International Journal of Audiology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/iija20

A systematic review on the impact of auditory functioning and language proficiency on psychosocial difficulties in children and adolescents with hearing loss

Tjeerd J. de Jong, Marc P. van der Schroeff, Luuk Stapersma & Jantien L. Vroegop

To cite this article: Tjeerd J. de Jong, Marc P. van der Schroeff, Luuk Stapersma & Jantien L. Vroegop (27 Oct 2023): A systematic review on the impact of auditory functioning and language proficiency on psychosocial difficulties in children and adolescents with hearing loss, International Journal of Audiology, DOI: 10.1080/14992027.2023.2261074

To link to this article: https://doi.org/10.1080/14992027.2023.2261074

INTERNATIONAL JOURNAL OF AUDIOLOGY
https://doi.org/10.1080/14992027.2023.2261074

REVIEW ARTICLE

OPEN ACCESS Check for updates

A systematic review on the impact of auditory functioning and language proficiency on psychosocial difficulties in children and adolescents with hearing loss

Tjeerd J. de Jong[a], Marc P. van der Schroeff[a], Luuk Stapersma[b,c,d] and Jantien L. Vroegop[a]

[a]Department of Otorhinolaryngology, Head and Neck Surgery, Erasmus University Medical Center, Rotterdam, The Netherlands; [b]Department of Child and Adolescent Psychiatry/Psychology, Erasmus University Medical Center, Sophia Children's Hospital, Rotterdam, The Netherlands; [c]Levvel, Academic Center for Child and Adolescent Psychiatry, Amsterdam, The Netherlands; [d]Child and Adolescent Psychiatry, Amsterdam UMC location University of Amsterdam, Amsterdam, The Netherlands

ABSTRACT

Objective: Approximately 20% to 40% of children with hearing loss encounter psychosocial difficulties. This prevalence may be outdated, given the advancements in hearing technology and rehabilitation efforts to enhance the psychosocial well-being of these children. A systematic review of up-to-date literature can help to identify factors that may contribute to the children's psychosocial well-being.

Design/Study sample: A systematic review was conducted. Original articles were identified through systematic searches in Embase, Medline, PsychINFO, and Web of Science Core Collection. The quality of the papers was assessed using the Newcastle-Ottawa Quality Assessment Scale and custom Reviewers' Criteria.

Results: A search was performed on 20 October 2022. A total of 1561 articles were identified, and 36 were included for review. Critical appraisal led to 24 good to fair quality articles, and 12 poor quality articles.

Conclusion: Children with hearing loss have a twofold risk of experiencing psychosocial difficulties compared to normal hearing peers. Estimates for functioning in social interactions, like speech perception (in noise) or language proficiency, have proven to be more adequate predictors for psychosocial difficulties than the degree of hearing loss. Our findings can be useful for identifying children at risk for difficulties and offering them earlier and more elaborate psychological interventions.

ARTICLE HISTORY
Received 29 June 2022
Revised 9 September 2023
Accepted 13 September 2023

KEYWORDS
Communication; psychosocial well-being; speech perception; language proficiency; children; hearing loss

Objective

It is well-established that children with hearing loss are at an increased risk for experiencing psychosocial difficulties compared to their peers with normal hearing (Hoffman et al. 2016; Netten et al. 2018; Theunissen et al. 2014a; Theunissen et al. 2011; Theunissen et al. 2014b). These difficulties can be broadly classified into emotional and behavioural problems, such as anxiety, depression, aggression, and hyperactivity (Hintermair 2007; Stevenson et al. 2015; van Gent et al. 2007), and social difficulties, such as poor peer relationships and low assertiveness in social interactions (Martin et al. 2011; Rieffe et al. 2018; Wolters et al. 2011).

The exact prevalence of psychosocial difficulties in children with hearing loss is difficult to determine, with estimates ranging from 20% to 40% (Stevenson et al. 2015). It is important to note that these estimates may not accurately reflect the current prevalence, as they are based on studies conducted prior to the widespread implementation of newborn hearing screening programs. Additionally, it is important to acknowledge the significant advancements in hearing technology and the focused rehabilitation efforts aimed at improving the psychosocial well-being of these children. With the availability of early detection and intervention for hearing loss, the landscape of psychosocial difficulties may have evolved, potentially affecting prevalence rates.

Hearing loss can have a significant impact on perceiving and distinguishing speech sounds, hindering children's ability to develop vocabulary, grammar, and comprehension. This may create a developmental gap between children with hearing loss and those without, leading to a mismatch in communication strategies. The impact of hearing loss becomes particularly evident in social environments with background noise. In such settings, the perception of multiple auditory cues can be hindered, requiring significant listening effort which may lead to fatigue (McGarrigle et al. 2014). This may limit their social learning and lead to a reduction in self-esteem and a further decline of social interactions (Ching et al. 2007; Hoffman et al. 2016; Theunissen et al. 2014a). A likely hypothesis may be that more psychosocial difficulties could be present in children with higher degrees of hearing loss. Nonetheless, existing literature fails to find an association between degree of hearing loss and the severity of psychosocial difficulties (Bat-Chava et al. 2001; Bat-Chava et al. 2005; Calderon 2000; Fellinger et al. 2008; Huber et al. 2015; Leigh et al. 2015; Most et al. 2012; Stevenson et al. 2010; Stika et al. 2015; Theunissen et al. 2015; Wake et al. 2004; Wong et al. 2020; Wong et al. 2018b; Wong et al. 2017). One potential

CONTACT Tjeerd J. de Jong Tjeerd.dejong@erasmusmc.nl Department of Otorhinolaryngology, Head and Neck Surgery, Erasmus University Medical Center, PO box 2040, 3000 CA Rotterdam, The Netherlands.

Supplemental data for this article can be accessed online at https://doi.org/10.1080/14992027.2023.2261074

explanation may be the fact that early and adequate rehabilitation with hearing aids or cochlear implants can significantly improve a child's auditory functioning and language skills. This improved functioning can have a positive impact on the child's psychosocial well-being and may mitigate any negative effects of increased hearing thresholds. As a result, the degree of hearing loss may not accurately reflect the daily life auditory functioning of children who have received rehabilitation. This is supported by a previous study that found no association between pure tone audiometry and psychosocial difficulties, while at the same time a questionnaire on auditory functioning in daily life was strongly related to the children's psychosocial functioning (Wong et al. 2017). Auditory functioning can be assessed through measures of speech perception or questionnaires on daily life functioning. Additionally, better language proficiency in children has been associated with a more solid social network (Gerich and Fellinger 2012; Wong et al. 2018a). Recently, the review of Byatt et al. (2019) provided a narrative assessment of the importance of adequate language development, which has been mentioned by other reviewers as well (Brice and Strauss 2016; Stevenson et al. 2015). It is important to recognise that psychosocial functioning is an important aspect of patient-centered healthcare and to identify children at risk in order to provide appropriate support and resources to help them manage their challenges and maintain good psychosocial well-being.

An up to date systematic review, including studies after introduction of newborn hearing screenings, can help to identify the factors that may contribute to psychosocial difficulties in children with hearing loss and provide a more comprehensive understanding of how to address these challenges. This may include examining auditory functioning and linguistic skills, as well as other communicative factors, and addressing the mediating role of these factors in the relationship between hearing loss and psychosocial difficulties.

We therefore formulated three research aims:

1. To investigate the present known risk on psychosocial difficulties in children with hearing loss;
2. To investigate the extent to which auditory functioning is related to psychosocial difficulties in children with hearing loss;
3. To investigate the extent to which language proficiency is related to psychosocial difficulties in children with hearing loss.

Design/Study sample

Protocol

A review protocol was made, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) guidelines, updated in 2015 (Moher et al. 2015). It contains a 17-item checklist that describes the rationale and the systematic approach of the review (see Supplemental File 1 for the protocol).

Search strategy

A search strategy was created by a trained librarian, in accordance with the authors. Studies were identified by searching electronic databases. The search string for each database can be found in Supplemental File 2. This search was applied to Embase, Medline and PsychINFO (OvidSP), and Web of Science Core Collection. The search was performed on 20 October 2022.

