International Journal of Pediatric Otorhinolaryngology 141 (2021) 110506

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Self-concept of children and adolescents with cochlear implants

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ARTICLE INFO

Keywords:
Cochlear implant
Hearing loss
Self-concept
Perceived competence
Global self-worth

ABSTRACT

Objectives: Communicative disorders can complicate social interactions and may be detrimental for one's self-concept. This study aims to assess the self-concept of children with Cochlear Implants (CI). Results of educational peer groups (special needs or typical) were compared. Correlations amongst speech perception, language comprehension, self-concept and other study variables are determined.

Methods: This retrospectively patient file study contained 53 CI participants with a mean age of 14.2 (SD = 2.8). Self-concept was measured with the Dutch language version of the Self-Perception Profile for Children and Adolescents. Proportions of low, normal and high competence scores were compared to a normative sample. Outcomes were analyzed for the total CI group and for the two educational peer groups. **Results**: In the Scholastic Competence, Athletic Competence, Physical Appearance and Behavioral Conduct domains larger proportions of high perceived competence levels were found in the CI Total group compared to the hearing normative sample. Children with CIs in the Mainstream educational subgroup were found to have larger proportions of high levels on these domains. Remarkably, children with CI in the Special hearing impaired educational subgroup reported comparable self-concept scores as their hearing peers. Speech perception and language comprehension were positively correlated to Scholastic Competence.

Conclusion: This study has shown that self-concept levels of profoundly hearing impaired children with CI are comparable to those of hearing peers. They are generally satisfied with their functioning in various domains. Better speech perception and language comprehension levels are related to higher outcomes in the Scholastic Competence domain.

1. Introduction

Children with special needs are at greater risk of being stigmatized and labeled as being different [1–3]. This may result in social exclusion in the form of victimization, peer exclusion and teasing. Hence, children with special needs are more likely to develop a negative self-concept [1,4]. Special needs in hearing and communication are potentially detrimental to the development of a positive self-concept. Therefore, it is highly relevant to monitor the development of self-concept in profoundly hearing impaired (HI) children.

Self-concept can be generally defined as the perception of 'our self' [5]. The terms self-concept and self-esteem are often used interchangeably. In this study the term self-concept is used as the cognitive/knowledge aspect of the perception of our self, whereas self-esteem is seen as the evaluative and emotional aspect of the perception of our self [6]. The development of self-concept commences at 8 years of age. In a first stage a child begins interpreting his/her own cognitions, feelings and abilities and also considers feedback from others [7–9]. The ability to reflect on oneself evolves through interactions and social comparison with others [5,10–12]. The conceptual domains of reflection alter gradually from physical to mental and volitional aspects [9]. For example, a young child will state 'I can run fast', while the older child or adolescent will state: 'I'm friendly', or 'I'm sensitive'. A positive self-concept is associated with a positive adjustment to the environment and to positive mental health outcomes. In contrast, negative self-concept is associated with poor adjustment to the environment and higher levels of emotional and psychosocial problems (e.g.,

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https://doi.org/10.1016/j.ijporl.2020.110506
Received 8 August 2020; Received in revised form 13 November 2020; Accepted 13 November 2020
Available online 17 November 2020

depression, anxiety, conduct disorders) [13–15].

There are several ways to measure self-concept. For an overview see Butler and Gasson [12]. A frequently used theoretical construct of self-concept was developed by Harter [5,7,16,17]. She approaches self-concept as a multidimensional construct that comprises two concepts: perceived competence and global self-worth. The first concept, *perceived competence*, can be defined as a specific evaluation of one's own functioning or appearance in different areas or domains for example scholastic competence or friendships. Perceived competence is the awareness of competence in a functioning or appearance in a certain domain. The relative importance of the domains depends on the developmental age of the child [5,7,18]. Within this concept of perceived competence Harter and colleagues identify two clusters. The first cluster is related to peer support and comprises the subdomains Physical Appearance and Social Acceptance. The second cluster is mainly related to parental support and comprises the subdomains Scholastic Competence and Behavioral Conduct. The subdomain Athletic Competence can be included in both clusters [17,19]. The second concept is *global self-worth*, which represents a more general view of one's self-functioning and should be seen as an independent construct which entails more than the sum of the perceived competence domains. It refers to the global evaluation of the self and the extent to which one feels competent in domains that one values most [5,20–22].

