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Intervention research to increase pediatric hearing device use: A scoping review

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No conflicts of interest to disclose

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Abstract

Purpose: This study is a scoping review examining interventions to increase hearing device use for children.

Method: Online databases were used to identify peer-reviewed journal articles published prior to November 1, 2021, yielding 1,288 after duplications were removed. Four articles met the inclusion criteria after articles were screened by title name and abstract and subsequent full-text screening of six articles. A qualitative analysis was conducted to identify features of the intervention studies related to the participants, design, intervention, key findings, and limitations.

Results: The included studies were published between 1982 and 2021, and in all four studies, the children used hearing aids. All four of the studies used a longitudinal design to address hearing aid use problems, with the timeframe ranging from approximately one month to six months and had variable success in increasing use time. None of the studies included a protocol, such as counseling skills, for addressing internal challenges that interfere with hearing aid use.

Conclusions: Review of the limited research in this area found variable effectiveness for the interventions studied. There is an urgent need for research in this area to inform clinical practice and provide evidence-based interventions to address malleable factors that interfere with audibility for children who use hearing devices.

Introduction

Worldwide there are 34 million children who require (re)habilitation for hearing loss (World Health Organization, 2021). In the United States, approximately 6,000 infants are born each year with permanent hearing loss (Centers for Disease Control and Prevention, 2021), and the number increases from two to three per 1,000 infants to one in eight people aged 12 through geriatric (National Institute on Deafness and Other Communication Disorders, 2021). For children who communicate using spoken language, oral language skills are foundational for academic performance and have been found to be moderated by the extent hearing aids provide audibility in early elementary school (Tomblin et al., 2020), underscoring the importance of education to support capacity building so parents and children are equipped to effectively manage hearing device routines and challenges they experience in partnership with their audiologist and other hearing care providers.

There are problems with consistent device use in pediatric populations, and this is concerning for optimizing developmental and academic outcomes. Young children who use hearing aids have shown better language outcomes when hearing aids are worn ten or more hours per day (Tomblin et al., 2015). Evidence suggests that use is frequently well below this benchmark; however, as illustrated by the following studies: an accelerated longitudinal study found children six months to seven years ($N = 272$) had an average of eight hours of use per day (Walker et al., 2013); a large cross-sectional study found children under four years of age ($N = 2,162$) used their hearing aids less than five hours per day (Jones, 2013); and a small cross-sectional study found children under five years of age ($N = 29$) used hearing aids 4.6 hours per day on average (Muñoz et al., 2014).

Parents of young children have reported emotional and practical challenges that interfere with hearing aid use, such as a lack of confidence, feelings of anxiety, uncertainty about how to

handle child behaviors and difficulty managing in different environments (Sjoblad et al., 2001; Russ et al., 2004; Muñoz et al., 2015). Similarly, there is evidence of inconsistent cochlear implant use for children (Wiseman & Warner-Czyz, 2018) and that child's age when full-time use is achieved is a better predictor of language outcomes than the age when a child receives their implant (Park et al., 2019). Older children have also shown evidence of problems with consistent hearing aid use (Gustafson et al., 2015; Gustafson et al., 2017). Taken together, the evidence suggests there is a need to attend to barriers that arise related to hearing device use over time for children. It is reasonable to expect that parents and children need intentional support to work through and overcome challenges that interfere with device use.

In other areas of healthcare patients have reported needing emotional, informational, and practical support to be able to effectively self-manage their condition (Zuidema et al., 2015; Coffey et al., 2016). Not only is timely access to learning and adjustment support important for parents and children who are deaf or hard of hearing, there is a need for purposeful intervention focused on health behavior change. Health-related behavior change can be difficult, even when it is desired, and providers can positively influence treatment adherence barriers when they guide patients in addressing challenges (Mostofsky, 2014). The field of audiology currently does not provide practice recommendations for identifying and addressing treatment barriers parents and children experience that interfere with consistent audibility.

Audibility of linguistic input is a critical foundation for spoken language development and academic success. The model of cumulative auditory experience describes how communication development is negatively affected by hearing loss and that interventions to address malleable factors that influence auditory access can minimize those negative effects (McCreery & Walker, 2017). In a recent scoping review that explored factors affecting

consistent hearing aid use for young children, the authors identified sixteen factors, and of those, twelve were malleable (Nailand et al., 2021). The purpose of this scoping review was to identify and describe intervention research that has been done to increase hearing device use for children, and to illuminate gaps in research that can inform future research.