Study selection

Eligibility assessment was performed independently in a standardised manner by two reviewers (T.J.d.J., M.P.v.d.S.). For inclusion, articles had to focus on the relationship between either auditory functioning or language proficiency and psychosocial difficulties in children with hearing loss. Measures for auditory functioning were speech perception in quiet or in noise, or reported outcomes on hearing abilities in daily life, for example estimated with the Parents' Evaluation of Aural/Oral Performance of Children (PEACH; Ching et al. 2007). Language proficiency was measured with clinical tests on receptive and expressive speech/language, or reported outcomes on language abilities in daily life. The age restriction of participants was set on zero to 21 years, to include studies on all developmental stages in youth. Only articles written in English were included. To ascertain that most participants were screened in early detection programs, and utilised modern Cochlear Implant (CI) systems, articles were included when published from January first, 2015 and onward.

All relevant articles were screened by title and abstract. When disagreements arose, the rationale for inclusion was discussed by three authors (T.J.d.J., M.P.v.d.S., J.L.V.) until agreement was reached. Afterward, the full texts of all eligible articles were read and assessed according to the eligibility criteria.

Study assessment

We assessed the methodological quality of each paper using the Newcastle-Ottawa Quality Assessment Scale (NOS) adapted for cross sectional studies. Due to the variety in approaches used by the different studies, we formulated four Reviewers' Criteria for befitting the aim of the current review. Each criterion met, yielded one point. A higher score would indicate the study to be more in line with the aim of the current review (specifics and application of the NOS and Reviewers' Criteria can be found in Supplemental File 3).

In total, 14 points could be scored in the Value Rating, specifically 10 on the NOS and 4 for meeting all Reviewers' Criteria. A higher Value Rating would indicate a more solid approach in investigating influences on psychosocial difficulties. Two authors assessed the Value Rating of the included papers (T.J.d.J. and J.L.V) independently. The rationale for scoring was discussed until agreement was reached (Value Ratings are displayed in Table 1, along with other study characteristics). In this review, conclusions were drawn when the majority of the papers reported a certain finding. In case of a tie (i.e. a similar quantity of papers reported contrasting results), conclusions were based upon the papers with the highest Value Rating.

Some of the included articles were study reports of a sample already represented by another paper. It is likely that the articles by Wong (2017, 2018b, 2020) and Ching et al. (2021) contain samples of the same cohort. Although it was often clear that the study samples were drawn from larger cohorts, the size of the sample overlap was not stated. Therefore, when calculating total sample sizes, possibly identical samples were left out. We also performed a *post-hoc* analysis, where we compared the prevalence of psychosocial difficulties in children with hearing loss to the prevalence in each paper's normal hearing reference groups.

Table 1. Overview of Study Characteristics and Reported Results.

First Author	Year	Country	Device	Sample Size	Minimal Age	Maximal Age	NOS Score	RC Score	Total Score	Main outcomes
Boerrigter	2018	Netherlands	CI	59	11	21	6	3	9	children with poorer aural language comprehension had more recalcitrance though more perseverance
Boerrigter	2019	Netherlands	CI	71	1	16	6	3	9	better auditory performance and better oral language correlated with better CBCL results
Brown	2015	Australia	Both	89	11	18	7	2	9	oral language use at home (vs. sign or combined) predicted better behaviour
Castellanos	2018	USA	CI	57	7	19	8	3	11	better oral language predicted higher psychosocial scores
Chang	2015	Korea	CI	65	1	7	7	2	9	higher pre-implant social scores predicted more gains in both auditory performance and oral language
Chao	2015	China	CI	60	6	18	8	2	10	better auditory performance and speech production intelligibility correlated with better CBCL results
Ching	2021	Australia	Both	144	9	9	8	4	12	better auditory performance predicted better psychosocial outcomes
Desoky	2021	Egypt	Both	75	6	7	5	1	6	lower degrees of hearing loss and higher language age correlated better CBCL results
Eichengreen	2023	Netherlands	CI	80	9	16	8	2	10	better oral language predicted fewer depressive symptoms and less externalising behaviour
Fitzpatrick	2022	Canada	–	69	4	4	6	2	8	better auditory performance correlated with better CBCL results
Guerzoni	2016	Italy	CI	28	2	18	8	3	11	better oral language correlated with higher social scores; pre-implant hearing was related to post-implant social scores
Haukedal	2020	Norway	CI	84	5	12	10	4	14	better oral language skills and using oral language (vs. sign or combined) predicted better hearing related quality of life
Hoffman	2015	USA	CI	74	2	5	8	2	10	better oral language proficiency in both deaf and hearing children correlated with better social competence
Huber	2015	Germany/Austria	CI	140	12	17	9	2	11	better speech perception in noise correlated with better behaviour
İkiz	2022	Turkey	CI	32	6	10	6	2	8	better oral language correlated with better psychosocial outcomes and academic competence
Jimenez-Romero	2015	Spain	CI	104	2	16	5	1	6	better hearing abilities correlated with fewer internalising symptoms
Le Clercq	2020	Netherlands	None	4779	9	11	9	4	13	lower hearing thresholds predicted better social skills, attention and school performance
Leigh	2015	Australia	Both	301	3	4	9	4	13	better language correlated with better social development, oral language (vs. combination) predicted better social development
Mann	2015	USA	–	37	6	11	5	1	6	weak language learners required more support in behaviour
Netten	2015a	Netherlands	Both	122	9	16	9	2	11	better oral language correlated with higher empathy scores, more prosocial motivation in orally communicating children (vs. sign)
Netten	2015b	Netherlands	Both	85	2	6	7	2	9	broader (spoken) vocabulary correlated with better psychosocial functioning
Netten	2018	Netherlands	CI	74	1	5	8	2	10	language skills did not predict psychosocial scores
Park	2016	Korea	CI	32	–	–	6	1	7	auditory performance did not correlate with CBCL outcomes
Percy-Smith	2021	Denmark	Both	58	0	10	8	1	9	social wellbeing was not different between groups with low vs. high language proficiency

(*continued*)

Table 1. Continued.

First Author	Year	Country	Device	Sample Size	Minimal Age	Maximal Age	NOS Score	RC Score	Total Score	Main outcomes
Sarant	2018	Australia	CI	159	5	8	8	2	10	higher receptive aural language predicted absence of psychosocial problems
Stevenson	2017	England	–	120	13	20	6	2	8	better language correlated with better psychosocial scores, children with hearing loss gain prosocial behaviour over time, while children without hearing loss do not
Stevenson	2018	England	–	57	6	20	7	2	9	better language abilities at age 6-10 correlated with better psychosocial scores at age 13-20, as rated by teachers, not by parents
Stika	2015	USA	HA	28	1	2	7	2	9	degree of hearing loss did not correlate with psychosocial outcomes
Stika	2021	USA	–	39	2	3	7	2	9	better oral language correlated with better socialisation skills, though not with psychological difficulties
Theunissen	2015	Netherlands	Both	132	8	16	8	2	10	better oral language predict better psychosocial outcomes
Wischmann	2022	Denmark	Both	47	4	9	6	1	7	no difference in social well-being was observed between high-, and low language performers
Williams	2020	USA	Both	22	2	11	6	2	8	no difference in social interaction between children with language impairment and children without
Wong	2017	Australia	Both	356	4	6	9	4	13	better oral language and auditory functioning predict better psychosocial outcomes, while degree of hearing loss does not
Wong	2018a	Australia	Both	24	11	14	6	1	7	oral language proficiency was related to neither parent- nor child reported social functioning
Wong	2018b	Australia	Both	356	4	6	9	4	13	better oral language and better response to sound predict better psychosocial outcomes
Wong	2020	Australia	Both	224	5	6	9	4	13	better hearing related functioning predicted better parent and teacher reported psychosocial outcomes

Notes: Table presents an overview of study characteristics, quality scores, and reported results. The SDQ and CBCL were most frequently used in psychosocial assessment, therefore results on these specific lists are denoted in the table. The 'informant' column describes who filled out the questionnaire (C = child, P = parent, T = teacher), a forward slash (/) indicates multiple informants. 'Test' indicates the psychosocial assessment in a test setting, performed by a clinician/investigator. In the rightmost column, most important results are briefly described. NOS: Newcastle-Ottawa Quality Assessment Scale; RC: Reviewers' criteria; CI: Cochlear implant; HA: Hearing aid; SDQ: Strengths and difficulties questionnaire; CBCL: Child behaviour checklist; USA, United States of America. The use of a dash (-) indicates that the characteristic was not specified in the study.