Auditory perception and speech- and language development are important factors for adequate communication and functioning in the hearing society. Auditory-verbal communication in profoundly HI children is severely compromised by the inability to perceive and interpret meaningful auditory cues and verbal communication. Their problems involve impaired speech perception and hampered speech and language development [23–25]. Profoundly HI children may therefore not achieve an adequate understanding of social and emotional language and relationships [23,26–28], which negatively influences their social and emotional development with anxiety, aggression or withdrawal behavior as a result [28,29]. Several studies endorse the assumption that HI children experience more difficulties in positive self-concept in the domains of social acceptance and close friendship than normal-hearing peers [30,31], as well as in the cognitive and school domains [32].

As a result of the application of cochlear implant (CI) substantial gains in auditory perception and recognition in profoundly HI children have been reported. These improved auditory abilities provide profoundly HI children the ability to develop sufficient speech- and language development [33–36], and thus the possibility of improved social-emotional developmental outcomes. Theunissen et al. [37] found that better language and communication skills in children with CIs are related to less emotional and behavioral problems. Several studies show that children with CIs have levels of self-esteem, psychopathology symptoms, mental health and personality traits that are similar to those of normal-hearing peers [37–41]. Hence, one would assume that self-concept of children with CIs with age-appropriate language abilities would also be comparable to that of normal-hearing peers.

In the model, Harter et al. refer to the role of peers in the development of self-concept. Self-concept is a reflection on oneself that evolves through interactions and social comparison with others. In children and adolescents 'the other' is often a peer [19]. Peer interactions can occur during leisure and school activities. Children with CIs are placed in both mainstream and special educational settings, with typical respectively HI peer groups. Nowadays children with CIs who demonstrate sufficient auditory skills and language learning capacity and who have no cognitive or learning disorders are enrolled in mainstream educational settings. In the Netherlands and Flanders (Belgium) this is 46%–66% of the HI children with CIs between 6 and 18 years of age [42,43]. The specific characteristics of the educational settings will affect the quantity and quality of peer interactions and, thus, will influence the development of self-concept in children with CIs. After all, the educational setting determines the type of peer group which children compare themselves to (i.e., typical normal-hearing or HI peers) [44,45].

In special HI educational settings the educational and the communication levels are adapted to the usually poorer ability level of the children, and there is a limited number of children in a group, in quantity and diversity. In the Netherlands special schools are regional based resources which often requires boarding school placement or long distance transportation, which can result in limited contacts with peers in the home environment. The use of sign language or sign supported Dutch in special HI educational settings facilitates communication with and between profoundly HI peers and curriculum content transfer from teachers to the children. In mainstream educational settings the educational curriculum is less well adapted to HI children. Groups are usually larger than in special HI educational settings. Therefore less attention and information is directed to the individual pupils. Communication mode used by teachers and peers is spoken language. These HI children in mainstream educational settings therefore often receive additional support. Schools are at closer range, diverse peer contacts are relatively accessible.

Despite relatively adequate speech perception abilities in optimal listening environments, in less optimal conditions substantial information may not be accessible for (unilateral) CI users [46]. Speech perception in noise remains difficult, resulting in increased listening effort and a burden on auditory verbal working memory. This complicates adequate perception of verbal information even further [47]. Daily communication frequently takes place in degraded acoustical environments resulting in misinterpretations, which may not always be noticed by the child with CI. As a result of both decreased accurate auditory and linguistic input implicit learning is hindered, which complicates social learning [48,49].

Research in self-concept in deaf children shows that identification with deaf peers is positively related to self-esteem and leads to shared understanding and fewer feelings of isolation [50,51], which may provide positive self-concept development in special educational settings for HI children. However, study of HI children in mainstream educational settings shows that these children have more self-esteem and positive self-perception than HI children in HI special educational settings. Children educated in mainstream educational settings are often more likely to be hearing acculturated [30,45,52,53]. Other studies found no difference in self-esteem and self-concept between children enrolled in special educational setting for HI children and those enrolled in mainstream educational setting [50,54].

Hence, the developmental perspectives of profoundly HI children dramatically increased following cochlear implantation. Notwithstanding, little is known about the impact of CI on self-concept. Therefore, this study focused on assessment of the perceived competence and global self-worth in children and adolescents with CI. Furthermore, outcomes were compared with those of hearing peers. Differences between CI children in mainstream and special HI educational settings were investigated. In addition, the relations between self-concept and speech perception, language comprehension and other study variables were determined.

