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Research article

Health-related quality of life in children who use cochlear implants or hearing aids

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ABSTRACT

Objectives: First, this study aimed at evaluating the health-related quality of life (HRQoL) and socio-demographic characteristics of children with cochlear implants (CIs) and hearing aids (HAs) from the 2 provinces of the Canary Islands (Spain) on the Kid-KINDL^R_children_7–13. The second goal was to analyze parental background factors and the perspectives of their children with CIs and HAs on Kid_Kiddo-KINDL^R_Parents_ 7–17. Finally, the third objective was to explore agreement between children's self-reports and their parents' reports concerning HRQoL.
Design: The data consisted of 89 children with CIs and 63 children with HAs and their 89 parents, respectively. The socio-demographic characteristics of children and parental background factors included demographic and audiological variables. Student's *t*-test, one-way ANOVA, post hoc analysis and 4 concordance correlation coefficients (CCC) were used to address the 3 aims.
Results: Children with CIs exhibited a perception of better HRQoL in comparison with children with HAs. Among other differences, children with CIs and HAs and their parents were significantly distinct in *Setting* (i.e., provinces of Tenerife and Gran Canaria) ($t = 2.921$, $p < 0.010$). Moreover, parents were significantly different in some background factors (i.e., age, socioeconomic status, and learning). While Cohen's Kappa values for most dimensions were too small, the ICC and Student's *t*-test expressed only concordance in the overall HRQoL and *Physical well-being*.
Conclusions: Children with CIs and their parents demostrated a perception of better HRQoL than children with HAs and their parents. Overall, children's self-ratings of HRQoL differed from their parents' reports.

1. Introduction

Primary Education is the longest compulsory stage to the Spanish public-school system. Since early 2015, when the Spanish Ministry of Health, Social Services and Equality approved the "cochlear implant, including bilateral implantation after individualized assessment in children and adults" (*Act SSI/1356/2015, 2 of July*), the number of children who have cochlear implants has increased in mainstream settings. Young children spend a great deal of time in non-school settings, and families play a more prominent role at this stage in child development. Accordingly, it is important to assess patterns of parent-child agreements regarding child's health-related quality of life (HRQoL).

The study of HRQoL of children with CIs or HAs is important because it can help to identify school social climate and interpersonal relationships between children and their families and prevent possible risk factors.

The concept of HRQoL affects an individual's health triangle, which includes bodily functions, social conditions, and mental fitness. Its theoretical model assumes that involving students, teachers, and family cultures shaped children's social and cognitive development.

1.1. Family HRQoL of parents raising children with CIs or Has

Researchers had not sufficiently established the agreement between CIs and HAs children's self-reports and parent's reports for HRQoL measures (Stevanovic et al., 2013). The way that individuals view family tensions has been examined in different ways. Although parents of children with bilateral CIs were significantly less stressed than parents of children with unilateral CIs (Sarant and Garrard, 2014), parents of deaf children perceived slightly fewer feelings of stress than their children and adolescents (Duarte et al., 2014). Parents of children and adolescents with CIs rated overall HRQoL positively across psychosocial domains

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(Kumar, Warner-Czyz, Silver, Loy, & Tobey, 2015). Within the parenting styles paradigm, families reported contradictory outcomes HRQoL in their children (Haukedal et al., 2018; Zhao et al., 2018).

1.2. Intervention through modern personal amplifiers

Initially, Most, Shina-August and Meilijson (2010) revealed that children with hearing loss used varied pragmatic functions. Also, researchers found no differences emerged between children who used CIs vs. HAs. The factors that improved attitudes toward the use of hearing technology were unquestionably related to deaf and hearing loss individuals (e.g., environment and technology) (Rekkedal, 2012). The results of Meserole et al. (2014) revealed that components of family stress (resource demands, costs, and restrictions) were associated with worse HRQoL, and children with CIs reported HRQoL comparable to normal hearing peers. Advances in HA technology combined with improvements in the management of deafness reduced subsequent damages in the majority of hearing loss issues that children suffer (e.g., auditory deficiency, social dysfunction, and cognitive decline) (see Roche and Hansen, 2015; Alegre et al., 2016). Nevertheless, the treatment of chronic sensorineural hearing loss employing technical amplification was "complex and not always satisfactory" (Hoppe and Hesse, 2017, p. 20).

1.3. Psychometric properties of the health-related quality of life questionnaire (KINDL)

In Spain, investigators confirmed the construct validity of the first Spanish version of KINDL for evaluating students in 2 public schools in Asturias (Fernández-López et al., 2004). The psychometric properties of the KINDL^R questionnaire satisfied the standards of reliability, validity, and sensitivity on scales for different contexts (i.e., languages, countries, diseases, and populations) (see Lee et al., 2008; Serra-Sutton et al., 2009; Stevanovic, 2009; Yamaguchi et al., 2010; Warner-Czyz et al., 2011; Stevanovic et al., 2013; Jardine et al., 2014; Sakiz et al., 2015; Paixão et al., 2016; Rojhani Shirazi, Tonekaboni, Azargashb, Derakhshannia and Aghdasta, 2016; Razafimahefa-Raoelina et al., 2016; Navarro and Merino, 2016; Pérez Zaballos, Ramos Macías, Pérez Placencia, Borkoski Barreiro and Ramos de Miguel, 2016; Neumann et al., 2017; Hoffman et al., 2018).

1.4. Purpose of this study

The study addressed the following 3 research questions:

1. How do the 6 dimensions of HRQoL—*Physical well-being*, *Emotional well-being*, *Self-Esteem*, *Family*, *Friends*, and *Everyday Functioning (School or Nursery School)*—and socio-demographic characteristics of primary school children using CIs differ from primary school children using HAs from the 2 provinces of the Canary Islands using the Spanish version of *Kid-KINDL^R_children_7–13*?
2. How do background factors of primary school children's parents with CIs perceive the 6 dimensions of HRQoL of their children— Physical well-being, Emotional well-being, Self-Esteem, Family, Friends, and Everyday Functioning (School or Nursery School)—compared with background factors of primary school children's parents with HAs from the 2 provinces of the Canary Islands using the Spanish version of *Kid_Kiddo-KINDL^R_Parents_ 7–17*?
3. What kind of agreement on the HRQoL exists between self-reports of children with CIs and HAs measured by the Kid-KINDL^R_children_7–13 and their parents' reports assessed using the Kid_Kiddo-KINDL^R_Parents_ 7–17?

First, the study aimed to evaluate the HRQoL of children with CIs and HAs on the Kid-KINDL^R_children_7–13. The second aim was to analyze parental perspectives of their children with CIs and HAs on Kid_Kiddo-KINDL^R_Parents_ 7–17. The third purpose was to explore agreement between children's self-reports and their parents' reports concerning HRQoL.