Methods

Search Strategy

A scoping literature review was completed in November 2021. The Joanna Briggs Institute approach for scoping review source selection, data extraction, and presentation of data was used to guide this scoping review. Scoping reviews follow a systematic process to examine a broad area and can be used to identify key concepts and research gaps. The purpose of a scoping review is to identify what kind of evidence is available, not necessarily to provide a critical appraisal of the evidence. The Joanna Briggs Institute provides a detailed description of the purpose and objective process for conducting scoping reviews (Aromataris & Munn, 2020).

The specific inclusion criteria included: 1) intervention studies aimed at increasing hearing device use for a pediatric population (<18 years of age), and 2) published prior to November 1, 2021. Exclusion criteria included: 1) published in a language other than English, 2) study did not conduct an intervention to increase hearing device use, and 3) study not published in a peer-reviewed journal. Inclusion of only peer-reviewed journal articles were chosen because we were interested in identifying studies that had gone through a rigorous review process.

To identify potentially relevant articles, three databases were searched (MEDLINE, CINAHAL Complete and PsycINFO all via EBSCOhost) using the following keywords: 1. (hearing loss OR deaf OR hearing impairment OR hearing disorder); 2. (hearing aid OR cochlear implant); 3. (use OR “wear time”); 4. (child OR pediatric OR infant); 5. (intervention OR

education OR program). Additional subject terms were identified specific to each database. Medline's medical subject heading (MeSH), CINAHL Complete's subject headings and APA PsycINFO's thesaurus were utilized in identifying subject terms associated with each keyword. Each keyword was searched in the database's subject term browser to find the broadest subject term associated with the keyword being used in the database. Once the broadest subject term associated with each keyword was identified, an overarching search string was created that incorporated both the keywords and associated broadest subject terms for the database. Appendix A lists keywords and subject terms utilized in the search string. Appendix B shows an example of how the search was performed.

Data Extraction

The database search was independently performed for 100% of the search by the second and third authors (DO; CB). The two reviewers jointly developed a data charting form prior to independently completing the search. First, article titles and abstracts were reviewed, and articles were selected or removed based on the inclusion and exclusion criteria, and documented on a separate charting form by each reviewer. Then the reviewers came together to discuss and resolve any discrepancies in selected articles. In the event of disagreement over inclusion, the first author reviewed the article in question. Second, a full text review of all eligible articles was completed (DO) and data were extracted in an expanded charting form to include study details (i.e., purpose, participants, intervention, measurements, findings, limitations, implications) followed by a discussion with the first author to finalize article inclusion decisions. Finally, reference lists of included articles were reviewed (DO) to identify additional articles for consideration. No additional articles were found through this process.

Analysis

A qualitative analysis was conducted to identify features of the intervention studies related to the participants, design, intervention, key findings, and limitations. For all included articles, the second author entered the data extracted into an Excel file. The first author reviewed the articles and verified the data extracted. Summaries of the identified research studies are provided, and future research opportunities are discussed.

Results

The scoping review identified four articles that conducted research on an intervention to increase hearing device use and met the inclusion criteria. The database search identified 1,288 articles after duplications were removed. After the title and abstract review, a full text review was conducted for six articles, with two articles being excluded at this stage. See figure 1 for article inclusion flowchart. The included studies were published between 1982 and 2021, and in all four studies, the children used hearing aids. See Table 1 for article summaries.

Study Methodology

The first study used a multiple baseline design conducted during a 25-day period by audiologists with teachers (N = 9) who had classrooms of children aged five to twelve years (N = 56) at one elementary school (Hundert et al., 1982). The second study used a longitudinal case study design conducted during a six-month period by audiologists with families (N = 4) who had children birth to five years of age (Muñoz et al., 2016). The third study was a single-case multiple baseline design conducted during a 24-to-47-day period by early interventionists with mothers (N = 3) who had children 14 to 36 months of age (Ambrose et al., 2020). The final study was a randomized controlled trial comparing an eHealth parent education and support intervention to treatment as usual, conducted during a 12-week period by audiologists with parents (N = 82) of children birth to 42 months of age (Muñoz et al., 2021).

Interventions and Hearing Aid Use Findings

The Hundert et al (1982) study assessed hearing aid use using a six-item checklist. Students used school hearing aids and teachers were responsible for making sure students put the hearing aids on in the morning and that they were functioning. The teachers were divided into three groups for the study. At baseline, the audiologist completed the checklist. In the next phase, teachers completed the checklist and were given feedback, and then in the finale phase, the percentage of children using hearing aids (based on affirmative responses for all of the checklist items) was posted publicly on a poster hung in the entrance to the school. Hearing aid use increased from baseline (78%; 80%; 91%) to the feedback/public posting phase (95%; 97%;100%) for groups 1-3 respectively. Change was not seen when public posting was initiated given the already high percentages with feedback. The researchers found that 62% of the teachers did not think there was a problem with hearing aid use, and after the study that 60% thought the checklist helped them support hearing aid use.

