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Long-Term Outcomes of Early Intervention Programs for Children with Hearing Impairment: A Systematic Review

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Abstract

Hearing impairment significantly impacts a child's language development, communication, and academic achievement. This study aims to evaluate the long-term effectiveness of early intervention strategies and analyze variations in language development based on the use of hearing aids and the level of parental involvement. The research methodology employs a Systematic Literature Review (SLR) guided by PRISMA standards, involving a comprehensive analysis of 11 relevant articles from the Scopus and Web of Science databases for the period of 2022 to 2025. Findings indicate that the intervention timeline is the most critical factor; interventions initiated before 6 months of age achieve language success rates of up to 90%, whereas delays beyond 2 years reduce this rate to 30–40%. The use of hearing aids significantly enhances audibility, allowing children to achieve language levels comparable to their typical-hearing peers in certain instances. Furthermore, parental self-efficacy and active involvement were identified as primary variables, contributing to an 85% success rate in language skills. However, the study also reveals that developmental gaps in morphosyntax remain difficult to close entirely by the onset of formal schooling. In conclusion, intensive early intervention, precise technological application, and the empowerment of the family's role are the keys to optimizing language development outcomes for children with hearing impairment

Keywords: Hearing Impairment, Early Intervention, Children And Language

Introduction

Hearing impairment is one of the sensory disabilities that has a significant impact on children's language development, communication, and academic achievement. It is often categorized as an invisible handicap because its effects cannot be directly identified without specific screening. According to the World Health Organization (2025), undetected and untreated hearing loss at an early stage can lead to long-term implications for language development, social skills, literacy, and individuals' socioeconomic prospects throughout their lives. From a broader social perspective, children with hearing impairment are at risk of experiencing communication barriers, social exclusion, and limited educational opportunities if appropriate support systems are not provided early. Therefore, early detection and the

implementation of appropriate intervention programs are critical components in supporting the development of children with hearing impairment.

From a theoretical standpoint, this study is grounded in developmental and ecological perspectives, particularly Bronfenbrenner's Ecological Systems Theory, which emphasizes that children's development is influenced by interactions within multiple environmental systems, including family, school, and community. In addition, language acquisition theories highlight the importance of early sensory input and stimulation during the critical period of development, where delays in auditory access may significantly affect linguistic outcomes. These theoretical perspectives underscore the importance of timely and structured early intervention in shaping developmental trajectories among children with hearing impairment. Early intervention programs are designed to minimize delays in language development and to enhance children's communication skills in order to support their learning and social development. Interventions implemented as soon as hearing loss is identified have been shown to produce more significant positive outcomes compared to those initiated later (Devi, 2023; Al Babtain et al., 2023). These programs typically include several key components, namely early detection, therapeutic interventions such as speech and language therapy, the use of hearing assistive devices, and continuous monitoring of children's development. The effectiveness of these interventions depends on factors such as the duration of implementation, service intensity, and continuous support from families and professional service providers.

Previous studies have shown that early intervention initiated before the age of six months, including the use of hearing aids and speech therapy, significantly improves the language and communication development of children with hearing impairment compared to programs that begin after the critical period of language acquisition (Centers for Disease Control and Prevention, 2025; Effectiveness of Early Intervention, 2025). In addition, the implementation of programs such as Early Hearing Detection and Intervention (EHDI) at the global level is recognized as an effective approach in reducing the negative effects of delayed detection and intervention (Findlen et al., 2022). However, the effectiveness of early intervention programs does not solely depend on the existence of policies and early screening, but also on the quality of implementation, access to services, and the availability of human resources and supporting facilities.

In the Malaysian context, although early detection initiatives such as the Newborn Hearing Screening Programme have been implemented, various challenges remain in ensuring that children with hearing impairment receive timely and adequate early intervention. Limited access to healthcare and educational services, particularly in rural and remote areas such as Sabah and Sarawak, a shortage of specialists such as speech-language pathologists and audiologists, as well as service disparities between urban and rural areas, have been identified as key issues (Mazlan & Othman, 2023; Utusan Sarawak, 2025; Suara Sarawak, 2025). From a policy and service delivery perspective, these challenges reflect gaps between policy implementation and actual practice, which may influence the effectiveness of intervention outcomes. This situation raises questions regarding the effectiveness of existing early intervention programs and the factors influencing their outcomes.

