\alpha = 0.745$ ) and 'CI' groups of children aged 7–13 years ( $\alpha$  values of 0.745 and 0.927, respectively). However, the 'emotional well-being' and 'family' subscales showed a lower alpha value in the NH control group (ew: 0.343; fa: 0.346). This might have been due to the fact that children from the control groups from Slovakia and from Germany were asked to complete the questionnaires. Cultural differences might have led to the lower internal consistency. Both groups, the NH control group, and the CI group, were statistically

**Tab. 3. Results of the CI group only.**

| CI children age 4–6 years              | n  | Items | Mean   | Median | SD     | Minimum | Maximum |
|--|----|-------|--------|--------|--------|---------|---------|
| Total                                  | 2  | 11    | 88.89  | 88.89  | 15.713 | 77.78   | 100.00  |
| CI children aged 7–17 years            | n  | Items | Mean   | Median | SD     | Minimum | Maximum |
| total                                  | 9  | 22    | 74.182 | 73.864 | 14.548 | 52.27   | 95.45   |
| pw                                     | 9  | 4     | 78.472 | 87.500 | 19.543 | 43.75   | 100.00  |
| ew                                     | 9  | 4     | 73.611 | 68.750 | 19.460 | 37.50   | 100.00  |
| se                                     | 9  | 4     | 68.056 | 68.750 | 17.524 | 37.50   | 93.75   |
| fa                                     | 9  | 3     | 80.556 | 83.333 | 15.590 | 58.33   | 100.00  |
| fr                                     | 9  | 3     | 76.852 | 75.000 | 15.466 | 50.00   | 100.00  |
| sc                                     | 9  | 4     | 69.676 | 68.750 | 22.051 | 31.25   | 100.00  |
| Parents of CI children aged 3–6        | n  | Items | Mean   | Median | SD     | Minimum | Maximum |
| Total                                  | 7  | 22    | 76.949 | 81.818 | 10.973 | 61.36   | 89.77   |
| pw                                     | 7  | 4     | 80.357 | 87.500 | 18.551 | 50.00   | 100.00  |
| ew                                     | 7  | 4     | 82.143 | 81.250 | 14.174 | 56.25   | 100.00  |
| se                                     | 7  | 4     | 72.321 | 75.000 | 14.815 | 50.00   | 93.75   |
| fa                                     | 7  | 3     | 88.095 | 83.333 | 9.449  | 75.00   | 100.00  |
| fr                                     | 7  | 3     | 66.667 | 83.333 | 27.217 | 25.00   | 91.67   |
| sc                                     | 7  | 4     | 72.321 | 81.250 | 22.493 | 25.00   | 87.50   |
| Q.7                                    | 7  | 22    | 77.134 | 79.546 | 11.280 | 58.09   | 90.91   |
| Parents of CI children aged 7–17 years | n  | Items | Mean   | Median | SD     | Minimum | Maximum |
| Total                                  | 14 | 22    | 75.537 | 76.136 | 12.644 | 54.55   | 90.48   |
| pw                                     | 14 | 4     | 74.554 | 71.875 | 17.925 | 43.75   | 100.00  |
| ew                                     | 14 | 4     | 75.893 | 87.125 | 17.991 | 43.75   | 100.00  |
| se                                     | 14 | 4     | 68.304 | 68.750 | 12.848 | 50.00   | 87.50   |
| fa                                     | 14 | 3     | 89.286 | 91.667 | 15.821 | 41.67   | 100.00  |
| fr                                     | 14 | 3     | 70.833 | 75.000 | 22.349 | 16.67   | 100.00  |
| sc                                     | 14 | 4     | 76.935 | 78.125 | 16.616 | 43.75   | 100.00  |

NH: normal hearing; CI: cochlear implant; SD: standard deviation; pw: physical well-being; ew: emotional well-being; se: self-esteem; fa: family; fr: friends; sc: school

**Tab. 4. Friedman test for the CI group.**

| CI children aged 7–13 years            | pw   | ew   | se   | fa   | fr   | sc   | n  | Chi-square | p      |
|--|------|------|------|------|------|------|----|------------|--------|
| Mean rank                              | 4.17 | 3.56 | 2.17 | 3.89 | 4.11 | 3.11 | 9  | 7.833      | .166   |
| Parents of CI children aged 3–6 years  | pw   | ew   | se   | fa   | fr   | sc   | n  | Chi-square | p      |
| Mean rank                              | 4.14 | 3.57 | 2.71 | 4.43 | 2.86 | 3.29 | 7  | 4.936      | .424   |
| Parents of CI children aged 7–17 years | pw   | ew   | se   | fa   | fr   | sc   | n  | Chi-square | p      |
| Mean rank                              | 3.25 | 3.50 | 2.32 | 5.11 | 3.04 | 3.79 | 14 | 18.297     | .003** |

\* significance on the level of 0.05

\*\* significance on the level of 0.01

NH: normal hearing; CI: cochlear implant; pw: physical well-being; ew: emotional well-being; se: self-esteem; fa: family; fr: friends; sc: school

compared using the Mann-Whitney U test (Tab. 2). No statistically significant differences are found.