2. Materials and methods

2.1. Participants

The data collection size was the target population of children and adolescents with CIs or HAs in the two Spanish provinces: Gran Canary and Tenerife. The Canary School Council of the schools' centers approved the research project (reference: CSOCSED03) and provided the education statistics of the children. Respondents also included parents of children with CIs or HAs. The Association of Parents of Children with Cochlear Implants of the Canary Islands provided information and facilitated access to the parents. The Doctor Negrín University Hospital of Gran Canaria Ethics Committee followed its own protocol and approved the current study by reviewing the methods proposed for ensuring confidentiality for the research project on 22 March 2016. Specifically, Dr. Ramos Macías, Head of Otolaryngology service, certified the research project on 21 February 2016. Additionally, the Hospital provided support for children with CIs and their families. The consent form that participants signed covered the following main points: the aims of the study, the motives for collaboration with the parents, the implications for the students, the instruments that were intended to be applied to the students and the parents, and the right to remove their participation from the study at any point. Researchers expected students with hearing difficulties from diverse rural and urban settings and educational backgrounds reflecting the multicultural character of the population in the two Canary provinces where participants live.

The *Psychopedagogical Team* (PT) for schoolchildren with hearing difficulties in the Canary Islands helped the investigators to access the schools where children with CIs or HAs studied. In the case of a problem requiring the intervention of an itinerant professional in regular or inclusive schools, the PT ensured that they would work alongside educational psychologists, pedagogues, school doctors, inclusion education teachers, and social workers.

The criterion to take part in the study was that the classroom teacher had to be currently teaching at least one child with CI or HA. Students who had additional cognitive, physical, and communicative disabilities possibly affecting different aspects related to the QoL—such as autism spectrum disorder, attention-deficit/hyperactivity disorder, or chronic illnesses—were excluded. All students had similar characteristics with regard to the homogeneity of variance across groups in 3 tests: the *Raven's Progressive Matrices* (Raven, 2000), the *Peabody Picture Vocabulary Test* (Dunn and Dunn, 2007), and the *Illinois Test of Psycholinguistic Abilities* (ITPA) (Kirk et al., 1968), and language background. No participants received compensation for their input. All children with CIs or HAs attended inclusive and regular schools belonging to the educational system of the autonomous community of the Canary Islands (See Table 1).

2.2. Instruments

For the present study, 2 Spanish versions of KINDL^R were used to measure HRQoL in children and parents: Kid-KINDL^R_children_7–13 and Kid_Kiddo-KINDL^R_Parents_ 7–17. (For a list of the types of questionnaires in all available languages, see https://www.kindl.org/english/questionnaires/.) These instruments assembled various dimensions of HRQoL (e.g., physical well-being (WB), social WB, and emotional performance) (Paltzer et al., 2013).

Both KINDL^R contained 24 questions distributed across 6 dimensions. We collected the responses on a five-point Likert scale that categorized frequency on a range from "1 = never" to "5 = always." We obtained the profile delivered by the instrument, a single overall score or average of HRQoL from the means of the 6 dimensions.

Additionally, children with CIs or HAs were asked to complete a battery of tests (e.g., Raven's Progressive Matrices) (Raven, 2000),

Table 1. Socio-demographic and clinical characteristics of children with CIs or HAs as well as their parents.

Variable	*N*	%
Children's age 6–12 years old	152	100
Children with CIs/Has	89/63	58.5/41.4
Gender		
Girls with CIs/Has	42/29	47.2/46.0
Boys with CIs/Has	47/34	52.8/53.9
Schooling		
Inclusive children with CIs/Has	63/48	70.8/76.1
Regular children with CIs/Has	26/15	29.2/23.8
Home language		
Oral children with CIs/Has	49/49	55.0/77.7
Bilingual children with CIs/Has	40/14	44.9/22.2
Province		
Tenerife children with CIs/Has	43/18	48.3/28.5
Gran Canaria children with CIs/HAs	46/45	51.7/71.4
Cause of deaf		
Prenatal children with CIs/HAs	46/36	51.7/57.1
Degree of hearing loss (left ear/right ear)		
Mild <40 dB HL.		
Children with CIs	17/16	9.1/8.6
Children with HAs	32/25	28.3/22.1
Moderate to severe (41/90 dB HL).		
Children with CIs	42/29	22.5/15.5
Children with HAs	57/63	50.4/55.8
Profound >90 dB HL.		
Children with CIs	62/59	69.7/66.3
Children with HAs	24/25	21.2/22.1
Age at Cochlear implantation or Hearing aid		
From 1 to 2 years of age. Children with CIs	31	41.3
From 2 to 3 years of age. Children with HAs	15	23.8
After 3 year of age. Children with HAs	48	76.1
Bilateral/unilateral implantation		
Bilateral children with CIs	61	68.5
Unilateral children with CIs	28	31.4
Parents of children with CIs/HAs	89/63	58.5/41.4
Fathers had Primary Education Diploma.	46/37	51.7/58.7
Mothers had Primary Education Diploma	38/26	42.7/41.2
Fathers of children with CIs/HAs were working	56/30	62.9/47.6
Mothers children with CIs/HAs of were working	32/39	35.9/61.9

Peabody Picture Vocabulary Test (Dunn and Dunn, 2007), and ITPA (Kirk et al., 1968). Moreover, this study used a deliberate short socio-demographic characteristic questionnaire about each child's setting, educational outcomes at school, sex, personal resources, number of siblings, sibling ordinal position, and health/clinical information. Parents assessed background factors (e.g., cochlear implant or hearing aid, setting, age, marital status, employment status, educational level, and type of school placement) and certain variables relevant to hearing loss (e.g., child's etiology of hearing loss, time of deafness diagnosis, parental hearing status, preferred mode of communication at home and by the child, parent courses in which parents participated, and number of weekly hours of logopedics). Both information surveys were included to elucidate the variables that may impact children and parents' average HRQoL (Upton et al., 2008; Hintermair, 2011; Freeman et al., 2017; Haukedal et al., 2018; Hoffman et al., 2018).

2.3. Procedure

The current study included socio-demographic variables (age and sex), educational variables (school system and school environment), diversity variables (cause of deafness, age of deafness diagnosis, deafness in the family, and type of communication in the family), parents' proxy (father, mother, and sibling), and information sessions led by a qualified PT. These weekly hour-long sessions equipped parents with the skills to motivate their children and justify parental choice while having a sense of empowerment and fun when interacting with their children. Parents learned how to make efficient use of time and intervention material as well as the skills to monitor and measure achievable goals. Researchers provided parents with information about the voluntary nature and confidentiality of the study.

The school principal provided a room where researchers and teachers were involved in familiarization with how to use the coding sheets while preparing the surveys. When studying children younger than 7 years of age, a teacher read each item and asked the child to respond by circling the selected Kid-KINDL^R_children_7–13 item. The time spent completing the assignments in the research project varied to some degree for different children. Students did not complete all tests simultaneously.

The data collection process took place over approximately 1 school calendar year. In the data reported here, there were no missing items. The transformed data were entered into a database by a researcher, and then another researcher double-checked data entry for all participants.