Data extraction

From all included articles, we extracted data about the study design, the number of participants included, their health and developmental status, age, communication mode, hearing device, auditory functioning, language proficiency, and reported psychosocial difficulties.

Results

Literature search and selection

The literature search resulted in 1561 study reports. After the removal of 628 duplicates, the titles and abstracts of 933 articles were screened. This resulted in the exclusion of 883 articles for not meeting the inclusion criteria. We read full text reports of 50 articles. We excluded an additional 16 articles, based upon the full text assessment, and we included two articles through reference list examination. This resulted in the inclusion of 36 articles for review (see the flow diagram of the study selection in Figure 1).

Quality of study methodology

With the aid of the NOS assessment, the general methodology of twenty-one papers (58%) qualified as good. Three papers (8%) qualified as fair. The remaining twelve papers (33%) had a poor general methodologic quality (Table 1 summarises the Value Rating per paper). The assessment of methodologic quality has been performed in the context of the present study's aims, therefore methodology may be judged differently against other backdrops. Seven papers (19%) met four out of four Reviewers' Criteria. Four papers (11%) met three criteria. Eighteen papers (50%) met two criteria. Seven papers (19%) met one criterion. Total value scores ranged from six to fourteen, where thirty papers (83%) scored eight points or more. A more detailed description of the study characteristics can be found in Supplemental File 4.

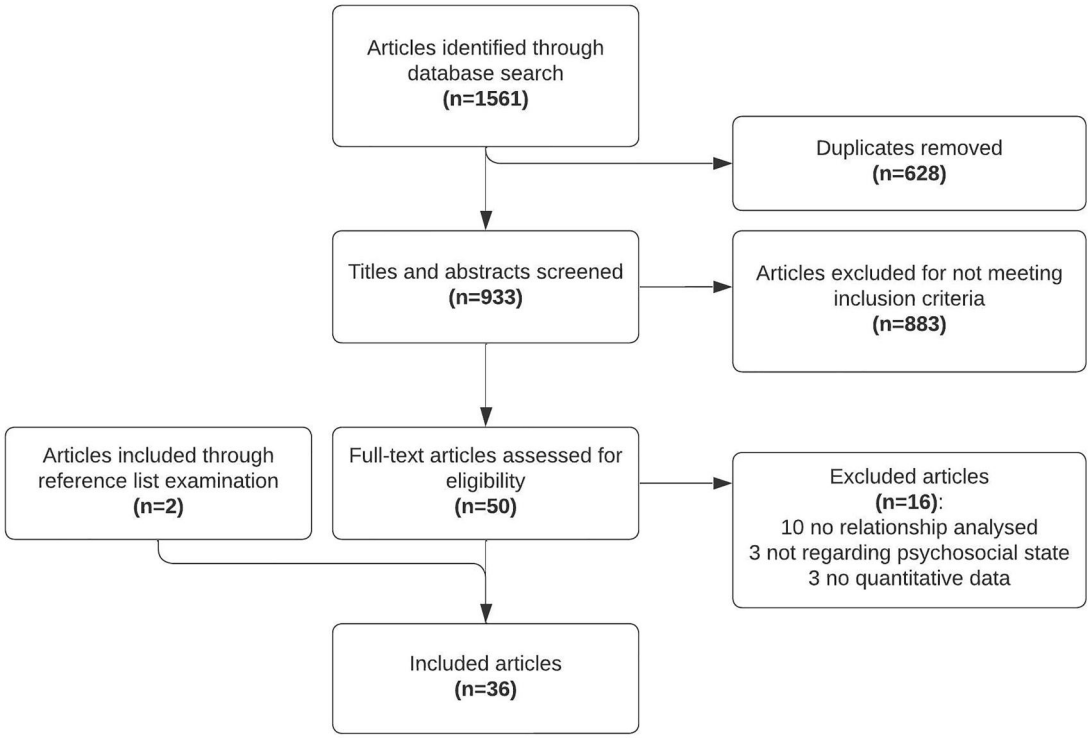

Figure 1. The Flow Diagram of the Article Identification and Inclusion.

Characteristics of the study populations

Thirty-six articles were included for systematic review. Sample sizes were between 22 and 356 participants, except for one study, which included 4779 participants. The characteristics of the study populations can be found in Table 2. Fourteen of the papers (38%) exclusively examined children wearing a CI, whereas only one paper focused entirely on children wearing hearing aids (HA).

Psychosocial difficulties in children with hearing loss

To address the research aim number one, the prevalence of psychosocial difficulties in children with hearing loss was compared to the general population in seven papers, with a total of 694 participants, and a good Value Rating, ranging between 8 and 12 (Boerrigter et al. 2018; Boerrigter et al. 2019; Chao et al. 2015; Ching et al. 2021; Fitzpatrick et al. 2022; Jimenez-Romero 2015; Sarant et al. 2018; Theunissen et al. 2015).

The majority of these papers (five out of seven) reported an elevated risk for psychosocial difficulties in children with hearing loss (Boerrigter et al. 2018; Chao et al. 2015; Ching et al. 2021; Jimenez-Romero 2015; Sarant et al. 2018; Theunissen et al. 2015). Especially delays in the development of prosocial behaviour were seen (Sarant et al. 2018). One article reported no difference in prevalence of difficulties between hard of hearing children and norm groups (Boerrigter et al. 2019). The prevalence of psychosocial difficulties ranged from 13% to 36%. Not all papers reported the same prevalence, and the range is likely due to different cut-off values for clinical scores. Therefore, on the five papers reporting an elevated risk, we performed a *post-hoc* analysis, where we compared the prevalence of psychosocial difficulties in children with hearing loss to the prevalence in each paper's normal hearing reference groups. We found that children with hearing loss were at odds of $1.9-2.2$ for experiencing psychosocial difficulties, compared to the normal hearing population (Boerrigter et al. 2018; Chao et al. 2015; Ching et al. 2021; Sarant et al. 2018; Theunissen et al. 2015).

Auditory functioning in relation to psychosocial difficulties

Speech perception

To address research aim number two, the relationship between speech perception and psychosocial difficulties was analysed in four papers, with a total of 5049 participants, and a good Value Rating range of 9–13 (Boerrigter et al. 2018; Boerrigter et al. 2019; Huber et al. 2015; Le Clercq et al. 2020). Speech perception was assessed with tests on word or sentence comprehension in silence, or word comprehension in noise.

All four papers reported that children with poor speech perception skills are at higher risk for psychosocial difficulties. Due to speech perception problems, children may withdraw from contact with peers, which decreases the time they spend on social interactions. This can lead to loneliness, low self-esteem, and depressive symptoms (Barker et al. 2009). Speech perception problems may also cause difficulties in understanding teachers and classmates in school, which can lead to poor educational attainments (Boerrigter et al. 2019; Le Clercq et al. 2020).

Daily auditory functioning was also commonly investigated through questionnaires, which were used in eleven papers, with a total of 1739 participants, and a generally good Value Rating, ranging between 6 and 13 (Chang et al. 2015; Chao et al. 2015; Ching et al. 2021; Fitzpatrick et al. 2022; Guerzoni et al. 2016; Jimenez-Romero 2015; Leigh et al. 2015; Park et al. 2016; Wong et al. 2020; Wong et al. 2018b; Wong et al. 2017). The Parents' Evaluation of Aural/Oral Performance of Children (PEACH) was used in five papers (Ching et al. 2021; Leigh et al. 2015; Wong et al. 2018b; Wong et al. 2017; Wong et al. 2018a). This is a 13-item questionnaire for parents on their children's ability to listen

and communicate in daily situations (T. Y. Ching and Hill 2007). One paper used the teacher version in addition (Wong et al. 2020). All PEACH papers demonstrated that better daily auditory functioning was associated with fewer parent-rated psychosocial difficulties. In the papers by Wong et al., this effect was also present after adjustment for language proficiency, maternal education, communication mode, age at intervention, severity of hearing loss, device (CI or HA), comorbidity, and nonverbal cognitive abilities (Wong et al. 2018b; Wong et al. 2017; Wong et al. 2018a). Four papers used the Categories of Auditory Performance (CAP) for investigating speech perception (Chang et al. 2015; Chao et al. 2015; Guerzoni et al. 2016; Park et al. 2016). The CAP is a one-item scale with a range of 0-7. Level 0 is "no awareness of environmental sounds" and level 7 "uses a telephone with a known speaker" (Archbold et al. 1995). It is often applied in research for assessment of the level of speech perception of children (Dammeyer 2010). A significant association between better speech perception and better psychosocial outcomes was also reported in two out of the four CAP papers (Chang et al. 2015; Chao et al. 2015), with moderate Value Ratings of 9 and 10. More favourable behaviour in school was related to better responsiveness to sound and clarity of speech, regardless of gender and severity of additional needs (Dammeyer 2010). Two CAP articles did not find an association between auditory functioning and psychosocial outcomes (Guerzoni et al. 2016; Park et al. 2016).