2. Materials and methods

2.1. Participants

The data was collected retrospectively through the examination of CI patient files. Participants have been examined based on consecutive sampling as part of standard CI follow-up for children between 2008 and 2015. All participants had an unaided pure tone average of 90 dB or higher, averaged over the frequencies of 1000, 2000 and 4000 Hz before cochlear implantation. Only data of participants with no diagnosed additional problems, such as developmental disorders and psychopathology, were included. Data included information on 53 eligible participants. The descriptive statistics of the total CI group are listed in Table 1. Four children were one or two years older than the

Table 1
Descriptive statistics of the CI total group and the CI participants in mainstream and special HI educational setting.

		CI Total group n = 53		Mainstream n = 38	Special HI n = 15	*p*
		N	%	n (%)	n (%)	
Gender	Female	25	47	18 (47)	7 (47)	.96
	Male	28	53	20 (53)	8 (53)	
Etiology	Congenital	29	55	19 (50)	10 (66)	.64
	Acquired – prelingual (age <3)	12	22	10 (26)	2 (13)	
	Acquired – postlingual (age >3)	2	4	1 (3)	1 (7)	
	Progressive	3	6	2 (5)	1 (7)	
	Unknown	7	13	6 (16)	1 (7)	
Unilateral or bilateral CI	Unilateral	40	75	27 (71)	13 (87)	.23
	Bilateral	13	25	11 (29)	2 (13)	
		M (SD)	Range	M (SD)	M (SD)	
Age at testing (in years)		14.2 (2.8)	8.1–20.9	14.4 (3.0)	13.7 (2.4)	.47
Age at 1st ear implanted (in years)		3.8 (2.4)	1.0–11.6	3.9 (2.7)	3.5 (1.2)	.60

recommended age range of 18 years for the self-concept questionnaires (respectively 19.0, 19.1, 20.4 and 20.9 years). We decided to keep the data of these children in the study, as they were still receiving guidance from the children's cochlear implant team at that time. Children attended mainstream education or education specialized for HI children. Data of the participants was divided into two subgroups related to educational setting; mainstream educational setting and special HI educational setting. The descriptive statistics of the both subgroups are also presented in Table 1.

2.2. Procedure and assessments

The long-term evaluation of CI rehabilitation in children included auditory, language and psychosocial assessments and was performed during evaluations 3–10 years after children received a CI. Auditory and language evaluation was repeated each year, psychosocial evaluation every 5 year. The audiological and language data are derived from the evaluation moment at which the children also completed the CBSK/CBSA. After technical inspection of the CI and a fitting session, speech perception assessments were conducted by an audiologist or audiologist assistant. Next, a receptive vocabulary test was conducted by a language and speech pathologist or speech therapist. Furthermore, children completed a self-concept questionnaire. Support of a social worker or psychologist was available for clarification of the questions, because reading comprehension remains difficult for profoundly HI children and profoundly HI children with CI [55,56]. The participants were addressed in their preferred mode of communication; spoken, sign supported Dutch or Dutch sign language. The order of the assessments was random for each participant.

2.3. Speech perception

Speech perception was tested with the Dutch Audiology Society (NVA) children's test containing consonant – vowel – consonant (CVC) words [57]. This test was carried out in a sound-treated booth by an audiologist. Stimuli were presented in the sound field at a presentation level of 65 dB SPL. The NVA children's test consists of lists of 12 CVC words, in which a correct phoneme score is calculated over the last 11 words per list. Scores are expressed as a percentage of correctly repeated phonemes. Speech recognition scores at or above 85% were considered adequate [58,59].

2.4. Language comprehension

Language comprehension z-scores were derived from three different assessments: the Reading Comprehension Test [60] (n = 28), the Peabody Picture Vocabulary Test–III–NL (PPVT) [61] (n = 20) and the Receptive One-Word Picture Vocabulary Test (ROWPVT) [62] (n = 5). The three language tests are all standardized and validated for normal hearing Dutch children and adolescents [60–62]. Language tests differ because the protocol for the evaluations has changed in these years. Receptive vocabulary (word comprehension) is known to be an important factor in and is strongly associated with reading comprehension for hearing children [61,63] as well as for deaf children [64]. Therefore, we used these receptive language outcomes and transformed them into *z*-scores. For example a *z*-score below −1.00 the average range was considered to be a low reading comprehension result.