2.4. Statistical analyses

Authors converted HRQoL direct data collected from the two KINDL^R questionnaires into average items per dimension. All aspects and the overall scores of HRQoL were subjected to statistical analysis using the Statistical Package for Social Sciences (SPSS 16).

Researchers used Student's *t*-tests to compare the groups of children with CIs or HAs on each dimension of the Kid-KINDL^R_children_7–13 in the first question. Furthermore, the authors employed the one-way ANOVA to determine whether there was any statistically significant difference between the average total scores of the Kid-KINDL^R_children_7–13 for selected variables. After completing an ANOVA, a Scheffé *post hoc* test was applied because of different sample sizes, to find means that were significantly different from each other.

With respect to the second research question, the authors performed the same procedure and type of analysis with the Kid_Kiddo-KINDL^R_-Parents_ 7–17.

Authors applied the following methods for the third study question: correlation coefficient of agreement (CCC), intraclass correlation coefficients (ICC), Model I which had different judges evaluate each item, and Bland and Altman (1986) agreement limits of 95% and level of agreement measured by the Cohen's kappa. Finally, Student's *t*-test of paired samples examined the agreement between children CIs and HAs and their parents' responses. The bidirectional random-effects model estimated ICC: "Intraclass correlation coefficients provide reliability measures, but there are many forms, and each is appropriate only in certain circumstances" (Shrout and Fleiss, 1979, p. 427).

An ICC equal to or less than .40 indicated a poor to fair agreement; from 0.40 to 0.60, it suggested a moderate agreement; from 0.61 to 0.80 a good deal, and an ICC above 0.80, an excellent understanding. The 95% agreement level of Bland-Altman plot was calculated following the procedure of these authors, which has been maintained by other researchers (Worsfold et al., 2010). This level of agreement represented a probable range of 95% for the differences between the parent reports and the children's self-reports. The data were presented graphically following the Bland-Altman frames. Differences between the two measurements plotted the mean and the level of agreement.

3. Results

3.1. Differences in HRQoL dimensions of children with CIs and HAs

In order to address the first research question of the study, we compared children's HRQoL mean dimensions and assessed children's

socio-demographic characteristics. Table 2 displays the mean score of each dimension in the Kid-KINDLR_children_7–13 and shows that the Cronbach's alpha is highly reliable (0.976). Moreover, it reveals that the mean values ranged from 18.80 to 71.51, indicating that children considered the HRQoL positive. Self-Esteem received the highest scores ($M = 71.51$; $SD = 33.57$), followed by Friends ($M = 69.15$; $SD = 31.18$) and Everyday Functioning (School or Nursery School) in children with CIs ($M = 61.12$; $SD = 27.50$). Emotional well-being obtained the lowest score ($M = 18.80$; $SD = 22.85$), followed by Family ($M = 19.20$; $SD = 23.24$) and Physical well-being in children with HAs ($M = 19.92$; $SD = 23.88$). Student's t-test revealed a significant difference in all HRQoL dimensions between children with CIs and HAs. There were significant differences ($t = 5.661$, $p < 0.000$) in the average HRQoL score of children with CIs and HAs; children with CIs ($M = 50.91$; $SD = 22.00$) displayed a better perception of HRQoL with regard to children with HAs ($M = 26.83$; SD = 30.44).

3.2. Differences in socio-demographic characteristics of children with CIs and HAs

Table 3 presents statistically significant differences between levels of socio-demographic characteristics for each group of children with CIs and HAs in the overall mean HRQoL score. Moreover, it shows statistically significant differences in the overall mean HRQoL score of children with CIs and HAs.

There were no statistically significant differences between the groups of children with CIs and HAs concerning Sex and Raven's Progressive Matrices. Moreover, there were no statistically significant differences in Last semester marks awarded, Last course marks awarded, Personal resources, Number of siblings, Sibling ordinal position, Left ear hearing loss, ITPA, or Peabody Picture Vocabulary Test in children with HAs. Furthermore, there were no statistically significant differences in Setting, Last semester marks awarded, Last course marks awarded, Sibling ordinal position, Left ear hearing loss, and Peabody Picture Vocabulary Test in children with CIs. However, this group of children had the highest number of significant inner characteristic differences.

There were statistically significant differences between children with HAs in Setting (i.e., provinces of Tenerife and Gran Canaria) ($t = 3.230$, $p < 0.004$). In addition, there were statistically significant differences between children with CIs and HAs in Setting ($t = 2.921$, $p < 0.010$).

A one-way ANOVA, followed by the Scheffé post hoc test (-34.06, $p < 0.004$), revealed that the scores of children with Outstanding marks ($N = 11$, $M = 58.56$, $SD = 4.31$) were higher in HRQoL ($F(4,147) = 3.669$, $p < 0.010$) than those children with Insufficient marks ($N = 33$, $M = 24.49$, $SD = 29.56$) in Last semester marks awarded. Similar results occurred with the values obtained in the Last course marks awarded where those children with better marks displayed better HRQoL ($F(4,147) = 4.219$, $p < 0.003$). Post hoc comparisons showed statistically significant differences between children with Insufficient marks and children with other marks (good: -20.50, $p < 0.029$; remarkable: -19.49, $p < 0.043$, and outstanding: -33.45, $p < 0.005$).

Children with CIs had statistically significant differences according to the Personal Resource ($F(3) = 4.109$, $p < 0.009$). Children with CIs provided with one personal resource attained higher scores than children with CIs who needed 2 personal resources (i.e., Speech and language therapist (SLT) and a Spanish sign language teacher (SSLT) (Scheffé: 51.20, $p < 0.006$). The study also indicated that children with CIs had statistically significant differences in the Number of siblings ($F(4) = 5.999$, $p < 0.0021$). Post hoc analysis revealed a significant difference between 1 and 4 siblings (Scheffé: 50.22, $p < 0.012$), obtaining a higher average score in HRQoL those children who have only 1 sibling ($N = 31$, $M = 57.31$, $SD = 13.93$) compared with those children who have 4 siblings ($N = 4$, $M = 7.98$, $SD = 14.16$).

Furthermore, children with CIs and HAs had statistically significant differences in Number of siblings ($F(4,147) = 2.954$, $p < 0.05$) and Sibling ordinal position ($F(3,148) = 3.557$, $p < 0.010$). In this demographic characteristic, the first sibling had the highest mean ($N = 98$, $M = 44.92$, $SD = 26.88$). A post hoc indicated that there was indeed a significant difference between the first and the third sibling (Scheffé: 26.40, $p < 0.034$) in favor of those who were first-borns.

There were statistically significant differences between children with CIs and HAs in Left ear hearing loss ($F(2,149) = 3.425$, $p < 0.05$). Post hoc testing indicated a significant difference between children with profound hearing loss and severe-medium hearing loss (Scheffé: -5.59, $p < 0.029$).

Children with CIs and HAs had statistically significant differences in Age at diagnosis of hearing loss ($F(4,147) = 2.540$, $p < 0.042$). Post hoc indicated that children diagnosed between 1 to 2 years of age had better HRQoL (Scheffé: 23.52, $p < 0.027$).