Hearing device related factors

No differences in psychosocial difficulties were observed between CI users and HA users. This was reported by the two papers with the highest Value Rating (13/14; Leigh et al. 2015; Wong et al. 2018b). No significant association was observed between device experience and the burden of psychosocial difficulties (Chao et al. 2015; Huber et al. 2015; Netten et al. 2018; Netten et al. 2015b).

The age at hearing rehabilitation was not associated with the burden of psychosocial difficulties in the majority of articles (9/13), among which five papers with the highest Value Rating (≥13/14; Haukedal et al. 2020; Huber et al. 2015; Leigh et al. 2015; Netten et al. 2018; Netten et al. 2015a; Netten et al. 2015b; Wong et al. 2020; Wong et al. 2018b; Wong et al. 2017). This is likely because most children were rehabilitated with hearing devices in early stages of infancy (23 months on average across studies), and the low variation in time of intervention explains why no differences were found.

Language proficiency in relation to psychosocial difficulties

Oral language skills

To investigate research aim number three, we reviewed thirty papers that evaluated the relationship between oral language skills and psychosocial difficulties, with a total of 3074 participants, and a good Value Rating, ranging from 6 to 14 (Boerrigter et al. 2018; Boerrigter et al. 2019; Castellanos et al. 2018; Chao et al. 2015; Ching et al. 2021; Desoky et al. 2021; Eichengreen et al. 2023; Fitzpatrick et al. 2022; Guerzoni et al. 2016; Haukedal et al. 2020; Hoffman et al. 2015; Ikiz and Yucel 2022; Leigh et al. 2015; Mann et al. 2015; Netten et al. 2018; Netten et al. 2015a; Netten et al. 2015b; Percy-Smith et al. 2021; Sarant et al. 2018; Stevenson et al. 2017; Stevenson et al. 2018; Stika et al. 2021; Stika et al. 2015; Theunissen et al. 2015; Williams et al. 2020; Wischmann et al. 2022; Wong et al. 2020; Wong et al. 2018b; Wong et al. 2017; Wong et al. 2018a). Oral language skills comprised proficiency in language comprehension and expression, measured through either objective language tests (27 articles), or through parent/therapist administered questionnaires (three articles).

The majority of articles describing the use of objective tests (20/27), reported fewer psychosocial difficulties in children with better language proficiency (Boerrigter et al. 2019; Desoky et al. 2021; Eichengreen et al. 2022; Haukedal et al. 2020; Hoffman et al. 2015; Ikiz and Yucel 2022; Mann et al. 2015; Netten et al. 2018; Netten et al. 2015a; Stevenson et al. 2017; Stevenson et al. 2018; Stika et al. 2021; Theunissen et al. 2015; Williams et al. 2020; Wong et al. 2018b; Wong et al. 2018a), in contrast to six studies that found no association (Ching et al. 2021; Fitzpatrick et al. 2022; Netten et al. 2015b; Lone Percy-Smith et al. 2021; Stika et al. 2015; Wischmann et al. 2022). In five studies, after adjustment for age, age of intervention, gender, nonverbal cognitive abilities, and socioeconomic status (SES), the link between language proficiency and psychosocial outcomes remained significant (Castellanos et al. 2018; Haukedal et al. 2020; Netten et al. 2018; Sarant et al. 2018; Stika et al. 2021). All articles with report measures, found that better reported use of oral language was related to fewer psychosocial difficulties (Chao et al. 2015; Guerzoni et al. 2016; Leigh et al. 2015).

Mode of communication

Three modes of communication were determined by the papers: oral language, sign language, and a combination of oral and sign language. Five papers reported the use of oral language to be associated with better psychosocial wellbeing compared to sign language or a combination of the two (Brown and Cornes 2015; Haukedal et al. 2020; Leigh et al. 2015; Netten et al. 2015a;

Table 2. Characteristics of the Populations in the 36 Reviewed Papers.

Sample size[a]		
Mean (SD)	240	(807)
Range (min, max)	22	4779
Median	75	
Age		
Mean (SD)	8.5	(4.2)
Range (min, max)	1	21
Mean adjusted for sample size	9.0	
Hearing device		
Cochlear Implant	14	39%
Hearing Aid	1	3%
Cochlear Implant and/or Hearing Aid	15	42%
Unspecified	5	14%
None	1	3%
Degree of hearing loss, as reported by papers		
Mild (< 41 dB HL)	1	3%
Mild - severe (20–90 dB HL)	3	8%
Mild - profound (>20 dB HL)	8	22%
Moderate - profound (>40 dB HL)	7	19%
Severe - profound (>70 dB HL)	5	14%
Profound (>90 dB HL)	6	17%
Unspecified	6	17%
Population's health		
children without additional needs	17	47%
children with additional needs not excluded	11	31%
Unspecified	8	22%

Notes: Table displays the population characteristics of the papers included in this review. For each characteristic, the absolute amount and share of total are denoted. For *Age*, 'Mean' indicates the average age per study, 'Mean adjusted for sample size' indicates the average age for all included participants. dB HL is an abbreviation for decibels hearing level.

[a]The frequency of sample sizes were not normally distributed, the Mean and Standard Deviation should therefore be interpreted with caution.

Wong et al. 2018b). Four papers, with slightly lower Value Ratings, found no relationship between communication mode and psychosocial outcomes (Netten et al. 2018; Netten et al. 2015b; Theunissen et al. 2015; Wong et al. 2017).

Discussion

With this review, we aimed to investigate the connection between psychosocial difficulties in children with hearing loss, and their auditory functioning and language proficiency. Therefore we examined 36 articles involving more than 7000 unique children who participated in various research studies. We conducted a systematic evaluation of these articles, assessing both the quality of the study design and the impact of communication abilities on psychosocial health. The review of these articles is observation based, as a meta-analysis was not feasible. Overall, we found that the vast majority of the articles had a satisfactory methodology. The majority of the articles were considered to be of high quality. Notably, the studies included children with a diversity in sound access, communication styles, aural rehabilitation and educational supports. The extensive range and sample size of participants contribute to the high representativeness of this review, enhancing its credibility and the generalisability of the findings to a broader population. Nonetheless, the presence of such heterogeneity poses a challenge in interpreting the results, as individualised solutions may be necessary to address the specific needs of children with different backgrounds.

Risk for psychosocial difficulties in children with hearing loss

The articles included in this review highlight an increased risk of psychosocial challenges among children with hearing loss when compared to normal hearing peers. Recent studies have iterated prevalence rates similar to those reported in Hindley's 2005 review, indicating that despite advances in rehabilitative care, and a more holistic approach to addressing their needs, these challenges may persist (Hindley 2005). It is possible that increased awareness of these issues has led to more reporting of them, also, the challenges faced by children with hearing loss may vary depending on their backgrounds. To assess the extent of these difficulties, we calculated the relative risk for such children compared to their normal hearing peers. Our findings indicate that children with hearing loss have twice the risk of experiencing psychosocial difficulties compared to their normal hearing counterparts, as demonstrated by the studies we reviewed that compared prevalence rates between the two groups.

Auditory functioning

This review creates more basis for understanding the relationship between psychosocial difficulties and communication abilities in children with hearing loss. When children are more capable to communicate, this may increase their aptness to participate in social interactions and friendships, which may explain their outcomes on psychosocial wellbeing. Social interactions may specifically take place in noisy environments, such as in classrooms, schoolyards, playgrounds, or during activities, such as sports, or parties. The ability to hear clearly in these settings is crucial for effective communication and participation. The findings of this review show that better auditory functioning reflects a healthier psychosocial state. Measures of auditory functioning, like speech perception tests (especially in noise) or questionnaires about daily life auditory functioning may therefore be predictive for psychosocial difficulties, as reported by all reviewed papers that investigated auditory functioning.