The Muñoz et al (2016) study assessed hearing aid use with data logging. The intervention included virtual visits in addition to routine service delivery to target hearing aid management challenges. The virtual visits supported one parent following infant hearing aid fitting, addressed challenges for two families related to learning needs of extended family members, and child behavioral challenges interfering with hearing aid use for one family. Hearing aid use was documented during three phases, initial observation, problem-solving period, and a monitoring period. Hearing aid use maintained during all waking hours for one child, and hours of use increased on average from 4.41 to 5.64 hours for the other three children. Both parents and clinicians were accepting of tele-support, and parents recognized benefits, including flexibility and timely access to support. The authors noted that the ability to collect

datalogging more frequently than traditional in office visits was important for effective problem solving to increase hearing aid use.

The Ambrose et al (2020) study assessed hearing aid use with data logging. This study used a structured protocol that included baseline data logging measurement, a pre-intervention assessment to identify challenges and barriers to device use, the intervention (i.e., workshop, coaching, check-ins), a post intervention assessment, and a one-month maintenance probe. The educational workshop allowed for individualization based on the pre-assessment within four structured topic areas. Hearing aid use increased and was maintained at the one-month probe (Dyad 1 [2.8 to 8.1 hours]; dyad 2 [2.3 to 11.3 hours], dyad 3 [0 to 3.4 hours]).

The Muñoz et al (2021) study assessed hearing aid use by parent report. The study provided a six-week eHealth education and support program for parents randomized to the intervention group. The other group received treatment as usual (TAU). Parents in both groups completed assessments at baseline, four- eight- and twelve-weeks. Parents in the intervention group participated in weekly phone coaching calls and watched a series of eight videos. This was a general sample of parents of children using hearing aids, not all parents were struggling with hearing aid use. Significant differences between groups were not observed for hearing aid use from baseline to 12-weeks (Intervention group: 9 hours to 9.5 hours; TAU: 7.6 to 8.4); however parents in the intervention had greater gains for confidence, knowledge, and device monitoring frequency compared to treatment as usual. The intervention was delivered successfully with low drop out, high session completion, and high program adherence. A small number of parents indicated they received data logging from their audiologist and used that information to report hours of use (Intervention: 8 to almost 11 hours; TAU: 6.5 to almost 8.5).

Summary

All four of the studies used a longitudinal design to address hearing aid use problems, with the timeframe ranging from approximately one month to six months and had variable success in increasing hearing aid use time. The interventions were designed for different stakeholders and focused on different issues impacting hearing aid use. Hundert et al (1982) only considered hearing aid use during the school day for younger elementary school children, and teacher feedback was limited to items on the checklist. Muñoz et al (2016) provided education and support to families; however, the intervention was unstructured and did not address internal challenges; discussions were focused on technical issues families were experiencing related to daily management of the hearing aids. Ambrose et al (2020) provided the intervention to mothers using a structured format with the ability to individualize based on parent challenges discovered during the pre-assessment; however, a specific approach for addressing internal challenges was not described. Muñoz et al (2021) provided a structured intervention to address parents' practical challenges; however, there was not a protocol for addressing internal challenges parents were experiencing with hearing aid management.

Discussion

This study was a scoping review to identify intervention research to increase hearing device use in children. Four articles met the inclusion criteria, and a qualitative description of study characteristics was provided to identify gaps and inform future research. The review revealed that there is limited intervention research aimed at addressing hearing device use to improve audibility for children. Children are receiving amplification earlier in life with widespread newborn hearing screening (CDC, 2021). Earlier intervention provides children with important developmental advantages; however, early access to amplification is just the first step. Children are reliant on others for consistent access to sound through their hearing devices.

Parents and children experience challenges with managing day-to-day issues that negatively affect audibility (e.g., Nailand et al., 2021), and clinicians need evidence-based interventions to effectively support children and their families. There is an urgent need for future research to address malleable factors that affect hearing device use in children.

Three fundamental elements need to exist for children to have audibility. First, hearing devices must be selected, programmed, and verified using evidence-based procedures to ensure the device provides the best possible audibility. Second, hearing devices need to be worn when children are awake so they can consistently access sounds and speech in their environments. Third, hearing devices need to be functioning appropriately to provide audibility and device function needs to be monitored. Each of these fundamental elements are complex and require training to effectively navigate decisions and problem-solve issues that arise. Current practice typically includes providing parents and children with information about device use and guidance on technical management of the device and does not typically address the internal or other sociocultural barriers that can interfere with device use and maintenance tasks (American Academy of Audiology, 2013).