#### Group of parents of children aged 3–6 years

The NH control group had a total score of  $M = 76.278$  and the CI group had a total score of  $M = 76.949$ . Therefore, both groups had an almost identical total QoL score with the CI group scoring higher. When observing the subscales, the NH control group had higher scores in the domains of 'friends' ( $M = 83.333$ ) and 'school' ( $M = 75.000$ ). In all other subscales, including the Q.7

scale, the CI group had higher scores. The biggest difference was seen in the ‘family’ subscale where the NH control group and CI group had mean scores of 79.167 and 88.095, respectively. The Mann–Whitney U test did not show any statistically significant differences between the NH control group and the CI group. When comparing the mean scores of the ‘friends’ subscale, it can be seen that the control group had a much higher score ( $M = 83.333$ ) than the CI group ( $M = 66.667$ ). Although not statistically significant, the  $p$ -value for the ‘friends’ subscale was  $p = .178$  and the effect size  $d$  was 0.34, which signified a medium effect. This suggests that with a larger group of participants, there might be a statistically significant difference between the two groups. The mean scores for the ‘family’ subscale also revealed a greater difference between the ‘NH control group and the CI group; however, the difference was not statistically significant ( $p = .211$ ). The effect in this subscale ( $d = 0.32$ ) was of medium size.

*Group of parents of children aged 7–17 years*

The mean total score of the NH control group was higher ( $M = 79.371$ ) than that of the CI group ( $M = 75.537$ ). The ‘family’ subscale was the only subscale in which the CI group ( $M = 89.286$ ) scored higher than the NH control group ( $M = 73.718$ ). The NH control group scored higher in the other five subscales. The biggest differences were seen in the ‘physical well-being’ subscale, where the control group scored  $M = 84.135$  while the CI group scored  $M = 74.537$ ; and in the ‘friends’ subscale, where the control group scored  $M = 82.051$  and the CI group scored  $M = 70.833$ . All of the Cronbach’s alpha values were considered good, thus allowing for further evaluation. According to the Mann-Whitney U test, a statistically significant difference of  $p = .003$  was found in the ‘family’ subscale. The children of the CI group scored significantly higher in this subscale ( $M = 89.286$ ) than the children in the NH control group ( $M = 73.718$ ), suggesting that the overall situation at home with the family is considered better by parents of the CI children than by those of NH children. In comparison, the NH control group scored higher in the ‘friends’ subscale ( $M = 82.051$ ) than the CI group ( $M = 70.833$ ), resulting in a medium effect of  $d = 0.3$ , which however is not statistically significant ( $p = .117$ ). This might show that in the eyes of their parents, children

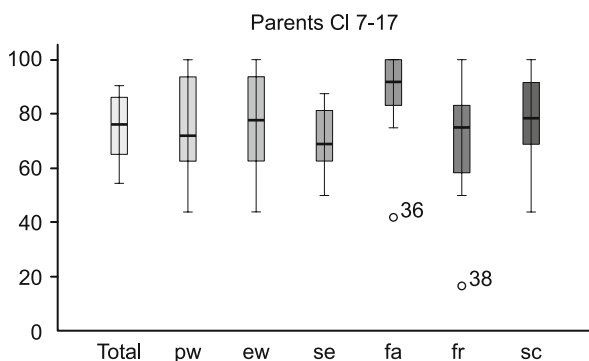
with CI feel more comfortable around their family, who are fully aware about their condition and accept the condition of CI as something normal. The parents of children in the NH group might score higher in the ‘friends’ subscale, as most children and adolescents in this age start to be more independent and want to spend more time with their friends than with their parents.