Social interactions and friendships are associated with better psychosocial wellbeing, like better self-esteem and emotion regulation (McElwain and Volling 2005). Isolation from social interaction, however, relates to loneliness, depressed mood, and low self-esteem (Bat-Chava et al. 2005; Castellanos et al. 2018; Dammeyer 2010; Netten et al. 2018). Moreover, limited opportunities for social learning may hinder the children's personality development, which can contribute to the development of psychiatric disorders, like depression, anxiety, or behavioural disturbances (Boerrigter et al. 2018). In addition to the social implications, speech perception plays a vital role in various daily life interactions, as well as understanding teachers and classmates in school, which can lead to poorer school functioning (Boerrigter et al. 2019; Le Clercq et al. 2020; Haukedal et al. 2020).

Using CIs represents a fundamentally distinct experience, involving differences in the associated degree of hearing loss, sound processing mechanisms, speech perception, and also their physical appearance. Nevertheless, there is no apparent disparity in the risk of developing psychosocial difficulties between children using CIs and those using HAs.

Language proficiency

In addition to auditory functioning, social interactions depend highly upon the level of language proficiency. Social- and pragmatic language skills aid in social learning, and could be protective against psychosocial symptoms (Stevenson et al. 2010; Theunissen et al. 2015; van Eldik et al. 2004). With age-adequate language proficiency, children with hearing loss may be more likely to be accepted by normal hearing peers, which improves social opportunities (Bat-Chava and Deignan 2001). Better language proficiency also increases the chance that children with hearing loss will attend regular schooling, which enables more exposure to verbal interaction, generating opportunities for more social and pragmatic development (Theunissen et al. 2015). Selection for the type of schooling should be carefully made, because children that communicate through sign language may encounter additional communicative barriers in a hearing environment. A mismatch in communication mode may be precursory for social isolation and psychosocial difficulties.

It's important to note that not all children with hearing loss may necessarily benefit from spoken language, as sign (supported) language may be a more suitable option for some individuals, as long as they can communicate effectively and without barriers. A recent review has revealed that children's language acquisition outcomes are comparable, regardless of whether they primarily use spoken language, sign language or bimodal bilingualism (Fitzpatrick et al. 2016). However, a mismatch in communication mode between the child and their environment, may lead to social isolation. Also, at home, children using sign (supported) language may not communicate as fluently with their hearing parents, that acquired signing as a second language, which could interfere with bonding (Brown and Cornes 2015).

The setting in which social-emotional behaviour is observed, may be of influence on the psychosocial outcomes. For instance, children more often face socially challenging situations at school, rather than at home. Language proficiency therefore may play a greater role in school, as illustrated by a study that found only teacher-reported psychosocial outcomes to be related to language, whilst parent-reports were not (Boerrigter et al. 2019).

Also, in earlier stages of youth, there is a lower demand on linguistic functioning. With age, speech vocabulary, syntax, and pragmatics increase in complexity (Sharp and Hillenbrand 2008). Therefore the effect of language proficiency in infants may not be as evident as in older children. Perhaps for this reason associations between language proficiency and psychosocial difficulties were absent in some of the studies including children aged one to six years (Netten et al. 2015b; Stika et al. 2015).

Signs of psychosocial problems increase when children get older up until the age of seven. After that period, a decline in psychosocial difficulties is observed (Netten et al. 2018). This reduction may be a result of increased social participation in adolescence, like sports, hobby's, or clubs, which may enhance social skills. Little is known, however, about the effect that social participation has on communication abilities and psychosocial outcomes alike. Capitalising on opportunities for social participation may be among the interventions that could eventually reduce psychosocial difficulties in children and teenagers with hearing loss. Therefore, the effect of social participation should receive a more prominent role in future research.

It is evident that better language skills are associated with better psychosocial outcomes and it is likely that this is related to better auditory functioning. However, the type of rehabilitation received by children with hearing loss is a mediating factor that has not been thoroughly considered in the studies included in this review. It is important to recognise that in addition to proper device fitting, children's communication abilities can be optimised with appropriate auditory rehabilitation and speech/-language therapy to optimise the acquisition of language (spoken, sign or bimodal bilingual).

Confounding variables

The presence of psychosocial difficulties is a multifarious subject, with links to many aspects of receptive and expressive communication. It is likely that social participation plays an intermediary role in the relationship between hearing loss and psychosocial health, along with a range of other variables. Higher intelligence, for instance, is related to more adequate language proficiency (Hohm et al. 2007), and better psychosocial functioning (Castellanos et al. 2018; Desoky et al. 2021; Nicholas and Geers 2003; Theunissen et al. 2014a; Wiley et al. 2012; Wong et al. 2020; Wong et al. 2018b; Wong et al. 2017). Intelligence is also closely related to other confounding factors such as socioeconomic status (SES) and additional needs. Previous studies investigating the latter reported more psychosocial difficulties in children with additional needs, such as physical requirements and/or mental disorders (Dammeyer 2010; Huber et al. 2015; Leigh et al. 2015; Wong et al. 2020; Wong et al. 2018b; Wong et al. 2017; Wong et al. 2018a). Also, more favourable psychosocial outcomes were observed in children with higher SES in several studies (Barker et al. 2009; Chao et al. 2015; Huber and Kipman 2011; Stika et al. 2015; Theunissen et al. 2014a; Theunissen et al. 2015; Wong et al. 2018b; Wong et al. 2017).

Ideally, a meta-analysis would have been carried out in order to investigate the confounding effects of these variables. Yet, studies differed to a great extent in methodology. Test materials often did not coincide, and results varied across the different approaches. In addition to methodological differences, many studies reported univariate analyses without confounder adjustment. In some studies, adjustments were made for daily auditory behaviour, nonverbal cognitive abilities, or SES (Castellanos et al. 2018; Haukedal et al. 2020; Netten et al. 2018; Sarant et al. 2018; Stika et al. 2021), after which language proficiency remained a significant predictor for psychosocial outcomes.

Agreement between informants

In Huber et al (2015), auditory functioning was only associated with parent-reported psychosocial outcomes, and not with child- and teacher-reports. Inter-rater disagreement was also seen in other studies. Haukedal et al. (2020)'s findings suggest that parents are likely to have more concerns than their children. Conversely, when investigating peer relationships, in Huber et al. (2015) and Stevenson et al. (2017) child-reported peer problems were overlooked by both parents and teachers. Stevenson et al. (2018) found that language skills were significantly related to teacher-rated behaviour, and not with parent-ratings. It can be expected that children encounter more social challenges at school than at home. Teachers therefore may have a better understanding of the children's capabilities, and that communication abilities may be more closely related to behaviour at school, rather than at home.

Future research

We discussed that social participation may be an important mediating factor between communication and psychosocial outcomes. Limited evidence, however, is available on the extent of social participation by children with hearing loss. Therefore, we suggest future (longitudinal) studies to also investigate the effect of social participation on psychosocial development.

It is likely that appropriate CI and HA rehabilitation has a protective effect against the development of psychosocial difficulties. Optimising CI and HA rehabilitation, by means of adequate surveillance of auditory functioning, language therapy, or psychological resilience training, may therefore cause a decline in difficulties. These effects could be investigated in the future. This review focused on several communication abilities, yet the communication spectrum consists of many more aspects. Future studies should investigate the influence of additional communicative aspects to further sort out the role of communication in the development of psychosocial difficulties in children with hearing loss.

Limitations and strengths

This systematic review has several strengths, (1) we included multiple measurements, thereby allowing more articles for inclusion and increasing generalisability; (2) the search was applied to all major databases, thereby increasing the coverage of literature; (3) the quality was both rated on general methodology and on befitting the objective of the review, thereby improving the indexing of articles. Yet, limitations do exist, specifically (1) we only included articles written in English; (2) due to the diversity of the measurements used, a meta-analysis was not possible; also (3) speech perception was not measured consistently across the studies, questionnaire-based, and test-based assessments may therefore reflect different aspects of speech perception. (4) The majority of children included was from Western descent, thereby decreasing generalisability.