2.5. Perceived competence and global self-worth

Perceived competence and global self-worth were assessed with the Dutch language version of the Self-Perception Profile for Adolescents [16] and the Perceived Competence Scale for Children [7]. The Dutch Perceived Competence Scale for Children (Competentie Belevingsschaal voor kinderen (CBSK)) was administered to children 4–12 years old [65]. The Dutch Perceived Competence Scale for Adolescents (Competentie Belevingsschaal voor adolescenten (CBSA)) was administered to adolescents 12–18 years old [20]. The CBSK and the CBSA are both standardized and validated for normal hearing Dutch children and adolescents [20,65]. The CBSK measures perceived competence in five specific domains of life: Scholastic Competence, Social Acceptance, Athletic Competence, Physical Appearance and Behavioral Conduct. In addition, an extra domain assesses Global Self-worth, which is the extent to which one likes himself or herself as a person overall. In addition to these six domains, the CBSA also measures an extra domain: Close Friendship.

Each domain of the CBSK and CBSA contains five or six items. Each item compromises descriptions of two different kind of peergroups. The respondent is first asked to decide which of the two peergroups he/she belongs to. For example, 'Some teenagers like to go to the movies' but 'Other teenagers don't like to go to the movies'. After making this choice, the respondent must rate how much (a lot or a little bit) this description describes him or her. Answers are scored from 1 to 4, with 4 representing a higher self-concept. Domain scores were derived by summing the scores of all the answers belonging to that domain and comparing this score to that of the Dutch normative sample. Test outcomes are expressed as percentile scores.

The data of CI participants between 8 and 12 years of age (n = 11) were compared to the Dutch normative sample of the CBSK, consisting of 361 children, of whom 50% were male and 50% were female [64]. Data of CI participants between 12 and 18 years of age (n = 42) were compared to the Dutch normative sample of the CBSA consisting of 1394 adolescents matched on educational level, of whom 44% were male and 56% were female [20].

2.6. Ethical considerations

This study was carried out in accordance with the recommendations of the Committee on Research involving Human Subjects of the Radboud University Medical Center. All parents of the participants gave written informed consent for the use of patient file data, in accordance with the Declaration of Helsinki.

2.7. Statistical analyses

For statistical analyses, IMB SPSS Statistics 25 was used. The assumption of normality, tested with Kolmogorov-Smirnov test, was violated for almost all the study variables; therefore, nonparametric analyses were used.

Firstly, we computed the median and interquartile ranges and range of the speech perception and language comprehension results for the CI Total group and the two educational subgroups. Proportions of low and adequate speech perception and language comprehension results were also computed for the CI Total group and the two educational subgroups. Next, The Mann-Whitney *U* test ($p < .05$) was used to evaluate whether speech perception and language comprehension results differ between the Mainstream educational subgroup and the Special HI educational subgroup.

Furthermore, the proportions of low, normal and high perceived competence and global self-worth in the CI Total group, in the Mainstream educational subgroup and the Special HI educational subgroup were computed. In line with the clinical use of the CBSK and CBSA, children with percentile scores lower than 15 were classified as having low perceived competence, children with a percentile score of 85 or higher were classified as having high perceived competence. All scores in between were classified as normal perceived competence [20,65]. To investigate the clinical significance, the percentages of low, normal and high perceived competence and global self-worth scores in the total CI group were compared with the percentages of the Dutch normative sample on the CBSK and CBSA. A total of 15% of the Dutch normative sample achieved a low perceived competence score, 70% a normal perceived competence score and 15% a high perceived competence score [20,65]. The chi-square test for goodness of fit ($p < .05$), with Cohen's *w* as a measure of effect size, was used for this comparison.

Next, the percentages of low, normal and high perceived competence and global self-worth scores of the Mainstream and Special HI educational setting subgroups were compared with the percentages of the Dutch normative sample of the CBSK and CBSA. Due to the small sample sizes of both groups, and therefore the violation of the expected frequencies, Fisher's - Freeman - Halton exact test ($p < .05$), with 5 min. time limit per test, was used for these comparisons. Cohen's *w* was used as a measure of effect size.

We used the Mann-Whitney *U* test ($p < .05$) to evaluate whether perceived competence and global self-worth differ amongst children with CIs in mainstream or special HI educational settings. Kendall's Tau-b ($p < .05$) was used to investigate any relationships between speech perception, language comprehension, the perceived competence domains, global self-worth, and other study variables.

3. Results

3.1. Speech perception and language comprehension results of the CI Total group & educational subgroups

Table 2 shows the results of the speech perception and language comprehension tests for the CI Total group and the two educational subgroups. Mann-Whitney *U* test showed no significant differences between both educational subgroups on the speech perception scores. Significant differences were found in the distributions of the language comprehension scores of the Mainstream educational setting subgroup (*Mean Rank*$_1$) and the Special HI educational setting subgroup (*Mean Rank*$_2$) (*Mean Rank*$_1$=30.18, *Mean Rank*$_2$ = 18.93, $U = 164.00$, $z = -2.39$, $p = .02$). A large proportion of approximate 50% the CI Total group achieved a low language comprehension score. In the special HI educational setting 67% of the CI children didn't achieved age appropriate language comprehension development, against 42% of the CI children in the mainstream educational setting. There was a wide range in speech perception scores and in language comprehension scores. Patiëntfile study shows that the two children with the lowest score on speech perception (8%) and language comprehension (−9.9) both received their CI post-lingually at the age of 7. Before implantation they were both deaf for several years.