Children with CIs were significantly different in the ITPA test scores ($F(3) = 3.105$, $p < 0.033$). Children who scored moderate in ITPA had higher HRQoL in comparison to those who scored low (Scheffé: -17.70, $p < .033$). Children with CIs and HAs who scored differently in ITPA had a distinct average mean HRQoL score ($F(3,102) = 4.119$, $p < 0.010$) with higher average values in those children who scored higher in ITPA.

Finally, children with CIs and HAs had statistically significant differences in the Peabody Picture Vocabulary Test scores ($F(5,122) = 2.432$, $p < 0.010$). Post hoc Scheffé probing analysis revealed that children with moderate low scores differed from those with low medium scores in favor of the latter (Scheffé: -17,70, $p < 0.033$).

Table 2. Children with CIs or HAs in Kid-KINDL^R_children_7–13 dimensions.

	Children with CIs/HAs	Mean	SD	Min-Max	t	α
Physical well-being	CIs	37.75	19.40	10.87 24.78	5.067***	.797
	HAs	19.92	23.88			
Emotional well-being	CIs	33.25	19.59	7.61 21.28	4.178***	.867
	HAs	18.80	22.85			
Self-Esteem	CIs	71.51	33.57	22.51 46.86	5.630***	.973
	HAs	36.82	42.28			
Family	CIs	32.69	19.26	6.65 20.32	3.901***	.853
	HAs	19.20	23.24			
Friends	CIs	69.15	31.18	22.66 45.65	5.871***	.941
	HAs	35.00	40.51			
Everyday Functioning (School or Nursery School)	CIs	61.12	27.50	19.72 39.98	5.822***	.880
	HAs	31.26	35.67			
Total	CIs	50.91	22.00	15.67 32.48	5.661***	.976
	HAs	26.83	30.44			

Note: Children with CIs (n = 89; 47 boys, 42 girls); children with HAs (n = 63; 34 boys, 29 girls).
α = Cronbach's alpha coefficients.
***$p < 0.001$.

3.3. Parents' comparisons in HRQoL dimensions

We compared the parents' HRQoL mean dimensions and assessed family background factors to address the second research question. Table 4 displays the mean score of each Kid_Kiddo-KINDL^R_Parents_7–17 dimension, and the Cronbach's alpha (0.984) indicated a higher internal consistency or reliability of the data set. All alpha scores were high in each dimension (e.g., Friends had the highest alpha) (0.978), and Emotional well-being had the lowest alpha (0.889). Student's t-test indicated statistically significant differences in the overall mean HRQoL score of parents of children with CIs and HAs, as well as in each HRQoL dimension ($t = 5.661$, $p < 0.001$). Parents of children with CIs had a higher overall mean HRQoL score ($M = 73.32$, $SD = 31.68$) than parents of children with HAs ($M = 38.64$, $SD = 43.84$).

Table 3. Differences in HRQoL between socio-demographic characteristics of children with CIs and HAs.

Sociodemographic Characteristics (Levels)	Total HRQoL Children with CIs $n = 89$ F	Total HRQoL Children with HAs $n = 63$ t	Total HRQoL Children with CIs and Has $N = 152$ t or F
Province (Tenerife/Gran Canaria)	NS	3.230**	2.921**
Last semester marks awarded (Insuf./Profic./Good/Remark./Ousts.)+	NS	NS	3.669**
Last course marks awarded: (Insuf./Profic./Good/Remark./Ousts.)+	NS	NS	4.219***
Personal Resources (SLT/SSLT/SLT and SSLT/Unsupported)++	4.109**	NS	NS
Number of siblings (0/1/2/3/4)	5.999***	NS	2.954*
Sibling ordinal position (1°/2°/3°/4°)	NS	NS	3.557**
Left ear hearing loss (Mild, Moderate to severe, Profound)	NS	NS	3.425*
Age at diagnosis of hearing loss (Before 6 months/6 months-1 year/ 1–2 years/2–3 years/4 year or later)	NS	NS	2.540*
ITPA (Very low/Moderate low/Medium/Moderate high)	3.105*	NS	4.119**
Peabody (Very low/Moderate low/Low medium/High medium/Moderate high/Very high)	NS	NS	2.432*

Note. *p < .05 **p < .010 ***p < .001.
+ Grades and marks in the Spanish Educational System (Insufficient 4, Proficient 5, Good 6, Remarkable 7–8, Outstanding 9).
++ Speech and language therapist (SLT), Spanish sign language teacher (SSLT).
NS, not significant ($p > 0.05$).

3.4. Comparing differences in family background factors

Table 5 presents statistically significant differences between levels of background factors for each group of parents of children with CIs or HAs in the overall mean HRQoL score.

There were no statistically significant differences in HRQoL between parents of children with CIs and HAs on the following background factors: Sex, Marital status, Educational level, Type of school placement, Child's etiology of hearing loss, Time of deafness diagnosis, Parental hearing status, and Number of weekly hours of logopedics.

In addition, there were no statistically significant differences within parents of children with CIs and HAs concerning preferred mode of communication at home or by the child. Furthermore, there were no statistically significant differences in HRQoL of parents of children with CIs keeping in mind the following background factors: Setting, Father's Age, Mother's Age, Fathers' employment status, and Preferred mode of communication at home or by the child. Moreover, there was no statistically significant difference in HRQoL of parents of children with HAs regarding parent courses in which they participated. However, this group of parents had the highest number of significant inner background differences.

There were statistically significant differences between parents of children with CIs and HAs regarding Setting (t (150) = 2.921, $p < 0.004$). As well, a one-way ANOVA, followed by the Scheffé post hoc test ($p < 0.05$), revealed that there were statistically significant differences between parents of children with CIs and HAs concerning Father's Age (F (3,148) = 3.904, $p < 0.010$). Post hoc test revealed significant differences between ages 31 to 40 and 41 to 50 (Scheffé: 44.83, $p < 0.040$) with higher HRQoL values in the case of younger parents of children with HAs. Similarly, there were statistically significant differences between parents of children with CIs and HAs regarding the Mother's Age (F (3,148) = 5.610, $p < 0.001$). A post hoc analysis revealed that mother's age between 31 to 40 years obtained higher mean ($M = 77.33$, $SD = 29.40$) between parents of children with CIs and HAs (Scheffé: 24.55, $p < 0.010$) and between parents of children with HAs (Scheffé: 49.34, $p < 0.007$).

There were statistically significant differences between parents of children with CIs and HAs concerning Fathers' employment status (F (2,149) = 10.270, $p < .000$). Post hoc test analysis indicated that employed parents of children with CIs and HAs ($M = 68.45$, $SD = 37.05$) had significantly higher HRQoL than unemployed or retired parents (Scheffé: -17.10, $p < 0.027$).