*Results within CI groups*

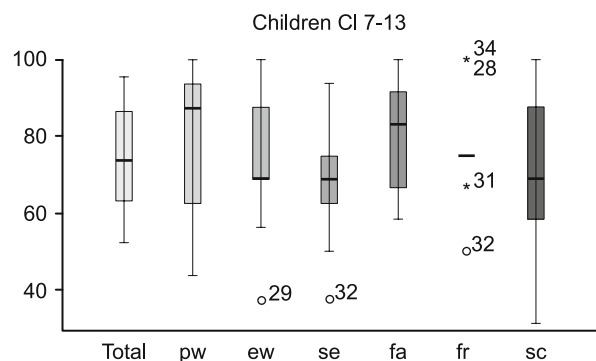
The total score was similar for the following subgroups: CI children aged 7–17 years ( $M = 74.182$ ), parents of CI children aged 3–6 years ( $M = 76.949$ ) and parents of CI children aged 7–17’ ( $M = 75.537$ ). The ‘CI children aged 4–6 years’ subgroup had the highest score ( $M = 88.89$ ) but as explained, this subgroup was excluded from further evaluation. In all three subgroups the highest mean score was found in the ‘family’ subscale while the lowest scores were in subscales of ‘self-esteem’ subscale (subgroups CI children aged 7–13 years, parents of CI children aged 7–17 years) and ‘friends’ (parents of CI children aged 3–6 years). This could indicate that the overall situation at home is good, and that children feel comfortable around their family. The lower scores in the ‘self-esteem’ and ‘friends’ subscales could be a sign of their feelings of being disadvantaged due to their hearing or wearing a CI (Tab. 3).

To analyse how the subscales behave with another in each subgroup, the Friedman test for dependent samples was conducted (Tab. 4). The CI children aged 7–13 years and parents of CI children aged 3–6 years subgroups did not show a statistically significant difference within their subscales, as opposed to the subgroup of parents of children aged 7–17 years which had a statistically significant  $p = 0.003$ , suggesting significant differences between particular domains of life quality.

A post hoc analysis was conducted to make a pairwise comparison of the subscales. The only statistical significance was found between the subscales of ‘self-esteem’ and ‘family’ ( $p = .002$ ). To display this graphically, a boxplot chart (Fig. 1) for the total score and each subscale score was created for the subgroup of parents with CI children aged 7–17 years. The median score for ‘self-esteem’ was 68.304 and the score for ‘family’ was 89.286. This might show that, according to their parents, the children or



**Fig. 1.** Boxplot chart for the total score and the subscale scores; group ‘CI parents of children aged 7–17 years’ pw: physical well-being; ew: emotional well-being; se: self-esteem; fa: family; fr: friends; sc: school.



**Fig. 2.** Boxplot chart for the total score and the subscale scores; group ‘CI children aged 7–13 years’ pw: physical well-being; ew: emotional well-being; se: self-esteem; fa: family; fr: friends; sc: school.

adolescents aged 7–13 years with a cochlear implant feel comfortable around their family at home while their self-esteem is significantly lower. This could be caused by the fact that as children grow, their appearance becomes more important. A cochlear implant is a clearly visible hearing aid and might be seen as something ugly, making the wearers feel uncomfortable and therefore has an effect of lowering their self-esteem.

The boxplot chart (Fig. 1) of the CI children aged 7–13 years subgroup shows the same tendencies within the ‘self-esteem’ (Md = 68.056) and ‘family’ (Md = 80.556) subscales; however, the difference is not statistically significant. The ‘friends’ subscale (Fig. 2) could not be represented graphically as a box because only five of the nine children had a mean score of 75.000. Two children had a mean score above 75.000 and two had a mean score below 75.000 (described by ‘\*’ in the chart).

#### The SSQ12

Two questions (Q.9 and Q.12) were excluded from the pool of questions, which reduced the number of items from 12 to 10. Table 5 shows the results of the SSQ12 questionnaire divided into two groups NH SSQ12 and CI SSQ12). The mean score of the NH control group was higher (M = 8.160) than that of the CI group (M = 6.855) and the comparison shows statistical significance ( $p = .027$ ) which was calculated by using the Mann-Whitney U test. In this small sample group, there is a statistically significant difference in hearing quality between the NH control group and CI group. The CI group scored the lowest (M = 5.00) in multiple speech streams questions, namely in Q.5: ‘You are with a group and the conversation switches from one person to another. Can you easily follow the conversation without missing the start of what each new speaker is saying?’ (Multiple speech streams), while the

NH control group scored M = 8.08. The CI group scored the highest (M = 9.44) in quality and naturalness question, namely Q.11: ‘Do everyday sounds that you can hear easily seem clear to you (not blurred)?’, while the NH control group scored slightly lower (M = 8.25). A Cronbach’s alpha was calculated for both groups combined and for each group separately (total 0.786, NH 0.772, CI 0.702,  $n = 10$ ), which is considered a good internal consistency.