3.2. Differences between the proportions of low, normal and high levels of perceived competence and global self-worth of the CI Total group & educational subgroups and the normal hearing children

The proportions of low, normal and high perceived competence levels and global self-worth level of the CI Total group and the educational subgroups were compared to those of the Dutch normative sample. The chi-square test for goodness of fit showed that the proportions of low, normal and high levels of perceived competence and global self-worth of the CI Total group differed significantly from the Dutch normative sample on the domains Scholastic Competence, Athletic Competence, Physical Appearance and Behavioral Conduct, with medium to large effect sizes. Remarkably, on these domains the proportion of high perceived competence levels in the CI Total group were higher than that in the normal-hearing normative sample. The proportions of low, normal and high levels of perceived competence and global self-worth levels, Fisher's - Freeman - Halton exact test P values and Cohen's *w* values are presented in Table 3 for the CI Total group.

Differences in the proportions of low, normal and high levels of perceived competence and global self-of the two distinct educational setting subgroups, Mainstream & Special HI, and the Dutch normative sample are also presented in Table 3. Significantly more children with CIs in mainstream educational setting reported a high perceived competence score on Scholastic Competence, Athletic Competence and Physical Appearance than the children in the Dutch normative sample. Fisher's - Freeman - Halton exact test could not be carried out for the

Table 2
Median, Interquartile Ranges, Range and Proportions of Speech Perception and Language Comprehension Results for the CI Total Group and the Mainstream and Special HI Educational Setting Subgroups.

Outcome	Group	N	Q1	Median	Q3	Range	Proportion (%)	
							Low	Adequate
Speech perception at 65 dB-SPL (%)								
	CI Total group	53	83	90	96	8–100	28	72
	Mainstream	38	85	92	98	8–100	24	76
	Special HI	15	78	89	93	52–97	40	60
Language comprehension (z-score)								
	CI Total group	53	−3.2	−1.0	0.2	−9.9–1.6	49	51
	Mainstream	38	−1.3	−0.6	0.3	−9.9–1.6	42	58
	Special HI	15	−6.4	−3.0	−0.9	−7.7–0.7	67	33

Table 3
Proportions of Low, Normal and High reported levels of Perceived Competence and Global Self-Worth of the CI Total group and the Mainstream and Special HI Educational Setting Subgroups, compared to the Dutch Normative Sample of the CBSK/CBSA and Fisher's Exact Test P values and Cohen's w.

Group	Domain	N	Proportions			P	w
			Low %	Normal %	High %		
Dutch Normative Sample			15	70	15		
CI Total group	Scholastic Competence	53	8	62	30	.01*	.45
	Social Acceptance	53	8	75	17		
	Athletic Competence	53	13	59	28	.03*	.37
	Physical Appearance	53	4	58	38	.00*	.67
	Behavioral Conduct	53	4	60	36	.00*	.62
	Close Friendship	42	14	72	14		
	Global Self-Worth	53	11	58	11		
Educational setting subgroups							
Mainstream	Scholastic Competence	38	3	60	37	.00*	.66
	Social Acceptance	38	8	71	21		
	Athletic Competence	38	13	53	34	.01*	.54
	Physical Appearance	38	5	53	42	.00*	.77
	Behavioral Conduct	38	0	55	45	a.	
	Close Friendship	32	16	68	16		
	Global Self-Worth	38	5	67	26		
Special HI	Scholastic Competence	15	20	67	13		
	Social Acceptance	15	7	86	7		
	Athletic Competence	15	13	74	13		
	Physical Appearance	15	0	73	27	a.	
	Behavioral Conduct	15	13	74	13		
	Close Friendship	10	9	82	9		
	Global Self-Worth	15	13	74	13		

Note. *$p < .05$ a. Low perceived competence was not observed. It was not possible to conduct Fisher's - Freeman - Halton exact test.

Behavioral Conduct domain because none of the children with CIs reported a low perceived competence score on this domain (empty cell), compared to 15% of the Dutch normative sample. However, 45% of the children with CIs in mainstream educational setting reported a high perceived competence score on this domain, compared to 15% of the Dutch normative sample. This percentage is the largest proportion of high scores of all domains so significance can be assumed.