There were statistically significant differences between parents of children with CIs and HAs concerning the Preferred mode of communication at home and by the child (F (2,149) = 3.354, $p < 0.038$). Post hoc test analysis stated that oral communication ($M = 61.99$, $SD = 40.66$) was the preferred mode of communication compared to other types (sign or bilingual).

Finally, there were statistically significant differences between parents of children with CIs and HAs who had engaged on hearing loss learning courses compared with those who had not taken courses (t (77) = 2.033, $p < 0.045$). Parents of children with CIs perceived better HRQoL.

Table 4. Parents of Children with CIs or HAs in Kid-KINDL^R_children_7–13 dimensions.

Kid- & Kiddo-KINDL^R/ Parents Dimensions	*Parents of children with CIs/HAs*	*Mean*	*SD*	*Min-Max*	*t*	*α*
Physical well-being	*CIs*	37.75	19.40	10.87 24.78	5.067***	.938
	HAs	19.92	23.88			
Emotional well-being	*CIs*	39.26	30.23	14.24 33.50	4.898***	.889
	HAs	15.39	28.68			
Self-Esteem	*CIs*	52.30	40.09	24.69 48.31	6.109***	.983
	HAs	15.79	30.11			
Family	*CIs*	22.97	20.54	3.323 18.18	2.860**	.950
	HAs	12.22	25.75			
Friends	*CIs*	53.98	40.76	21.48 46.80	5.329***	.978
	HAs	19.84	36.13			
Everyday Functioning (School or Nursery School)	*CIs*	45.39	38.04	19.22 41.56	5.377***	.953
	HAs	15.00	28.24			
Overall	*CIs*	73.32	31.68	22.57 46.77	5.661***	.984
	HAs	38.64	43.84			

Note. Parents of children with CIs (n = 89; 21 fathers, 66 mothers, y 2 proxies). Parents of children with HAs (n = 63; 10 fathers, 53 mothers).
α = Cronbach's alpha coefficients.
**p < 0.010 ***p < 0.001.

3.5. Agreement between children's self-ratings and their parents' reports in HRQoL

We measured the HRQoL agreement between children and parent using concordance correlation coefficients (CCC) to address the third research question. Table 6 provides complimentary statistics information in children-parents agreement on HRQoL. This research objective shows statistical information that comprises 4 agreement coefficients: Cohen's Kappa, ICC, Bland-Altman and Student's t-test. The coefficients took

Table 5. Differences in family background factors.

Family Background Factors (Levels)	Parents of Children with CIs $n = 89$ t	Parents of Children with HAs $n = 63$ t or F	Total HRQoL Parents of Children with CIs and HAs $N = 152$ t or F
Setting (Tenerife/Gran Canaria)	NS	3.230**	2.921**
Father's Age (20–30/31–40/41–50/50 or older)	NS	3.999*	3.904**
Mother's Age (20–30/31–40/41–50/50 or older)	NS	4.646 **	5,610 ***
Fathers' employment status (Unemployed/Employed/Retired)	NS	3.350*	10.270 ***
Preferred mode of communication at home and by the child (Sign/Oral/Bilingual)	NS	NS	3.354 *
Parent courses in which parents participated (Yes/No)	2.230 *	NS	2.033 *

Note. *$p < 0.05$, **$p < 0.010$, ***$p < 0.001$.
Parents of children with CIs ($N = 89$; 21 fathers, 66 mothers, and 2 proxies). Parents of children with HAs ($N = 63$; 10 fathers and 53 mothers).
NS, not significant ($p > 0.05$).

Table 6. Agreement between child self-reported and parent-reported HRQoL values.

HRQoL Children-Parents	k	ICC					Paired samples t test
		ICC	$L_{ower\ Bound}$	$U_{pper\ Bound}$	Bland-Altman		
					$M_{difference}/SD_{difference}$	$L_{ower\ Bound}$ $U_{pper\ Bound}$	
Dimensions							
Physical well-being	.239***	.885***	.845	.915	-.493 (10.715)	20.50; -21.49	t (151) = -.568, NS
Emotional well-being	.079***	.274*	.000	.473	-2.105 (35.516)	67.50; -71.71	t (151) = -.731, NS
Self-Esteem	.073**	.387***	.155	.555	19.967 (50.246)	118.44; -78.51	t (151) = 4.899***
Family	.090***	.011 NS	.000	.269	7.203 (31.954)	68.06; -53.66	t (151) = 2.779**
Friends	.082***	.401***	.176	.565	15.164 (49.825)	112.82; -82.49	t (151) = -3.752***
Everyday Functioning (School or Nursery School)	.076***	.404***	.179	.567	15.953 (43.879)	101.95; -70.04	t (151) = 4.483***
Overall	.240***	.967***	.955	.976	-18.012 (12.489)	6.33; -42.39	t (151) = -17.794***

Note. ***$p < 0.000$; **$p < 0.010$; *$p < 0.05$.
NS, not significant ($p > 0.05$).
k (*Kappa* de Cohen: <.020: Poor; 021–024: Week; 0.41–0.60: Moderate; 0.61–0.80: Good; 0.81–1.00: Very Good.
ICC (intraclass correlation coefficients); LoA (Bland–Altman 95% limits of agreement). *Moderate agreement (.40-.60); **Good agreement (.61-.80).

distinct values for the classification of the same HRQoL elements, as the dimension frequencies were unequal.

Cohen's kappa values for most dimensions were insignificant and discreet for the overall HRQoL, which expressed minimal agreement between children and their parents. However, the ICC indicated an agreement of intraclass concordance between children and their parents in the overall HRQoL (0.967) and Physical well-being (0.885). The agreement was moderate in Self-Esteem (0.387), Friends (0.401), and Everyday Functioning (School or Nursery School) (0.404) and poor in Emotional well-being (0.274) and Family (0.011). Paired samples *t*-test demonstrated statistically significant differences between children and parents in Self-Esteem, Family, Friends, and Everyday Functioning (School or Nursery School), as well as in the overall HRQoL.

We used the Bland-Altman plot as a mean-difference graphical tool (Figures 1, 2, 3, 4, 5, 6, and 7). This plot shows if mean differences between children and their parents are systematic or if they are due to chance. The solid central line signifies the average of differences; the pair lines (above and below the central line) indicates the limits of agreement revealed in Table 6. Physical well-being dimension (Figure 1) had scores close to the mean, and only 3 cases deviated considerably above the lower or upper limits. Therefore, data were consistent with the high concordance reported in the ICC (0.885). Emotional well-being dimension had no concordances as in the ICC (Figure 2). One situation followed the straight line of ascending regression to the upper limit with low and medium congruence values, while the other situation had high congruent scores, but data dispersed. Self-esteem domain demonstrated close scores to the mean that evidenced concordance, and some scores were dispersed at the upper and lower limits (Figure 3). Relationship with Family domain did not indicate agreement even though it was close to average values (Figure 4). Friends and Everyday Functioning (School or Nursery School) dimensions presented 3 groups of situations; most of them were close to the average with the high average agreement, while 2 groups deviate by lower and upper limits. In the case of the Friends dimension (Figure 5), agreements between children and parents were evident in some cases with high average scores, although 2 groups tended to the lower and upper limits. This happened in the case of Everyday Functioning (School or Nursery School), although mean scores had lower values (Figure 6). We observed high concordance in the average HRQoL except in 2 cases that deviated from the mean (Figure 7). A regression line-shaped showed the inner limit with a high agreement score between children and parents, as found in the ICC index (.967).