Conclusion

This is the first systematic review on auditory functioning and language abilities and their association with psychosocial difficulties in children with hearing loss. Current evidence suggests that children with hearing loss are at twice the risk of experiencing difficulties on social, emotional, and behavioural domains compared to the normal hearing population. This review creates more basis for understanding the relationship between auditory functioning and language proficiency and psychosocial difficulties in children with hearing loss. When children are more capable to communicate, this may increase their aptness to participate in social interactions and friendships. Estimates for functioning in social interactions, such as speech perception (in noise) or language proficiency have proven to be more adequate predictors for psychosocial difficulties than degree of hearing loss. The predictive value of communication abilities can be useful for identifying children at risk for difficulties and offering them earlier and more elaborate psychological intervention to diminish psychosocial problems in children with hearing loss.

Acknowledgments

We thank Sabrina Meertens-Gunput and Wichor Bramer from the Erasmus MC Medical Library for developing and updating the search strategies.

Authors' contributions

T.J.d.J. designed the protocol and review, selected the articles, extracted the data, and wrote the paper. J.L.V. and M.P.v.d.S. selected the articles, and provided critical revision of the paper. L.S. provided critical revision of the paper. All authors discussed the results and implications and commented on the manuscript at all stages.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethics approval

Not applicable.

Consent to participate

Not applicable.

Consent for publication

Not applicable.

Funding

The authors received partial financial support from the Dorhout Mees Foundation.

Data availability statement

Not applicable.

References

Archbold, S., M. E. Lutman, and D. H. Marshall. 1995. "Categories of Auditory Performance." *The Annals of Otology, Rhinology & Laryngology. Supplement* 166:312–314.

Barker, D. H., A. L. Quittner, N. E. Fink, L. S. Eisenberg, E. A. Tobey, and J. K. Niparko, 2009. "Predicting Behavior Problems in Deaf and Hearing Children: The Influences of Language, Attention, and Parent - Child Communication." *Development and Psychopathology* 21 (2):373–392. https://doi.org/10.1017/S0954579409000212

Bat-Chava, Y., and E. Deignan. 2001. "Peer Relationships of Children with Cochlear Implants." *Journal of Deaf Studies and Deaf Education* 6 (3): 186–199. https://doi.org/10.1093/deafed/6.3.186

Bat-Chava, Y., D. Martin, and J. G. Kosciw. 2005. "Longitudinal Improvements in Communication and Socialization of Deaf Children with Cochlear Implants and Hearing Aids: Evidence from Parental Reports." *Journal of Child Psychology and Psychiatry, and Allied Disciplines* 46 (12): 1287–1296. https://doi.org/10.1111/j.1469-7610.2005.01426.x

Boerrigter, M., A. Vermeulen, H. Marres, and M. Langereis. 2018. "Personality Traits of Profoundly Hearing Impaired Adolescents with Cochlear Implants - A Comparison with Normal Hearing Peers." *Frontiers in Psychology* 9:161. https://doi.org/10.3389/fpsyg.2018.00161

Boerrigter, M., A. Vermeulen, H. Marres, E. Mylanus, and M. Langereis. 2019. "Frequencies of Behavioral Problems Reported by Parents and Teachers of Hearing-Impaired Children with Cochlear Implants." *Frontiers in Psychology* 10:1591. https://doi.org/10.3389/fpsyg.2019.01591

Brice, P. J., and G. Strauss. 2016. "Deaf Adolescents in a Hearing World: A Review of Factors Affecting Psychosocial Adaptation." *Adolescent Health, Medicine and Therapeutics* 7:67–76. https://doi.org/10.2147/AHMT.S60261

Brown, P. M., and A. Cornes. 2015. "Mental Health of Deaf and Hard-of-Hearing Adolescents: What the Students Say." *Journal of Deaf Studies and Deaf Education* 20 (1):75–81. https://doi.org/10.1093/deafed/enu031

Byatt, T. J., K. Dally, and J. Duncan. 2019. "Systematic Review of Literature: Social Capital and Adolescents Who are Deaf or Hard of Hearing." *Journal of Deaf Studies and Deaf Education* 24 (4):319–332. https://doi.org/10.1093/deafed/enz020

Calderon, R. 2000. "Parental Involvement in Deaf Children's Education Programs as a Predictor of Child's Language, Early Reading, and Social-Emotional Development." *Journal of Deaf Studies and Deaf Education* 5 (2):140–155. https://doi.org/10.1093/deafed/5.2.140

Castellanos, I., W. G. Kronenberger, and D. B. Pisoni. 2018. "Psychosocial Outcomes in Long-Term Cochlear Implant Users." *Ear and Hearing* 39 (3):527–539. https://doi.org/10.1097/AUD.0000000000000504

Chang, Y.-S., I. J. Moon, E. Y. Kim, J. Ahn, W.-H. Chung, Y.-S. Cho, and S. H. Hong. 2015. "Social Skills and Developmental Delay: Importance in Predicting the Auditory and Speech Outcomes after Cochlear Implantation in children." *Acta Oto-Laryngologica* 135 (2):154–161. https://doi.org/10.3109/00016489.2014.973531

Chao, W.-C., L.-A. Lee, T.-C. Liu, Y.-T. Tsou, K.-C. Chan, and C.-M. Wu. 2015. "Behavior Problems in Children with Cochlear Implants." *International Journal of Pediatric Otorhinolaryngology* 79 (5):648–653. https://doi.org/10.1016/j.ijporl.2015.02.006

Ching, Cupples, L. Leigh, G, et al. 2021. "Predicting Quality of Life and Behavior and Emotion from Functional Auditory and Pragmatic Language Abilities in 9-Year-Old Deaf and Hard-of-Hearing Children." *Journal of Clinical Medicine* 10 (22):5357. https://doi.org/10.3390/jcm10225357

Ching, T. Y., and M. Hill. 2007. "The Parents' Evaluation of Aural/Oral Performance of Children (PEACH) scale: normative data." *Journal of the American Academy of Audiology* 18 (3):220–235. https://doi.org/10.3766/jaaa.18.3.4

Dammeyer, J. 2010. "Psychosocial Development in a Danish population of Children with Cochlear Implants and Deaf and Hard-of-Hearing Children." *Journal of Deaf Studies and Deaf Education* 15 (1):50–58. https://doi.org/10.1093/deafed/enp024

Desoky, H., O. Raaft, and S. N. Azab. 2021. "Psycho-Communicative Interruptions in Hearing-Impaired Egyptian Arabic-Speaking Children." *Beni-Suef University. Journal Basic Applied Science* 10:35. https://doi.org/10.1186/s43088-021-00124-9

Eichengreen, A., E. Broekhof, Y. T. Tsou, et al. 2023. "Longitudinal Effects of Emotion Awareness and Regulation on Mental Health Symptoms in Adolescents with and without Hearing Loss." *European Child & Adolescent Psychiatry* 32:705–724. https://doi.org/10.1007/s00787-021-01900-9

Fellinger, J., D. Holzinger, H. Sattel, and M. Laucht. 2008. "Mental Health and Quality of Life in Deaf Pupils." *European Child & Adolescent Psychiatry* 17 (7):414–423. https://doi.org/10.1007/s00787-008-0683-y

Fitzpatrick, E. M., C. Hamel, A. Stevens, M. Pratt, D. Moher, S. P. Doucet, D. Neuss, A. Bernstein, and E. Na. 2016. "Sign Language and Spoken Language for Children With Hearing Loss: A Systematic Review." *Pediatrics* 137 (1) https://doi.org/10.1542/peds.2015-1974

Fitzpatrick, E. M., W. Jiawen, O. Janet, W. JoAnne, N. Flora, G. Isabelle, D.-S. Andrée, and C. Doug. 2022. "Parent-Reported Stress and Child Behavior for 4-Year-Old Children with Unilateral or Mild Bilateral Hearing Loss." *Journal of Deaf Studies and Deaf Education* 27 (2):137–150. https://doi.org/10.1093/deafed/enab042

Gerich, J., and J. Fellinger. 2012. "Effects of Social Networks on the Quality of Life in an Elder and Middle-Aged Deaf Community Sample." *Journal of Deaf Studies and Deaf Education* 17 (1):102–115. https://doi.org/10.1093/deafed/enr022

Guerzoni, L., A. Murri, E. Fabrizi, M. Nicastri, P. Mancini, and D. Cuda. 2016. "Social Conversational Skills Development in Early Implanted Children." *The Laryngoscope* 126 (9):2098–2105. https://doi.org/10.1002/lary.25809

Haukedal, C. L., B. Lyxell, and O. B. Wie. 2020. "Health-Related Quality of Life with Cochlear Implants: The Children's Perspective." *Ear and Hearing* 41 (2):330–343. https://doi.org/10.1097/AUD.0000000000000761

Hindley, P. A. 2005. "Mental Health Problems in Deaf Children." *Current Paediatrics* 15 (2):114–119. https://doi.org/10.1016/j.cupe.2004.12.008.