Children with CIs in special HI educational setting reported a similar distribution of low, average and high perceived competence levels as their peers in the Dutch normative sample. Results are presented in Table 3. There were no significant differences. Fisher's - Freeman - Halton exact test could not be carried out on the Physical Appearance domain because none of the children with CIs reported a low perceived competence score on this domain, against 15% of the normal-hearing normative sample. Of the children with CIs in special HI educational setting, 27% reported a high perceived competence score on this domain.

3.3. Differences in self-concept amongst the two educational subgroups of CI users, those in mainstream and those in special HI settings

The Mann-Whitney *U* test was used to evaluate whether there were differences in perceived competence and global self-worth scores between children with CIs in mainstream and special HI educational settings. Distributions of the scores of the Mainstream educational subgroup (*Mean Rank*$_1$) and the Special HI educational subgroup (*Mean Rank*$_2$) differed significantly on the Scholastic Competence domain (*Mean Rank*$_1 = 30.39$, *Mean Rank*$_2 = 18.40$, $U = 156.00$, $z = -2.55$, $p = .01$), the Athletic Competence domain (*Mean Rank*$_1 = 29.76$, *Mean Rank*$_2 = 20.00$, $U = 180.00$, $z = -2.08$, $p = .04$), and the Behavioral Conduct domain (*Mean Rank*$_1 = 31.24$, *Mean Rank*$_2 = 16.27$, $U = 124.00$, $z = -3.19$, $p = .001$). Children with CIs in the Mainstream educational setting subgroup reported significantly higher scores on these domains than children with CIs in the Special HI educational setting subgroup. Significant differences were also found in the Global Self-worth domain, on which children with CIs in the Mainstream educational subgroup (*Mean Rank*$_1 = 29.71$) reported higher scores than children with CIs in the Special HI educational subgroup (*Mean Rank*$_2 = 20.13$, $U = 182.00$, $z = -0.04$, $p = .04$). As illustrated in Fig. 1, children with CIs in the Mainstream educational subgroup reported a higher perceived competence score on the domains, as previously described, than children with CIs in the Special HI educational subgroup. No significant differences were found in the other domains.

3.4. Correlations between speech perception, language comprehension and perceived competence & global self-worth

Kendall's Tau-b was used to investigate associations between speech perception, language comprehension, and the perceived competence domains and global self-worth. The results indicated positive associations between speech perception and language comprehension, between speech perception and Scholastic Competence, and between language comprehension and Scholastic Competence. Test age showed a positive association with age at implant and negative associations with language comprehension, Social Acceptance and Global self-worth. Age at cochlear implantation showed negative associations with language comprehension, Social Acceptance and Global self-worth, which means that children implanted at a later age achieved lower language comprehension, Social Acceptance and Global self-worth results. Associations of the study variables are reported in Table 4.

4. Discussion

Our study shows that the total group of profoundly HI children with CIs reports positive levels of self-concept. That is, in all domains the proportion of low perceived competence levels is limited and the proportion of average or high levels is well within the normal range. Interestingly, on the Scholastic Competence, Athletic Competence, Physical Appearance and Behavioral Conduct domains the proportions of high perceived competence levels are even larger in children with CIs than those in the normal-hearing normative sample. Social Acceptance, Close Friendships and Global self-worth show distributions that are comparable to that of the normative sample. These results are in accordance with results of other studies on self-concept and self-esteem in CI children [41,66,67]. Previous findings of Van Gent et al. [31] noted lower social acceptance and close friendships scores than normal hearing peers in profoundly HI children without CIs, who do not have auditory access to spoken language. Our results suggest that the improved auditory abilities with a CI may have facilitated the development of a positive self-concept.