4. Discussion

4.1. Understanding Children's views regarding HRQoL

The first question of the study compared children's HRQoL dimensions. Results indicated that schoolchildren with CIs and HAs responded differently to the Kid-KINDLR_children_7–13, according to the discrepant perceptions of HRQoL. Apart from the item "I felt strong and full of energy," children with CIs and HAs differed in the rest of the 24 items assessed by the instrument. Thus, our findings contradicted somewhat Meserole et al.'s conclusion regarding the comparable HRQoL experience of CI recipients and hearing peers. In this respect, it would be thought-provoking to distinguish whether dissimilarities in HRQoL students' ratings developed from differences in 1 questionnaire item as some

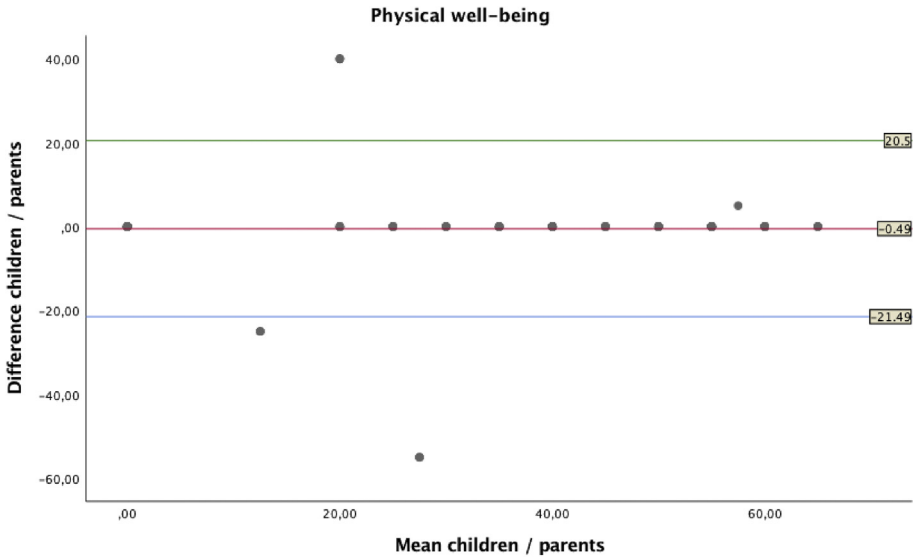

Figure 1. Bland-Altman plots of the intra-rater reliability to *Physical well-being* dimension.

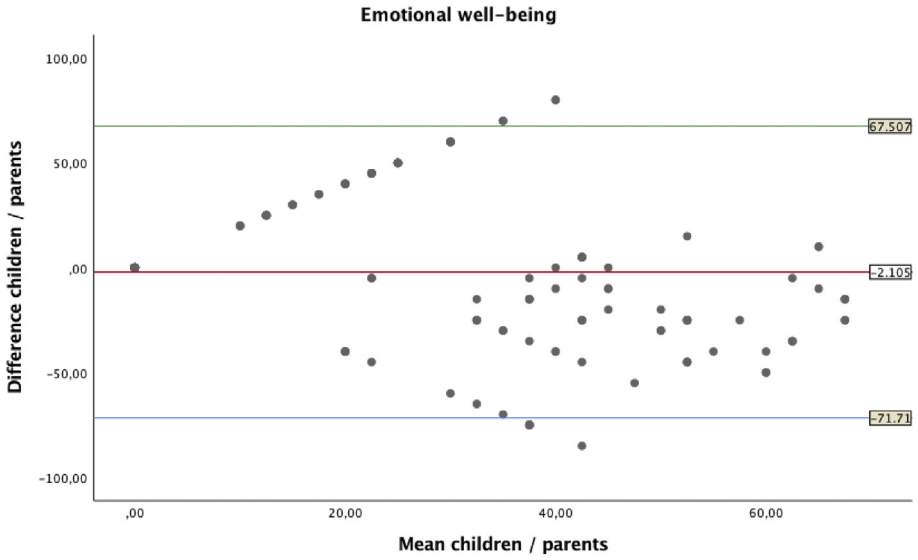

Figure 2. Bland-Altman plots of the intra-rater reliability to *Emotional well-being* dimension.

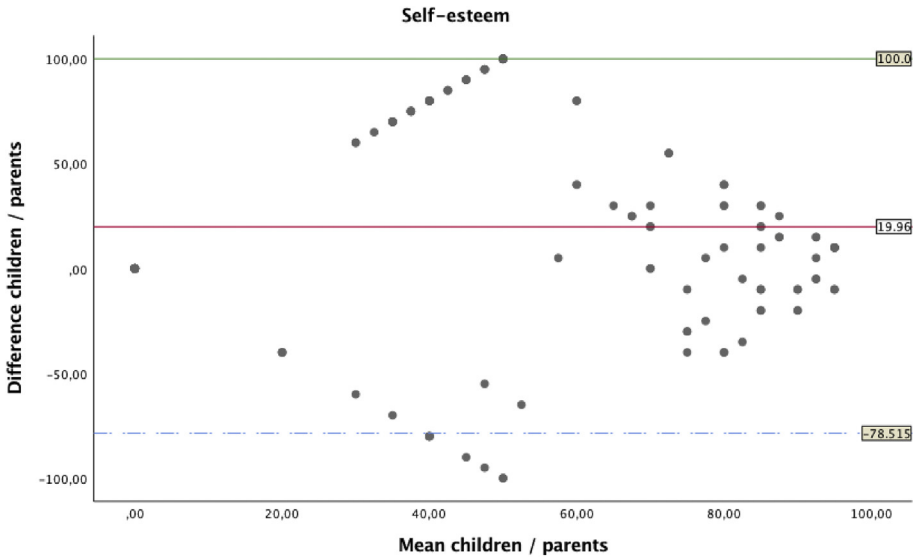

Figure 3. Bland-Altman plots of the intra-rater reliability to *Self-esteem* dimension.