Hintermair, M. 2007. "Prevalence of Socioemotional Problems in Deaf and Hard of Hearing Children in Germany." *American Annals of the Deaf* 152 (3):320–330. https://doi.org/10.1353/aad.2007.0028

Hoffman, M. F., I. Cejas, and A. L. Quittner, 2016. "Comparisons of Longitudinal Trajectories of Social Competence: Parent Ratings of Children with Cochlear Implants Versus Hearing Peers." *Otology & Neurotology: Official Publication of the American Otological Society, American Neurotology Society [and] European Academy of Otology and Neurotology* 37 (2):152–159. https://doi.org/10.1097/MAO.0000000000000938

Hoffman, M. F., A. L. Quittner, and I. Cejas. 2015. "Comparisons of Social Competence in Young Children With And Without Hearing Loss: A Dynamic Systems Framework." *Journal of Deaf Studies and Deaf Education* 20 (2):115–124. https://doi.org/10.1093/deafed/enu040

Hohm, E., C. Jennen-Steinmetz, M. H. Schmidt, and M. Laucht. 2007. "Language Development at Ten Months. Predictive of Language Outcome and School Achievement Ten Years Later?" *European Child & Adolescent Psychiatry* 16 (3):149–156. https://doi.org/10.1007/s00787-006-0567-y

Huber, M., T. Burger, A. Illg, S. Kunze, A. Giourgas, L. Braun, S. Kröger, A. Nickisch, G. Rasp, A. Becker, et al. 2015. "Mental Health Problems in Adolescents with Cochlear Implants: Peer Problems Persist after Controlling for Additional Handicaps." *Frontiers in Psychology* 6:953. https://doi.org/10.3389/fpsyg.2015.00953

Huber, M., and U. Kipman. 2011. "The Mental Health of Deaf Adolescents with Cochlear Implants Compared to Their Hearing Peers." *International Journal of Audiology* 50 (3):146–154. https://doi.org/10.3109/14992027.2010.533704

Ikiz, M., and E. Yucel. 2022. " Examination of Language, Behavioral, Academic, and Social Skills of Cochlear Implant Users in Early Primary Education." *Journal of the American Academy of Audiology*. https://doi.org/10.1055/a-1889-6534

Jimenez-Romero, M. S. 2015. "The Influence of Cochlear Implants on Behaviour Problems in Deaf Children." *Psicothema* 27:229–234.

Le Clercq, C. M. P., L. J. E. Labuschagne, M.-C J. P. Franken, R. J. Baatenburg de Jong, M. P. C. M. Luijk, P. W. Jansen, and M. P. van der Schroeff. 2020. "Association of Slight to Mild Hearing Loss with Behavioral Problems and School Performance in Children." *Journal of Americal Medical Association Otolaryngology- Head & Neck Surgery* 146 (2):113–120. https://doi.org/10.1001/jamaoto.2019.3585

Leigh, G., T. Y. C. Ching, K. Crowe, L. Cupples, V. Marnane, and M. Seeto. 2015. "Factors Affecting Psychosocial and Motor Development in 3-Year-Old Children Who Are Deaf or Hard of Hearing." *Journal of Deaf Studies and Deaf Education* 20 (4):331–342. https://doi.org/10.1093/deafed/env028

Mann, W., E. D. Peña, and G. Morgan. 2015. "Child Modifiability as a Predictor of Language Abilities in Deaf Children Who Use American Sign Language." *American Journal of Speech-Language Pathology* 24 (3):374–385. https://doi.org/10.1044/2015_AJSLP-14-0072

Martin, D., Y. Bat-Chava, A. Lalwani, and S. B. Waltzman. 2011. "Peer Relationships of Deaf Children with Cochlear Implants: Predictors of Peer Entry and Peer Interaction Success." *Journal of Deaf Studies and Deaf Education* 16 (1):108–120. https://doi.org/10.1093/deafed/enq037

McElwain, N. L., and B. L. Volling. 2005. "Preschool Children's Interactions with Friends and Older Siblings: Relationship Specificity and Joint Contributions to Problem Behavior." *Journal of Family PsychologyJournal of the Division of Family Psychology of the American Psychological Association (Division 43)* 19 (4):486–496. https://doi.org/10.1037/0893-3200.19.4.486

McGarrigle, R., K. J. Munro, P. Dawes, A. J. Stewart, D. R. Moore, J. G. Barry, and S. Amitay. 2014. "Listening Effort and Fatigue: What Exactly are We Measuring? A British Society of Audiology Cognition in Hearing Special Interest Group 'White Paper." *International Journal of Audiology* 53 (7):433–440. https://doi.org/10.3109/14992027.2014.890296

Moher, D., L. Shamseer, M. Clarke, D. Ghersi, A. Liberati, M. Petticrew, P. Shekelle, and L. A. Stewart, 2015. "Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement." *Systematic Reviews* 4 (1):1. https://doi.org/10.1186/2046-4053-4-1

Most, T., S. Ingber, and E. Heled-Ariam. 2012. "Social Competence, Sense of Loneliness, and Speech Intelligibility of Young Children with Hearing Loss in Individual Inclusion and Group Inclusion." *Journal of Deaf Studies and Deaf Education* 17 (2):259–272. https://doi.org/10.1093/deafed/enr049

Netten, A. P., C. Rieffe, L. Ketelaar, W. Soede, K. D. Gadow, and J. H. M. Frijns. 2018. "Terrible Twos or Early Signs of Psychopathology? Developmental Patterns in Early Identified Preschoolers with Cochlear Implants Compared with Hearing Controls." *Ear and Hearing* 39 (3):495–502. https://doi.org/10.1097/AUD.0000000000000500

Netten, A. P., C. Rieffe, S. C. P. M. Theunissen, W. Soede, E. Dirks, J. J. Briaire, and J. H. M. Frijns. 2015a. "Low Empathy in Deaf and Hard of Hearing (Pre)Adolescents Compared to Normal Hearing Controls." *PLOS One* 10 (4):e0124102. https://doi.org/10.1371/journal.pone.0124102

Netten, A. P., C. Rieffe, S. C. P. M. Theunissen, W. Soede, E. Dirks, A. M. H. Korver, S. Konings, A. M. Oudesluys-Murphy, F. W. Dekker, J. H. M. Frijns, et al. 2015b. "Early Identification: Language skills and Social Functioning in Deaf and Hard of Hearing Preschool Children." *International Journal of Pediatric Otorhinolaryngology* 79 (12):2221–2226. https://doi.org/10.1016/j.ijporl.2015.10.008

Nicholas, J. G., and A. E. Geers. 2003. "Personal, Social, and Family Adjustment in School-Aged Children with A Cochlear Implant." *Ear and Hearing* 24 (1 Suppl):69S–81S. https://doi.org/10.1097/01.AUD.0000051750.31186.7A

Park, M., S. H. Oh, S. O. Chang, C. S. Kim, and J. H. Lee. 2016. "Long-Term Functional and Behavioral-Emotional Outcomes in Children with Early Cochlear Implants: Parental Testimonies." *International Journal of Pediatric Otorhinolaryngology* 83:137–142. https://doi.org/10.1016/j.ijporl.2016.01.038

Percy-Smith, L., S. Wischmann, J. L. Josvassen, C. Schiøth, and P. Cayé-Thomasen. 2021. "Language Development for the New Generation of Children with Hearing Impairment." *Journal of Clinical Medicine* 10 (11):2350. https://doi.org/10.3390/jcm10112350

Rieffe, C., E. Broekhof, A. Eichengreen, M. Kouwenberg, G. Veiga, B. M. S. da Silva, A. van der Laan, and J. H. M. Frijns. 2018. "Friendship and Emotion Control in Pre-Adolescents With or Without Hearing Loss." *Journal of Deaf Studies and Deaf Education* 23 (3):209–218. https://doi.org/10.1093/deafed/eny012

Sarant, J. Z., D. C. Harris, K. L. Galvin, L. A. Bennet, M. Canagasabey, and P. A. Busby. 2018. "Social Development in Children With Early Cochlear Implants: Normative Comparisons and Predictive Factors, Including Bilateral Implantation." *Ear and Hearing* 39 (4):770–782. https://doi.org/10.1097/AUD.0000000000000533