Accordingly, this Systematic Literature Review (SLR) was conducted to comprehensively examine empirical research findings related to early intervention for children with hearing impairment. The study aims to identify patterns in findings, research gaps, and key factors influencing the effectiveness of early intervention, including aspects such as duration of implementation, types and intensity of intervention, use of hearing assistive devices, and family involvement. Specifically, this study aims to:

1. Evaluate the long-term effectiveness of strategies used in early intervention programs for children with hearing impairment.
2. Analyze differences in language development in relation to the use of hearing assistive devices and the level of parental involvement in early intervention programs.

Through the SLR approach, this study is expected to provide a more comprehensive understanding of evidence-based early intervention practices, thereby serving as a foundation for policy development, professional practices, and further research in the fields of special education and audiology.

Methodology

The systematic review method (SLR) involves a structured procedure for identifying, evaluating, and synthesizing information from various literature sources selected systematically. The information search process was conducted by accessing major databases to obtain high-quality materials relevant to the study. A comprehensive search was carried out using databases such as Scopus and Web of Science (WoS).

In addition, this study followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2009) to guide the data search process. The use of this method helps produce clearer and more accurate literature reporting (Randour et al., 2020). PRISMA consists of four phases: identification, screening, eligibility, and inclusion. Therefore, this study adopted the PRISMA method to ensure the production of a high-quality SLR.

Instrument Criteria

Two databases were used in this SLR study, namely Scopus and Web of Science. The article search was conducted in November 2025. Following the identification and screening processes, a total of 12 articles were selected from both databases using predefined keywords, as shown in Table 1.

Table 1
Databases

Database	Articles Retrieved	Articles Screened
Scopus	**76**	**7**
Web of Science	**42**	**4**

The article search was limited to publications from 2022 to 2025. This time frame was selected because discussions on the long-term outcomes of early intervention programs for children with hearing impairment have been actively explored during this period.

This SLR study considered aspects such as the year of study, background, research problems, methodology, and findings. Only articles published in English were included. The search results yielded 76 articles from Scopus and 42 from Web of Science, resulting in a total of 118 articles.

At this stage, the screening process continued by excluding articles that did not meet the predefined inclusion criteria. A total of 107 articles were excluded after comprehensive reading. The selection criteria included publication year (2022 to November 2025), document type (journal articles), and English language. Table 2 presents the inclusion and exclusion criteria used in the article selection process.

Table 2
Inclusion and Exclusion Criteria

Criteria	**Inclusion**	**Exclusion**
Publication Year	2022 to 2025	Before 2022
Document TYpe	Journal Articles	Books, book chapters, theses, newspapers
Language	English Only	Non- English publications
Field of Study	Studies on hearing impairment Studies on intervention programs Studies on intervention programs for children	Unrelated studies

Data Collection Method

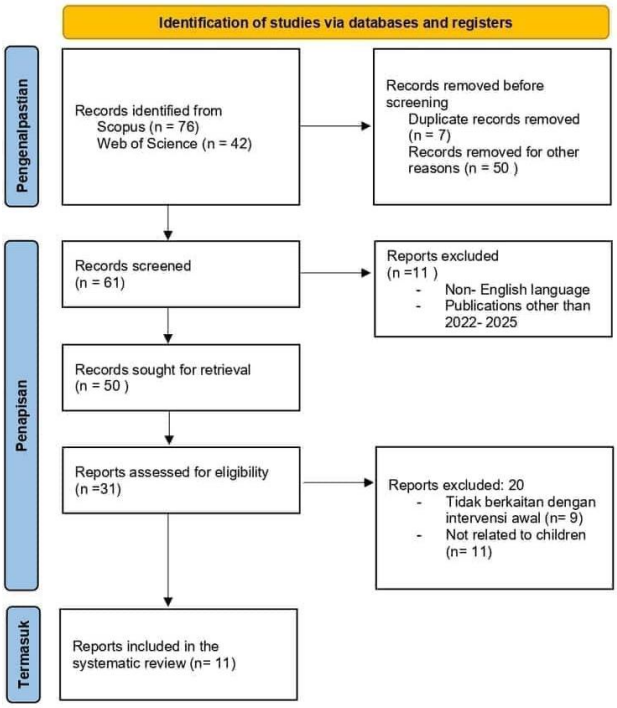
During the data selection process, the researcher identified a final total of 11 articles that met the criteria and were relevant to the long-term outcomes of early intervention programs for children with hearing impairment. Articles were selected manually to ensure that all selected studies met the criteria and aligned with the study objectives.