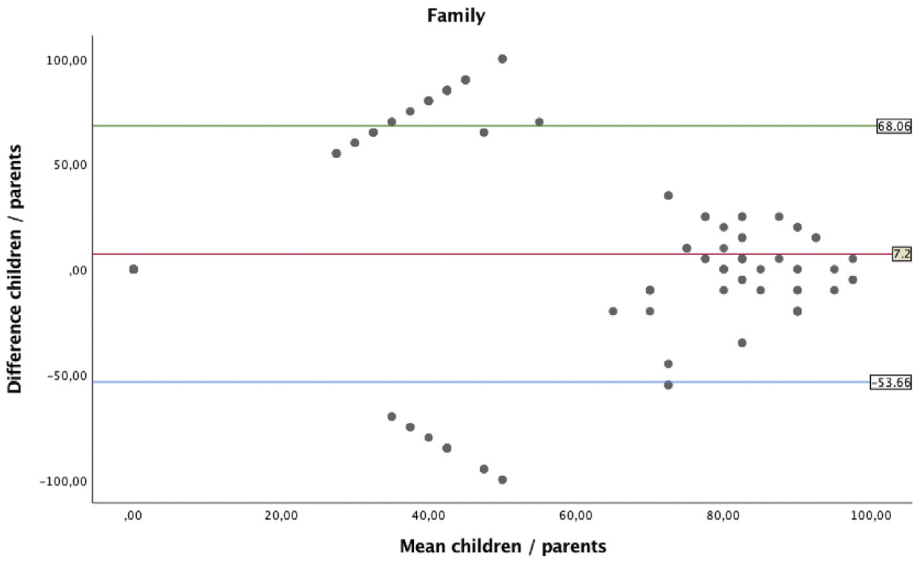

Figure 4. Bland-Altman plots of the intra-rater reliability to *Family* dimension.

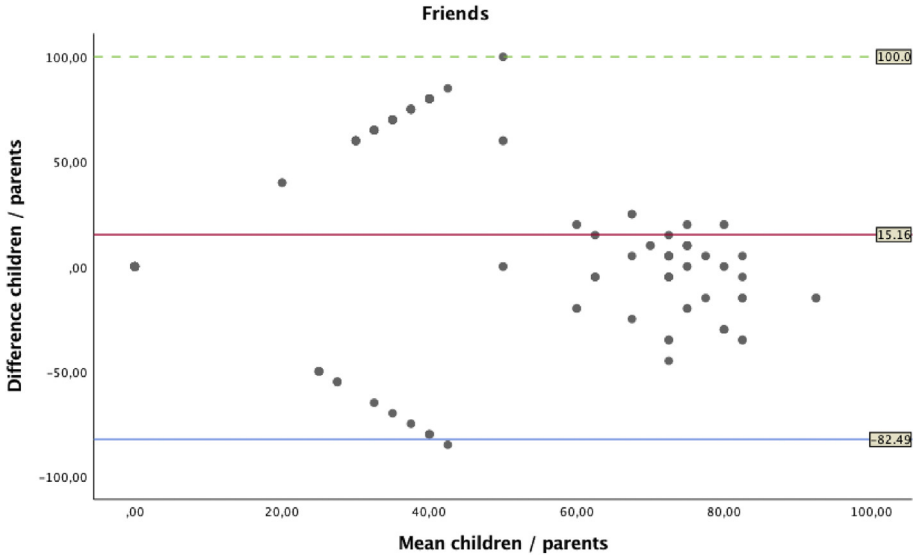

Figure 5. Bland-Altman plots of the intra-rater reliability to *Friends* dimension.

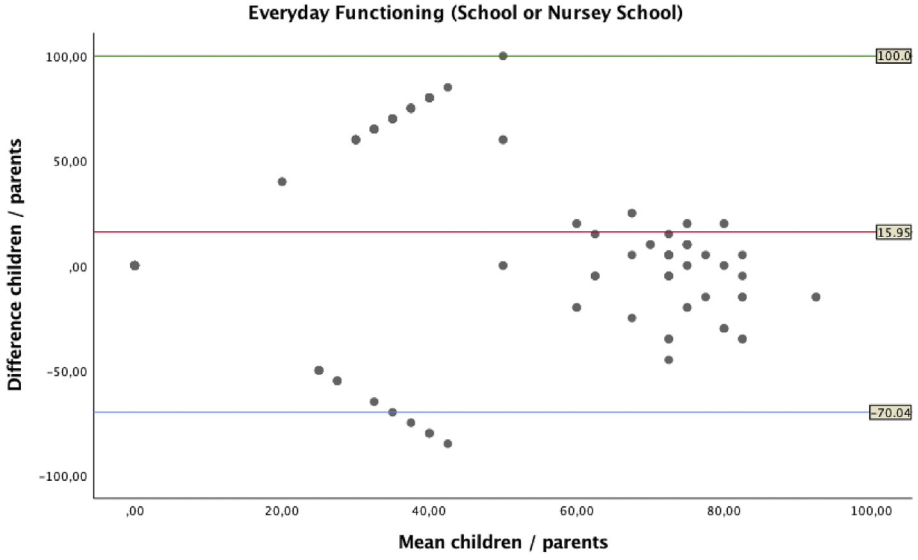

Figure 6. Bland-Altman plots of the intra-rater reliability to *Everyday Functioning (School or Nursery School)* dimension.

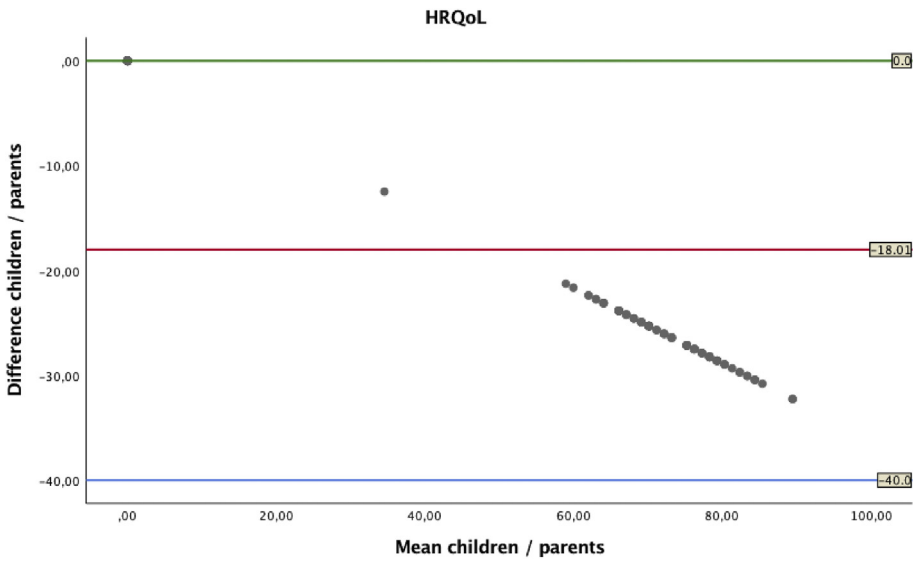

Figure 7. Bland-Altman plots of the intra-rater reliability to average *HRQoL*.

researchers reported (Warner-Czyz et al., 2011) or due to other causes (i.e., reading comprehension, speech intelligibility, or risk of fatigue) (Freeman et al., 2017; Hornsby et al., 2014).