To elaborate on this point, in a patient-centered model of care, providers need to address the myriad of variables that are influencing the target behavior. This can include sociocultural variables such as family, cultural, religious, or educational expectations. This might include working with immediate and extended family to adjust interaction styles and set firm expectations for hearing aid use. Audiologists are already quite good at addressing the technical variables. Most audiologists are skilled at teaching the client about their hearing and use of devices—although they can be overly technical at times (Coleman et al., 2018). Generally, audiologists have been poor at addressing internal barriers such as frustrations, fear of failure, or

simply feeling overwhelmed. We have shown that these variables interfere with hearing aid use (Muñoz et al., 2015) and that they can be addressed (Nichols et al., 2022). Complete patient-centered work should address all the levels of care as needed for each client.

The scoping review found three articles that addressed an intervention aimed at educating and supporting parents of young children, birth to five years, to increase hearing aid use. Similar to previous research findings demonstrating low hours of use for children (e.g., Walker, 2013) the intervention studies with parents of young children in our scoping review identified a need to address problems with low hours of use. Parents completed the interventions and were responsive to the interventions. Parents in each of the studies expressed feeling positive about the experience. In Ambrose et al (2020), the researchers also found that most hearing aid skills improved, as well as parent knowledge, confidence, and action scores. Similarly, in Muñoz et al (2021) the parents in the intervention group showed significantly greater gains over time for knowledge, confidence, and monitoring frequency related to hearing aid management. These findings are promising and suggest future intervention research can further identify how to have a positive impact on audibility.

Research is at an early stage in determining interventions that are effective in increasing audibility for children. Future research is needed with larger samples to determine factors that improve hearing device use compared to standard practice. Only one study used a randomized controlled trial with 82 parents to compare the intervention to treatment as usual. The other two studies had small sample sizes and no comparison group. In addition, interventions are needed with samples that include other types of hearing devices, older children, and diversity for race, ethnicity, education level, and language. Only one study (Muñoz et al., 2016) included two Spanish-speaking families. None of the studies included an evidence-based approach to assess

for and address internal challenges (e.g., emotions, thoughts) parents experience that interfere with engaging in hearing aid management. Future research is needed to determine key elements to include in the intervention, dosage of the intervention, and delivery considerations that positively influence device use.

There are limitations in scoping reviews that should be acknowledged. Relevant sources of information may have been omitted based on decisions for which databases to include and in the decision to only include peer-reviewed articles. The aim of the scoping review is not to rate the quality of the evidence and therefore no discussion on quality is included and implications for practice or policy are not included.

Conclusions

This scoping review provides a description of intervention studies that have been done to increase hearing device use for children. The limited research in this area found variable effectiveness for the interventions studied. There is an urgent need for future research in this area to inform clinical practice and provide evidence-based interventions to address malleable factors that interfere with audibility for children who use hearing devices. Children are reliant on others for consistent audibility, and importantly, audibility provides a critical underpinning for developmental outcomes and academic success.

Data Availability Statement: Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

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Figure 1. Article inclusion flowchart