The process began with an evaluation of titles and abstracts, followed by a full-text review of the articles. Articles that were not aligned with the study scope, did not focus on early intervention, or did not discuss long-term outcomes were excluded from further analysis.

In addition, articles that did not meet the language criteria—specifically those not written in English—were excluded, in accordance with the selection criteria outlined in Table 2. Non-empirical review articles, case reports without intervention outcome data, and studies that did not involve children with hearing impairment were also excluded.

As a result of the screening process, a total of 107 articles were excluded as they did not meet the criteria related to the long-term outcomes of early intervention programs for children with hearing impairment.

PRISMA Table



Jadual 3: jadual PRISMA

List of Article

No	Author(s) and Year	Article Title & Journal	Research Findings
1.	Chistina McKean, Anastasia Trebacz, Naomi Rose, Christine Jack, RobertRush, SeanPert, CarolynLetts, HelenStringer, MarkMasidlover, EmilyArmstrong, KateConn, JennySandham ElaineAshton. 2025	A Cluster Randomized Controlled Trial Comparing the Efficacy of Pre-School Language Interventions—Building Early Sentences Therapy and an Adapted Derbyshire Language Scheme, *International Journal of Language & Communication Disorders*	Both interventions showed significant improvements across all outcomes. BEST demonstrated significantly greater gains in NRDLS production SS (d = 0.55) and target sentences (d = 0.77). Children in BEST progressed faster post-intervention (T2–T3) in comprehension and production. 66% achieved clinically significant improvement in communicative participation (FOCUS-34).
2.	Magdalena Dall, Sandra Kiblböck, Daiva Müllegger, Johannes Fellinger, Johannes Hofer, Ruth Kapplmüller, Sandra Breitwieser, Katharina Schossleitner, Christoph Weber, Ruth Zöhrer and Daniel Holzinger. 2022	Understanding the Impact of Child, Intervention, and Family Factors on Developmental Trajectories of Children with Hearing Loss at Preschool Age: Design of the AChild Study *Journal of Clinical Medicine*	Initial sample (N=126) confirmed inclusivity; ~31.7% had additional disabilities and 31% were bilingual. Median age of enrolment was early (5.5 months). The design enables investigation of interaction effects between factors.

3.	AnuSharma,Kayla Cormier and Jim Grigsby 2025	Effect of Supplemental Language Therapy on Cortical Neuroplasticity and Language Outcomes in Children with Hearing Loss, *Brain Sciences*	Significant reduction in P1 latency beyond normal maturation rate. Cortical maturation improved (66% abnormal → 15% at follow-up). Language scores improved significantly (9–10 months gain in 6 months). HA users reached age-equivalent scores, while CI users remained lower.
4.	Yu-Chen Hung, Pei-Hsuan Ho, Pei-Hua Chen, Yi-Shin Tsai, Yi-Jui Li and Hung-Ching Lin 2024	Impact of Hearing Aids on Language Outcomes in Preschool Children With Mild Bilateral Hearing Loss, *Trends in Hearing*, 28: 1–13	HA users significantly outperformed non-users in all linguistic domains. Their language ability was comparable to normal-hearing peers. HA use was a significant predictor of language performance.
5.	Krystal L. Werfel, Gabriella Reynolds and Lisa Fitton 2022	Oral Language Acquisition in Preschool Children Who are Deaf and Hard-of-Hearing, *Journal of Deaf Studies and Deaf Education*, 27, 166–178	DHH children showed initial deficits compared to typically hearing peers. Although vocabulary improved, performance gaps persisted. Morphosyntactic gains were observed but remained below peers by age 6.
6.	Dr. Shahid Ali, Zainab M. Sadiq, Sonia Shah, Dr. Najam Ul Haq, Noor-ul-ain Asim dan Danyal Ul Haq 2025	Early Intervention Strategies for Speech Language and Hearing Disorders: An Audiological Perspective, *HEC Journal Recognition System (JCS)*, Online ISSN (3006-1504) / Print ISSN (3006-1490)	Intervention before 6 months led to 85–90% achieving age-appropriate language, while delays beyond 2 years reduced success to 30–40%. High parental involvement increased success to 85%. Major barriers include lack of screening and high costs in LMICs.
7.	Rasha Sami, Hebatallah S. Hashem and Sherine Ramzy 2025	Evaluating the effectiveness of pharmacological intervention vs placebo in speech-language therapy for children with delayed language due to recurrent otitis media, *The Egyptian Journal of Otolaryngology*, 41, 125	No significant difference between treatment groups. Both showed significant post-treatment language improvement. No correlation between IQ and language gains.
8.	E. S. Garbaruk, M. Yu. Boboshko, Yu. S. Kibalova, D. I. Chernego, A. A. Kozyreva, O. P. Pavlova, V. M. Knyazeva, and M. J. Vasilyeva 2025	Speech Perception and Communicative-Speech Characteristics of Hearing-Impaired Children with Late Hearing Aid Fitting, *Human Physiology*, 51, No. 4, 422–431	Significant delays in speech clarity and communication (average 24 months delay). Better outcomes observed in children with milder hearing loss. Speech clarity correlated positively with communication skills.