The first research objective also assessed children's socio-demographic characteristics. Lack of statistical significance between HRQoL and some socio-demographic variables could reflect the homogeneity of this sample due to low standard deviations of those research variables. However, the variable Setting (i.e., geographical and administrative provinces of Gran Canaria and Tenerife) maintained meaningful statistical differences between children with CIs and HAs on average HRQoL dimensions. Our analysis showed that provinces played an essential role in HRQoL for the Canary autonomous community. We conjectured that children with CIs who were served at the hospital in Gran Canaria had similar characteristics, while the socio-demographic variables were different for children with HAs.

We noticed meaningful differences between children with HAs in some items of the Friends dimension, although the Canary educational system affected children with CIs. We attributed these differences to the lack of peer friends who could improve the social distance of both groups of children. This supposition coincided too with findings previously declared by some researchers (Punch and Hyde, 2011, p. 488).

The school environment differed between children with CIs or HAs when examining the average HRQoL domains, except for Physical well-being. At the same time, this dimension was significantly different between children with CIs. This finding merits further investigation to know whether younger children would score higher than older ones in this dimension as reported by other researchers (Pardo-Guijarro et al., 2015). Put together, the present study validated the importance of the school environment (i.e., itinerant teachers, teachers, school counselors, and school psychologists) for the development of children with CIs as has been reported in past research (Hintermair, 2011; Kumar et al., 2015). Contrary to the opinion of Rekkedal (2012), children with CIs or HAs did not reveal that users' hearing devices predisposed their attitude to HRQoL. Together, these findings suggested that children with CIs noticed HRQoL differently and showed a better perception of HRQoL concerning children with HAs. Additionally, this finding was consistent with other studies that reported the efforts faced by children on the Family dimension (Loy et al., 2010).

4.2. Parents' perceptions of HRQoL: groups similarities and differences

Analysing the responses to the second question, parents of children with CIs or HAs had different HRQoL viewpoints. There were statistically significant differences between parents of children with CIs and HAs regarding Setting. Moreover, parents of children with CIs had a higher average HRQoL score than parents of children with HAs. Similarly, in a previous study, Kumar et al. (2015) reported that parents of children and adolescents with CIs rated HRQoL positively across HRQoL domains.

Parents of children with CIs overestimated HRQoL because they were supposedly more in touch with the Pediatric Audiology service at the Hospital of Gran Canaria. This result was opposite to other findings that showed that parents underrated their children's HRQoL (Razafimahefa-Raoelina et al., 2016).

Although oral communication was the preferred mode of communication of children at home compared to other types (sign or bilingual), there were significant differences between the 2 groups of children's parents. This explanation supported researchers' assertion that 1 factor of cognitive maturation in children's communication skills was early cochlear implantation (Huttunen et al., 2009; Alegre et al., 2016). Parents of children with HAs argued that they were scarcely exposed to sign language or communication strategies with acquaintances or peers (Most et al., 2010).

Three parenting background factors (i.e., age, socioeconomic status, and learning) compelled researchers to examine how parents experienced and challenged relationships with children fitted with HAs (Rotsika et al., 2011; Sarant and Garrard, 2014; Veland et al., 2014). These relevant factors increased the differences of all parents and demonstrated the need for additional program for understanding inclusive education. Parents' socioeconomic status and effective management strategies (i.e., parent–audiologist partnership) have been at the core of a very active field of research (Muñoz et al., 2016).

4.3. Agreements and disagreements in HRQoL between children and their parents

We studied 4 agreement coefficients with different results. While Cohen's kappa values for most dimensions were too small, the ICC and Student's *t*-test expressed the only concordance in the overall HRQoL and Physical well-being. It appeared that these results produced similar outcomes in the study by Jardine et al. (2014), which demonstrated that perceptions of HRQoL for domains such as emotional functioning were different in children and their parents, whereas other researchers found agreement in 2 *KIDSCREEN-27 questionnaire* dimensions (Pardo-Guijarro et al., 2015). Surprisingly, the Family dimension had a poor agreement (ICC) and was statistically different (Student's *t*-test), while other researchers identified consensus about the family effort as the principle of childhood development (Lam-Cassettari et al., 2015; Hintermair et al., 2017; Bruin, 2018). Meanwhile, a meta-analysis suggested

that the attention deficit hyperactivity disorder (ADHD), which impacted a child's or adolescent's HRQoL negatively, was assessed in children and adolescents with ADHD both by parents' reports and children's self-reports (Lee et al., 2016).

4.4. Study limitations and recommendations for further research

This study had certain limitations. This research has been circumscribed to the population of children with CIs or HAs in the 2 provinces of the Canary Islands. When studied in other Spanish autonomous communities than that of the present study, research could increase the knowledge about primary school children with CIs or HAs and uncover associations between HRQoL dimensions and IQ (Raven's Progressive Matrices), speech-language (Peabody Picture Vocabulary Test), and language background (ITPA). This study selected a child population in the primary school with similar levels of cognitive and linguistic development. Future studies could examine changes in HRQoL in children following their transition to upper grades and select new predictors (e.g., fatigue ratings, school achievement, and inclusive school cultures) to seek to improve HRQoL dimensions.

There are several recommendations for practice that arise from this study. Consistent with findings from Musyoka et al. (2017), we encouraged the design and validation of a KINDL^{R} questionnaire for teachers, adapting the one for parents, as Sakiz et al. (2015) recommended. In the context of research HRQoL on parents of children who have CIs and HAs, future research should examine additional parents' social-cognition aspects for comparative purposes (Hintermair et al., 2017). Moreover, the involvement of parents in child language acquisition was evident for children's development and well-being (Bruin, 2018). Provided the heterogeneity of the children with CIs or HAs and the different assumed causes of deafness, the Kid-KINDLR_children_7–13 can be used to compare HRQoL across etiologies (i.e., genetic loss versus unexplained deafness), associate outcomes of children with CIs or HAs across inclusive and regular schools, and analyze the benefits of simultaneous versus sequential bilateral cochlear implantation. Thus, one should work through complex experiments giving better answers to families, schoolteachers, and PT members, as researchers have previously reported (English, 2010; Muñoz et al., 2016). Furthermore, one must analyze other socio-demographic variables that affect a child's ability to communicate, as prior researchers have studied (Warner-Czyz et al., 2011). Hence, it will be plausible to know if bilateral cochlear implantation will bring added value in HRQoL to children and their families.

Investigators considered it reasonable to associate the HRQoL of hearing loss children with results of language and communication growth in infants without additional needs (Edwards et al., 2012; Rekkedal, 2012). In this study, the PTs assisted the children in answering the demographic questionnaires and aided their parents in completing the socio-demographic survey. Overall, we encouraged a line of research on parent mentoring. For example, parents trained by PTs should provide what is necessary for understanding and responding to the children's multiple disabilities and hearing-related topics (Narr and Kemmery, 2015).

In summary, this study provided a valuable contribution to our understanding of children with CIs and their parents. Both displayed a perception of better HRQoL than children with HAs and their parents, which may reflect higher caregiver insight and involvement related to children with CIs.

Declarations

Author contribution statement

Olga María Alegre-de la Rosa, Luis Miguel Villar-Angulo: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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