#### Discussion

The question that needs to be discussed is whether the QoL in children with CI is the same as in children without hearing deficiencies. The zero hypothesis is that children with cochlear implants would have the same quality of life as children with normal hearing (NH).

Loy et al (7) made a cross-sectional study in 2010 to evaluate the quality of life of children with cochlear implants using a generic QoL questionnaire, KINLDR, for measuring health-related quality of life. The study included children with at least one implant. Group one (8–11 years of age) consisted of 52 patients and group two (12–16 years of age) consisted of 34 patients. The comparison group of NH children consisted of 1,501 participants in the fourth and eighth school grades. The total score of the CI group in the study by Loy et al was rated less positively in both age groups (8–11: M = 75.35, 12–16: M = 69.72) than among their NH peers (8–11: M = 76.75, 12–16: 72.2); however, there was no statistical significance. In our study the total score was less positive for the CI children aged 7–13 years and parents of CI children age 7–17 years than for their normal-hearing peer groups; however, no statistically significant difference was seen. The parents of CI children aged 3–6 years scored slightly higher (M = 76.95) than

the parents of NH children aged 3–6 years (M = 76.28). The score of participants of the CI group aged 8–11 years in the ‘family’ subscale of the questionnaire was less positive (M = 72.5;  $SD = 15.52$ ) than that of their NH peers in the same age group (M = 83.98;  $SD = 13.02$ ), which was statistically significant ( $p < .0001$ ). The scores in all of the other subscales in this age group were comparable as for the CI and NH groups. This was different in our study. In all of the CI subgroups (children aged 7–13 years, parents of children aged 3–6 years, parents of children aged 7–17 years), the ‘family’ subscale scores were more positive than those in their NH peer groups. The difference was even statistically significant ( $p = .003$ ) in the subgroup of parents of children aged 7–17 years (NH: M = 73.72, CI: M = 89.27). This was the only statistically significant difference found in our study when comparing the CI and NH groups. In the second age group of 12–16 years in the Loy et al study, the CI group (M = 69.15) scored

**Tab. 5. Results of the SSQ12 questionnaire.**

| NH SSQ12 | n  | Missing | Mean  | Median | SD    | Minimum | Maximum |
|----------|----|---------|-------|--------|-------|---------|---------|
| total    | 24 | 0       | 8.160 | 8.050  | 1.108 | 5,40    | 9.80    |
| Q.1      | 24 | 0       | 7.63  | 8.50   | 2.568 | 1       | 10      |
| Q.2      | 23 | 0       | 7.00  | 8.00   | 2.939 | 1       | 10      |
| Q.3      | 24 | 0       | 8.42  | 9.00   | 1.767 | 4       | 10      |
| Q.4      | 24 | 0       | 8.58  | 9.00   | 1.558 | 5       | 10      |
| Q.5      | 24 | 0       | 8.08  | 8.50   | 1.586 | 4       | 10      |
| Q.6      | 24 | 0       | 9.13  | 10.00  | 1.116 | 6       | 10      |
| Q.7      | 24 | 0       | 8.25  | 8.00   | 1.294 | 5       | 10      |
| Q.8      | 24 | 0       | 8.46  | 8.50   | 1.474 | 5       | 10      |
| Q.10     | 24 | 0       | 7.71  | 9.00   | 2.331 | 3       | 10      |
| Q.11     | 24 | 0       | 8.25  | 8.00   | 1.567 | 5       | 10      |
| CI SSQ12 | n  | Missing | Mean  | Median | SD    | Minimum | Maximum |
| total    | 11 | 0       | 6.855 | 7.100  | 1.864 | 3.57    | 9.71    |
| Q.1      | 11 | 0       | 8.00  | 9.00   | 2.569 | 1       | 10      |
| Q.2      | 10 | 1       | 6.10  | 6.00   | 2.424 | 1       | 9       |
| Q.3      | 11 | 0       | 6.64  | 7.00   | 3.075 | 1       | 10      |
| Q.4      | 11 | 0       | 6.18  | 7.00   | 2.639 | 1       | 9       |
| Q.5      | 9  | 2       | 5.00  | 5.00   | 2.646 | 2       | 10      |
| Q.6      | 11 | 0       | 7.09  | 9.00   | 2.809 | 2       | 10      |
| Q.7      | 9  | 2       | 5.67  | 7.00   | 3.240 | 1       | 10      |
| Q.8      | 9  | 2       | 6.89  | 8.00   | 2.759 | 1       | 10      |
| Q.10     | 9  | 2       | 7.44  | 8.00   | 2.833 | 1       | 10      |
| Q.11     | 9  | 2       | 9.44  | 10.00  | 0.726 | 8       | 10      |