9.	Carrie A. Davenport, Elaine Smolen, Irina Castellanos, Evelien Dirks, Derek M. Houston 2025	Davenport et al. (2025), Parental self-efficacy and early language development in deaf and hard-of-hearing children, *Journal of Deaf Studies and Deaf Education*, 30, 31–40	No significant correlation between general parental self-efficacy and language scores. However, targeted parental actions (communication strategies and intervention participation) showed positive correlations.
10.	Luana Speck Polli Burigo, Anna Quialheiro, Karina Mary de Paiva, Thaiana Vargas dos Santos, Luciele Kauana Woide,Luciana Berwanger Cigana, Janaina Massignani and Patricia Haas 2024	Hearing and Language Skills in Children Using Hearing Aids: Experimental Intervention Study, *Journal of Personalized Medicine*, 14, 372	Significant improvement in phoneme discrimination (TFDF). Both groups improved in IT-MAIS scores. Some tests (GASP) were less sensitive to change.
11.	Bernadette A.M. Vermeij, J. Scholte, Carin H. Wiefferink, Harry Knoors, Ron H. 2023	Effects in language development of young children with language delay during early intervention, *Journal of Communication Disorders*, 103, 106326	Significant improvement across language domains. Younger children (<36 months) showed greater progress. Most remained "unchanged" in some domains except expressive vocabulary, which showed reliable improvement.

Results

Based on Table 4, there are 11 studies related to the Long-Term Outcomes of Early Intervention Programs for Children with Hearing Loss. From the literature review conducted, research on early intervention tends to focus more on the timing of intervention and the use of hearing assistive devices, while in-depth discussions on intervention effectiveness, specific therapeutic strategies, and morphosyntactic issues remain limited and require further investigation.

Importance of Timeline and Early Intervention

The findings consistently show that the timing of intervention is a critical factor in determining language development outcomes. Ali et al. (2025) emphasized that interventions initiated before the age of 6 months achieve favorable language development outcomes of up to 85–90%, whereas delays beyond the age of 2 years reduce this rate to only 30–40%. This is supported by Garbaruk et al. (2025), who found that late fitting of hearing aids (after 2.5 years) results in significant declines in speech clarity and communication delays of up to 24 months. Similarly, Vermeij et al. (2023) demonstrated that younger children (below 36 months) show greater progress in intensive intervention programs compared to older children, particularly in expressive vocabulary development.

Effectiveness of Intervention Strategies and Dosage

Several studies compare the effectiveness of different therapeutic models. McKean et al. (2025) found that low-dosage interventions such as Building Early Sentences Therapy (BEST) produced greater improvements in sentence production compared to traditional methods (A-

DLS). From a biological perspective, Sharma et al. (2025) provided evidence of neuroplasticity, showing that Listening and Spoken Language (LSL) therapy over six months accelerates auditory cortical maturation (P1 latency) beyond expected developmental rates. However, in cases of language delay due to otitis media, Sami et al. (2025) found that speech-language therapy (SLT) itself is the primary driver of improvement, with additional pharmacological supplements (e.g., omega-3) showing no significant difference compared to placebo. Furthermore, targeted short-term interventions, such as six sessions of speech therapy, have been shown to effectively improve phoneme discrimination abilities.