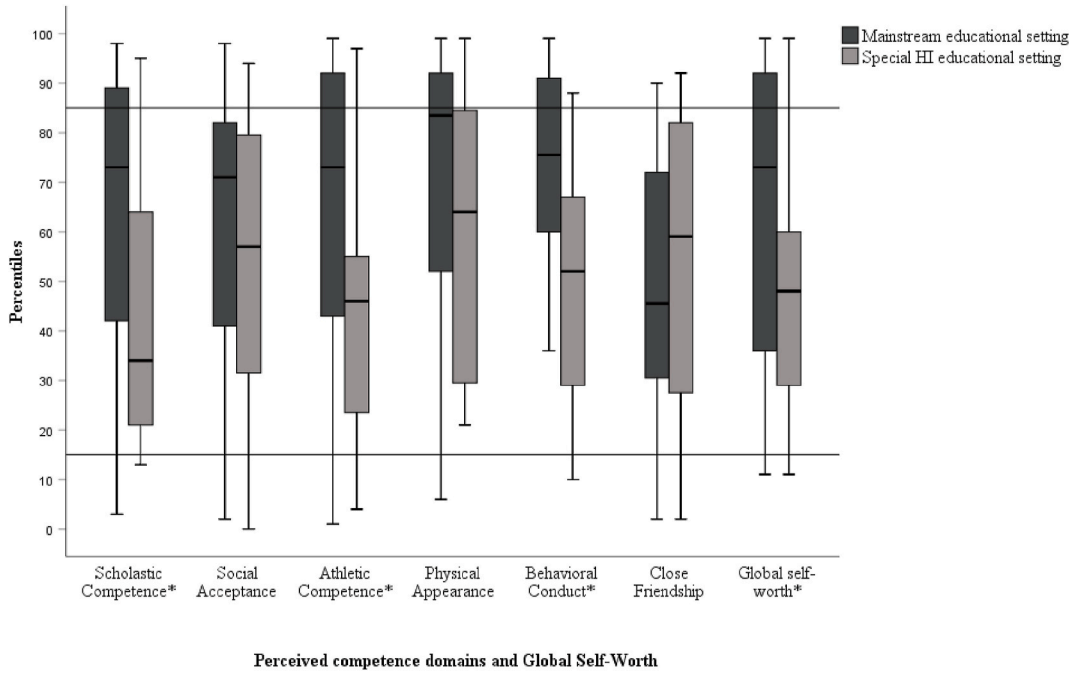

Fig. 1. Box plots illustrating the distribution of scores of children with CIs in the Mainstream and Special HI educational setting subgroups on the perceived competence domains and on global self-worth. The black center line in the boxes denotes the median value (50th percentile), while the upper and lower lines of the boxes denotes the 25th and 75th percentiles of dataset. The black whiskers mark the minimum and maximum score of all of the data. The horizontal lines at 15% and 85% represent the boundaries of low, normal and high perceived competence scores of the Dutch normative sample. Significant differences between the educational subgroups are marked with asterisks.

Table 4
Correlations of study variables.

Study variable		1	2	3	4	5	6	7	8	9	10	11
1	Test age	–										
2	Age of implant	.63*	–									
3	Speech perception	-.18	-.16	–								
4	Language comprehension	-.38*	-.36*	.42*	–							
5	Scholastic competence	-.21*	-.15	.27*	30*	–						
6	Social Acceptance	-.20*	-.20*	.14	.05	.15	–					
7	Athletic Competence	-.18	-.08	.04	.04	.35*	.35*	–				
8	Physical Appearance	-.13	-.14	.13	.01	.23*	.35*	.17	–			
9	Behavioral Conduct	.04	-.09	.01	.14	.19	.17	.14	.04	–		
10	Close Friendships	.13	.04	-.01	-.09	-.03	.44*	.09	.19	.03	–	
11	Global self-worth	-.28*	-.20*	.10	.09	.21*	.55*	.42*	.43*	.22*	.09	–

*$p < .05$.

The comparison of the proportions of the two distinct educational peer groups with the normative sample, shows that perceived competence of children in special HI educational settings is at a similar level as that of hearing peers. In mainstream educational settings perceived competence outcomes are even more favorable than the normative sample on Scholastic Competence, Athletic Competence, Physical Appearance and Behavioral Conduct domains. The positive outcomes of the CI Total group are a result of the high scores obtained by children in the Mainstream educational setting subgroup. Hintermair [68] also found better quality of life scores for HI children in mainstream educational settings than for their normal-hearing peers. The favorable outcomes of children in the mainstream educational setting compared to the normative sample, as opposed to those of children in special HI educational settings in our study are similar to those of Keilmann, Limberger et al. [52]. They also found scores of HI children in mainstream educational settings that were comparable to those of normal hearing peers, as well as higher self-confidence scores in HI children in mainstream educational settings than in those in special educational settings for HI children. Comparison amongst the two educational subgroups in our study shows significant differences in favor of the mainstream educational subgroup on all domains in which the mainstream subgroup obtains higher scores than the normative sample (Physical Appearance cannot be computed). Furthermore, the Mainstream educational subgroup obtains a significant higher median score on Global self-worth as compared to the Special HI educational subgroup.