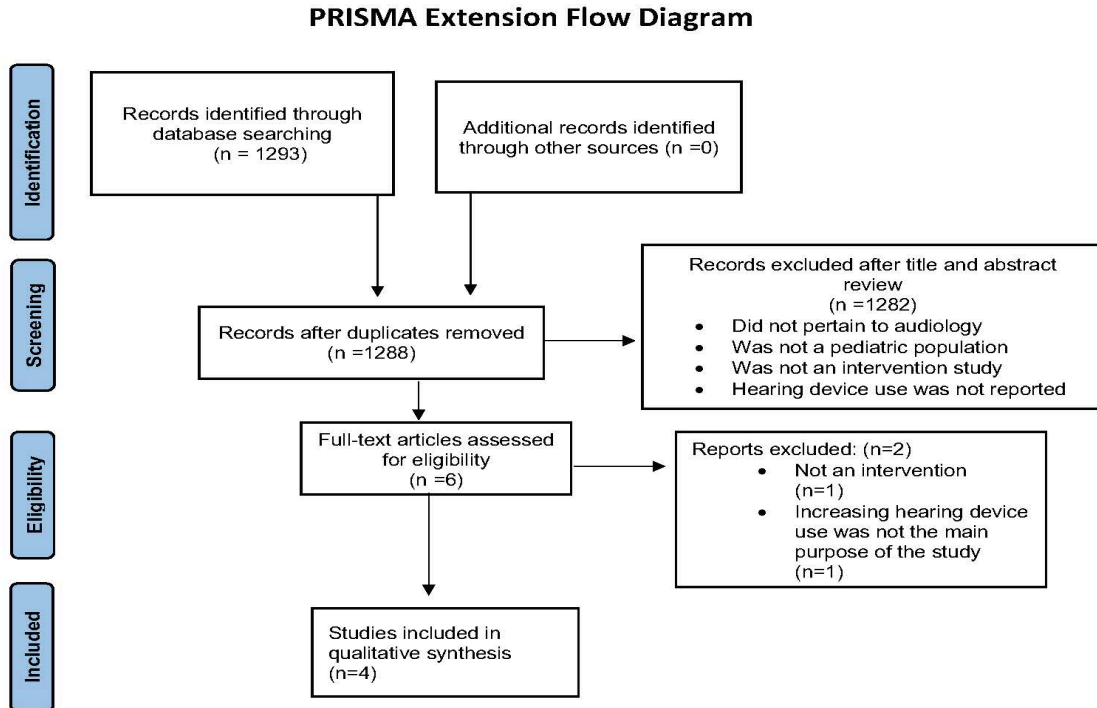


Table 1. Summary of included articles

First Author	Year	Sample Size	Device Type	Design	Intervention	How HA use was Measured
Hundert	1982	56 children 9 teachers	Hearing aids	Multiple baseline design	Feedback/public posting	Six item checklist
Muñoz	2016	4 families	Hearing aids	Longitudinal case study Design	Virtual visits	Datalogging
Ambrose	2020	3 mothers	Hearing aids	Single-case, multiple-baseline design	Workshop, coaching check-ins	Datalogging
Muñoz	2021	82 parents	Hearing aids	Randomized controlled trial	Six week eHealth program	Parent report

Appendix A
Keywords and Subject Terms

Concepts	Free text terms / natural language terms	Controlled vocabulary terms / subject terms
Hearing loss	individuals who have a hearing impairment	<p>(Keywords) hearing loss OR deaf OR hearing impairment OR hearing disorder</p> <p>(subject terms) <i>MEDLINE:</i> hearing loss OR deafness OR hearing disorders <i>CINAHL Complete:</i> hearing disorders OR deafness <i>APA PsycINFO:</i> hearing loss OR deaf OR hearing disorders:</p>
Hearing device type	any variation or type of hearing device aimed at making sounds audible for individuals with hearing loss.	<p>(keywords) hearing aid OR cochlear implant</p> <p>(subject terms) <i>MEDLINE:</i> hearing aids OR cochlear implants <i>CINAHL Complete:</i> hearing aids OR cochlear implant <i>APA PsycINFO:</i> hearing aids OR cochlear implants</p>
Pediatric population	hearing device users under 18 years of age	<p>(keywords) child OR pediatric OR infant</p> <p>(subject terms) <i>MEDLINE:</i> child OR pediatrics OR infant <i>CINAHL Complete:</i> child OR pediatrics or infant: <i>APA PsycINFO:</i> pediatrics</p>
Device use	studies aimed at increasing hearing device use	<p>(keywords) use OR "wear time"</p>
Intervention studies	studies where a type of intervention to increase hearing device use took place, increasing device use is the main purpose of the study and not something analyzed separately	<p>(keywords) intervention OR education OR program</p>

Appendix B

Search Example

(Literature Search performed: November 12, 2021)

Database Results

MEDLINE 561

1. (MH "Hearing Loss") OR (MH "Deafness") OR (MH "Hearing Disorders")
Limiters - Date of Publication: -10/31/2021
2. hearing loss OR deaf OR hearing impairment OR hearing disorder
Limiters - Date of Publication: -10/31/2021
3. S1 OR S2
4. (MH "Hearing Aids") OR (MH "Cochlear Implants")
Limiters - Date of Publication: -10/31/2021
5. hearing aid OR cochlear implant
Limiters - Date of Publication: -10/31/2021
6. S4 OR S5
7. (MH "Child") OR (MH "Pediatrics") OR (MH "Infant")
Limiters - Date of Publication: -10/31/2021
8. child OR pediatric OR infant
Limiters - Date of Publication: -10/31/2021
9. S7 OR S8
10. Use OR "wear time"
Limiters - Date of Publication: -10/31/2021
11. intervention OR Education OR Program
Limiters - Date of Publication: -10/31/2021
12. S3 AND S6 AND S9 AND S10 AND S11