Sharp, H. M., and K. Hillenbrand. 2008. "Speech and Language Development and Disorders in Children." *Pediatric Clinics of North America* 55 (5):1159–1173, viii. https://doi.org/10.1016/j.pcl.2008.07.007

Stevenson, J., J. Kreppner, H. Pimperton, S. Worsfold, and C. Kennedy. 2015. "Emotional and Behavioural Difficulties in Children and Adolescents with Hearing Impairment: A Systematic Review and Meta-Analysis." *European Child & Adolescent Psychiatry* 24 (5):477–496. https://doi.org/10.1007/s00787-015-0697-1

Stevenson, J., D. McCann, P. Watkin, S. Worsfold, and C. Kennedy, 2010. "The Relationship Between Language Development and Behaviour Problems in Children with Hearing Loss." *Journal of Child Psychology and Psychiatry, and Allied Disciplines* 51 (1):77–83. https://doi.org/10.1111/j.1469-7610.2009.02124.x

Stevenson, J., H. Pimperton, J. Kreppner, S. Worsfold, E. Terlektsi, and C. Kennedy. 2017. "Emotional and Behaviour Difficulties in Teenagers with Permanent Childhood Hearing Loss." *International Journal of Pediatric Otorhinolaryngology* 101:186–195. https://doi.org/10.1016/j.ijporl.2017.07.031

Stevenson, J., H. Pimperton, J. Kreppner, S. Worsfold, E. Terlektsi, M. Mahon, and C. Kennedy. 2018. "Language and Reading Comprehension in Middle Childhood Predicts Emotional and Behaviour Difficulties in Adolescence for Those with Permanent Childhood Hearing Loss." *Journal of Child Psychology and Psychiatry, and Allied Disciplines* 59 (2):180–190. https://doi.org/10.1111/jcpp.12803

Stika, C. J., L. S. Eisenberg, A. S. Carter, K. C. Johnson, D. M. Hammes Ganguly, S. C. Henning, and J. L. DesJardin. 2021. "Developmental Outcomes in Early-Identified Children Who Are Hard of Hearing at 2 to 3 Years of Age." *Ear and Hearing* 42 (5):1238–1252. https://doi.org/10.1097/AUD.0000000000001012

Stika, C. J., L. S. Eisenberg, K. C. Johnson, S. C. Henning, B. G. Colson, D. H. Ganguly, and J. L. DesJardin. 2015. "Developmental Outcomes of Early-Identified Children Who are Hard of Hearing at 12 to 18 Months of Age." *Early Human Development* 91 (1):47–55. https://doi.org/10.1016/j.earlhumdev.2014.11.005

Theunissen, S. C. P. M., C. Rieffe, M. Kouwenberg, L. J. I. De Raeve, W. Soede, J. J. Briaire, and J. H. M. Frijns. 2014a. "Behavioral problems in School-Aged Hearing-Impaired Children: The Influence of Sociodemographic, Linguistic, and Medical Factors." *European Child & Adolescent Psychiatry* 23 (4):187–196. https://doi.org/10.1007/s00787-013-0444-4

Theunissen, S. C. P. M., C. Rieffe, M. Kouwenberg, W. Soede, J. J. Briaire, and J. H. M. Frijns. 2011. "Depression in Hearing-Impaired Children." *International Journal of Pediatric Otorhinolaryngology* 75 (10):1313–1317. https://doi.org/10.1016/j.ijporl.2011.07.023

Theunissen, S. C. P. M., C. Rieffe, A. P. Netten, J. J. Briaire, W. Soede, J. W. Schoones, and J. H. M. Frijns. 2014b. "Psychopathology and its Risk and Protective Factors in Hearing-Impaired Children and Adolescents: A Systematic Review." *Journal of the American Medical Association Pediatrics* 168 (2):170–177. https://doi.org/10.1001/jamapediatrics.2013.3974

Theunissen, S. C. P. M., C. Rieffe, W. Soede, J. J. Briaire, L. Ketelaar, M. Kouwenberg, and J. H. M. Frijns. 2015. "Symptoms of Psychopathology in Hearing-Impaired Children." *Ear and Hearing* 36 (4):e190–e198. https://doi.org/10.1097/AUD.0000000000000147

van Eldik, T., P. D. Treffers, J. W. Veerman, and F. C. Verhulst. 2004. "Mental Health Problems of Deaf Dutch Children as Indicated by Parents' Responses to the Child Behavior Checklist." *American Annals of the Deaf* 148 (5):390–395. https://doi.org/10.1353/aad.2004.0002

van Gent, T., A. W. Goedhart, P. A. Hindley, and P. D. A. Treffers. 2007. "Prevalence and Correlates of Psychopathology in a Sample of Deaf Adolescents." *Journal of Child Psychology and Psychiatry, and Allied Disciplines* 48 (9):950–958. https://doi.org/10.1111/j.1469-7610.2007.01775.x

Wake, M., E. K. Hughes, Z. Poulakis, C. Collins, and F. W. Rickards. 2004. "Outcomes of Children with Mild-Profound Congenital Hearing loss at 7 to 8 Years: A Population Study." *Ear and Hearing* 25 (1):1–8. https://doi.org/10.1097/01.AUD.0000111262.12219.2F

Wiley, S., J. Meinzen-Derr, S. Grether, D. I. Choo, and M. L. Hughes. 2012. "Longitudinal Functional Performance among Children with Cochlear Implants and Disabilities: A Prospective Study using the Pediatric Evaluation of Disability Inventory." *International Journal of Pediatric Otorhinolaryngology* 76 (5):693–697. https://doi.org/10.1016/j.ijporl.2012.02.022

Williams, A., M. Pulsifer, K. Tissera, and L. A. Mankarious. 2020. "Cognitive and Behavioral Functioning in Hearing-Impaired Children with and without Language Delay." *Otolaryngology-Head and Neck Surgery : official Journal of American Academy of Otolaryngology-Head and Neck Surgery* 163 (3):588–590. https://doi.org/10.1177/0194599820915741

Wischmann, S., J. L. Josvassen, C. Schiøth, and L. Percy-Smith. 2022. "History Re-written for Children with Hearing Impairment." *International Journal of Pediatric Otorhinolaryngology* 152:110991. https://doi.org/10.1016/j.ijporl.2021.110991

Wolters, N., H. E. T. Knoors, A. H. N. Cillessen, and L. Verhoeven. 2011. "Predicting Acceptance and Popularity in Early Adolescence as a Function of Hearing Status, Gender, and Educational Setting." *Research in Developmental Disabilities* 32 (6):2553–2565. https://doi.org/10.1016/j.ridd.2011.07.003

Wong, C. L., T. Y. Ching, J. Whitfield, and J. Duncan. 2018a. "Exploring the Social Capital of Adolescents Who Are Deaf or Hard of Hearing and Their Parents: A Preliminary Investigation." *American Annals of the Deaf* 162 (5):463–478. https://doi.org/10.1353/aad.2018.0004

Wong, C. L., T. Y. Ching, G. Leigh, L. Cupples, L. Button, V. Marnane, J. Whitfield, M. Gunnourie, and L. Martin. 2018b. "Psychosocial Development of 5-Year-Old Children with Hearing Loss: Risks and Protective Factors." *International Journal of Audiology* 57 (sup2):S81–S92. https://doi.org/10.1080/14992027.2016.1211764

Wong, C. L., T. Y. C. Ching, L. Cupples, L. Button, G. Leigh, V. Marnane, J. Whitfield, M. Gunnourie, and L. Martin. 2017. "Psychosocial Development in 5-Year-Old Children with Hearing Loss using Hearing Aids or Cochlear Implants." *Trends in Hearing* 21:2331216517710373. https://doi.org/10.1177/2331216517710373

Wong, L C, Tyc, Ching, L, Cupples, G, Leigh, L, Button, L, Martin, L, Whitfield, M, Gunnourie, Marnane. (2020). Comparing Parent and Teacher Ratings of Emotional and Behavioural Difficulties in 5-year old Children who are Deaf or Hard-of-Hearing.*Deafness & Education International: The Journal of the British Association of Teachers of the Deaf*, 1, 22, 3–26. https://doi.org/10.1080/14643154.2018.1475956