higher in the ‘self-esteem’ subscale than the NH group ( $M = 60.79$ ) which had a statistical significance of  $p = .0207$ . In our study, the scores of the CI groups in the ‘self-esteem’ subscale were mainly less positive than those of the NH groups. The only exception was found in the group of parents of children aged 3–6 years where the CI group scored higher ( $M = 72.32$ ) than the NH group ( $M = 69.53$ ); however, the difference was not statistically significant. The CI group in latter age group had a less positive score in the ‘friends’ subscale ( $M = 68.35$ ;  $SD = 22.99$ ) as compared to the NH group ( $M = 78.25$ ;  $SD = 12.71$ ) with a statistical significance of  $p = .0119$ . Another statistically significant difference (with  $p = .0101$ ) was seen in the ‘school’ subscale where the CI group had fewer positive results ( $M = 55.24$ ;  $SD = 20.48$ ) than the NH group ( $M = 64.36$ ;  $SD = 13.64$ ). In our study, the scores of all of the CI subgroups in the ‘friends’ and ‘school’ subscales were less positive. However no statistically significant difference was found. Loy et al concluded that the general quality of life of children with cochlear implantations and their normal hearing peers was for the most part identical.

In the study by Huber et al (8) the QoL of children with CI was compared with NH children in Austria by using the generic KINDLR questionnaire. The group consisted of 44 patients, including 30 children (8–12 years of age) and 14 adolescents (13–16 years of age) who were attending school on a regular basis. All of the patients had been wearing a cochlear implant for at least 3 years. No comparison group of hearing peers was created in this study. Instead, the standard population mean scores for pupils in Germany were used to compare the outcomes of the children and adolescent CI groups with their age-related hearing pairs (918 children and 583 adolescents). No specific subscales were taken on during this comparison, just on the overall results of the questionnaires. The child group (8–12 years of age) rated their overall quality of life significantly lower than the age-related hearing group, while the adolescent group (age 13–16 years) did not show a significant difference compared to the hearing group (although the group of male adolescents was too small to be analysed). In our study, there was no significant difference in the total score of QoL for either of the age groups.

Smith et al (9) compared children with CI and their normal-hearing peers in self-esteem and social well-being subscales. The study took place in Denmark and featured the participation of 164 children with CI. Their age range was 2 to 17 years with a mean age of 7 years in the CI group and that of 9.4 years in the NH group. The questionnaire was developed by the National Institute of Public Health and consisted of questions aimed at the participants’ general well-being at school or kindergarten, number of good friends they had, as to whether they were being bullied, as well as to whether they were bullying others and how school-work was managed. The second questionnaire had a 7-point rating scale assessing dependence/independence, loneliness/sociability, being worried/ not being worried, being sad/ being happy and insecurity/ confidence in order to assess overall social well-being. In the general section of well-being (Smith et al study) at school and kindergarten, the CI group scored significantly higher than their NH peers ( $p < .0001$ ). This section was comparable to the ‘school’ subscale in our study. However, the NH group always

scored higher, albeit without any statistical difference from the CI group. Smith et al found a statistically significant difference in the subscale of ‘bullying other children’ with a higher score for the NH group ( $p = .02$ ). In our study, there was no comparable subscale. The 7-point scale (Smith et al) to assess self-esteem did not show any differences between the CI and NH groups except for the rating of ‘activity’ subscale. The children with cochlear implants were rated more active than their NH peers ( $p = .003$ ). This is comparable to our study, although no ‘self-esteem’ subscales were evaluated. In general, the differences between both groups were minor and could be rated as equal.

## Conclusion

The evaluation of the overall QoL of children with cochlear implants did not significantly differ from that of children with normal hearing. However, when considering the individual subscales, the CI groups had more positive scores in the ‘family’ subscale. In comparison, they scored lower in the ‘friends’ and ‘school’ subscales than their NH peer groups. The ‘self-esteem’ scores were lower in the CI subgroups of children aged 7–13 years and parents with children aged 7–17 years, but the CI subgroup of parents of children aged 3–6 years scored higher in this subscale than their NH peer group. Furthermore, our study has shown that the NH children had significantly higher hearing quality scores. However, considering that the overall QoL did not differ between these two groups, the difference in hearing quality did not seem to negatively influence the QoL in children with CI.

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Received October 17, 2022.

Accepted November 14, 2022.