Role of Technology and Audibility

The use of technology, such as hearing aids (HA), plays a significant role, even in cases of mild hearing loss. Hung et al. (2024) revealed that children with Mild Bilateral Hearing Loss (MBHL) who use hearing aids demonstrate language performance comparable to their normally hearing peers. However, a key challenge identified is parental reluctance, with approximately 50% hesitant to initiate hearing aid use due to the perception that it is unnecessary. Differences in outcomes are also observed across technologies; children using hearing aids tend to achieve age-appropriate language scores after therapy, whereas cochlear implant (CI) users may still exhibit lower language performance.

Parental Involvement and Self-Efficacy

Effective early intervention cannot be separated from the role of the family. Dall et al. (2022) emphasized the importance of modifiable factors such as the quality of parental linguistic input through Family-Centered Early Intervention (FCEI). Ali et al. (2025) further supported this, showing that high parental involvement contributes to an 85% success rate in achieving age-appropriate language skills. Interestingly, Davenport et al. (2025) highlighted that not only general parental confidence matters, but also specific beliefs that families can positively influence their child's development, along with active engagement using communication strategies, which are positively correlated with children's expressive language skills.

In conclusion, these studies collectively demonstrate that intensive early intervention, appropriate use of technology to enhance audibility, and active parental involvement are key factors in optimizing language outcomes. However, special attention should be given to children who are identified late or who exhibit significant morphosyntactic difficulties, as they are at risk of falling behind their peers upon entering formal schooling.

Discussion

This Systematic Literature Review (SLR) was conducted using several major databases to identify empirical studies related to early intervention and language development among children with hearing loss. Based on the SLR analysis, the findings indicate that research on early intervention has largely emphasized the importance of intervention timing and the use of hearing technology. However, comprehensive and in-depth discussions on factors such as intervention intensity, types of therapy, and long-term challenges in bridging language development gaps remain limited.

Most studies emphasize interventions initiated at an early age, particularly before 6 months, and their impact on language development. Nevertheless, the findings suggest that although early intervention has positive effects, language development outcomes for children with hearing loss are still insufficient to enable them to reach the same level as typically developing

peers, especially in terms of morphosyntactic skills. The findings also highlight that the use of technology, such as hearing aids and cochlear implants, plays an important role in improving audibility and supporting language development. However, challenges related to compliance with hearing aid usage and differences in outcomes between types of devices are still insufficiently explored in previous studies. Therefore, further research is recommended to examine the interaction between types of technology and therapeutic interventions in a more integrated manner.

Finally, the SLR findings also reveal a research gap in the context of low- and middle-income countries (LMICs), where the lack of hearing screening, limited access to hearing assistive devices, and the cost of intervention services serve as major barriers to successful language development. Hence, future research is recommended to focus on developing more inclusive, cost-effective intervention models that are suited to local sociocultural contexts to ensure the overall effectiveness of early intervention. Overall, the findings of this study demonstrate that although the effectiveness of early intervention on the language development of children with hearing loss has been established, there remains a pressing need for further investigation, particularly in aspects of family involvement and the implementation context of intervention programs. Continued research in this field is crucial to ensure that children with hearing loss are not left behind in language and academic development at the level of formal education.

Conclusion

In conclusion, early intervention plays a highly significant role in determining the language development outcomes of children with hearing loss. The findings consistently show that the timing of intervention, particularly when initiated at an early age, the use of appropriate hearing technology, and active parental involvement are key factors contributing to successful linguistic development in children with hearing loss. Therefore, the findings of this SLR highlight the need to expand the scope of research in early intervention for children with hearing loss by focusing on the long-term effectiveness of interventions and more strategic family-centered approaches. This is essential to ensure that children with hearing loss have the opportunity to achieve optimal language development and are well prepared for formal education and a more inclusive social life.

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