A possible explanation for the found differences in the educational subgroups could be due to speech perception and language abilities. Children with CIs experiencing problems with speech perception and/or language development are referred to special HI educational settings. The differences between educational subgroups thus are merely a reflection of the poorer speech perception and language abilities of children in special HI educational settings [42,43,52]. Poorer speech perception and/or lack of age adequate language levels are expected to complicate social learning. Indeed, the association between speech perception & language problems and social- and emotional problems & self-esteem is already well documented [29,30,69].

Another explanation for the observed differences in self-concept

scores between CI children in mainstream educational settings and special HI educational settings has been suggested by Keilmann et al. [52]; "*parents who are very involved and have self-confident children choose a regular school*". The domains on which the mainstream educational subgroup in our study obtains higher outcomes than the normative sample, belong to the cluster that is more strongly related to parental support than to peer support [17,19]. It might be the case that children in mainstream educational settings have experienced much positive parental feedback on these domains.

In our study only positive correlations of both speech perception and language comprehension with the reported self-competence on the scholastic domain are present. For children in mainstream educational settings this may reflect the direct role of spoken language in the educational curriculum. For children in special HI educational settings, where Dutch sign language or sign supported Dutch is used, scholastic competence does not necessarily rely on spoken language skills. Nevertheless, spoken language is an important prerequisite for language development, reading and academic performance [47,55,70]. Several studies endorse the relation between language development and the scholastic competence domain of the Self-Perception Profile for Adolescents and the Perceived Competence Scale for Children. Children with specific language impairment, and therefore lower levels of language comprehension, obtain lower levels of scholastic competence than typical developing peers without language impairment [71,72]. The found relation between language comprehension and scholastic competence in our study, as in other research [71,72] could be seen as a strand of evidence for validity to use these questionnaires in HI children.

No correlations amongst language and other self-concept domains were found. This could be due to the fact that the other domains do not rely on language skills in such a direct manner, or that language is sufficient for these purposes. Another reason for the lack of associations might be that in our study only receptive language has been measured, whereas several studies show that expressive language and especially communication abilities are also related to emotional development [23,26,28]. Test age showed a positive association with age at first cochlear implantation which is a consequence of the fact that the eldest adolescents have received their implant a decennium ago, at which age at implant was relatively high. This mechanism also explains the negative association of test age and of age of first cochlear implantation with language comprehension. After all, implantation at younger age leads to better language outcomes, because they received an implant at an age at which language development could be optimized [73]. In the same vein the relations with social acceptance and global self-worth may be explained.

Some additional considerations should be made concerning the interpretation of the outcomes; Firstly, biases in self-concept scores could have been caused for instance by cognitive distortion [74]. It is possible that due to insufficiently developed cognitive capacities, the distinction between their actual self and their ideal self is insufficient. Therefore it is possible that the CI children overestimated their own competencies. Data on cognitive capacities of all our participants was unfortunately not available, which could be considered as a limitation of this study. It is expected that there are no cognitive problems in the children with CI, as children with additional problems have been excluded from this study. Secondly, the involvement of a psychologist for clarification of the questions and/or translation into sign language is not according the standardized protocol [65]. Notwithstanding the fact that the psychologist's task was limited to clarification and they were instructed not to interfere with the choices the children would make, their presence may have affected the children's answers. Therefore, we cannot exclude some slightly increased tendency to social desirability in the responses of the children in our study [65]. In the Mainstream educational subgroup, for children with adequate reading and language skills, the involvement of the psychologist was minor and a possible effect will be minimalized. Thirdly, psychometric analyses of the Self-Perception Profile for Children show that all domains consist only five or six items that are nearly the same. Also, medium to high self-concept scores are difficult to distinguish from each other [75]. The outcomes of this study show relatively high levels of perceived competence on various domains; however, subtle needs might still be present.

5. Conclusion

This study has shown that the total group of profoundly HI children with CI report comparable or higher levels of self-concept than their normal-hearing peers. That is, they are generally satisfied with themselves and their functioning in various domains. Better speech perception and language comprehension levels were associated to better outcomes in the Scholastic Competence domain. Earlier cochlear implantation was associated with higher Social Acceptance and Global self-worth.

Funding

This study was financially supported by Cochlear Benelux.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Acknowledgements

The authors would like to thank Marit Lindner MSc., Dr. Nanda Poulisse, Wies Goossens MSc., Trees van Nunen MSc. and Fabienne Piso MSc. for their contribution regarding data collection, Lonneke Kersbergen - van Oord MSc. for her contribution regarding data preparation and Dr. Chris Verhaak for providing critical feedback regarding the manuscript.

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