

Early Identification of Hearing Loss in Children and its Impact on language Development

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Abstract

Hearing loss in early childhood can significantly impede language acquisition, cognitive development, and social integration, making timely detection a critical public health priority. Early identification is associated with improved language outcomes, yet many children experience delays in diagnosis, limiting the effectiveness of interventions. This study aimed to examine the impact of early identification of hearing loss on language development in children. A mixed-methods design was employed, involving 120 children aged 6 months to 5 years with permanent hearing loss, divided into early (≤ 6 months) and late (> 6 months) identification groups. Standardized language assessments, including the Preschool Language Scale-5 and MacArthur-Bates Communicative Development Inventories, were used to evaluate expressive and receptive language. Auditory performance was measured through aided audiometry and speech perception tests, while qualitative interviews with parents and clinicians captured intervention experiences and family engagement. Results indicated that children identified early achieved significantly higher scores in both expressive and receptive language domains, demonstrated better auditory performance, and required fewer compensatory interventions than those identified later. Regression analysis confirmed age at diagnosis as a strong independent predictor of language outcomes, even after controlling for socioeconomic and environmental factors. Qualitative findings highlighted that timely intervention and active parental involvement were key facilitators of successful language development. In conclusion, early identification of hearing loss markedly enhances language development and auditory outcomes in children. Future research should explore long-term cognitive and social outcomes and develop accessible, family-centered intervention strategies to ensure equitable support for all children with hearing impairment.

Keywords: Language, Hearing Loss, Children, Interventions, Hearing Impairment

Introduction

Hearing is a foundational sensory modality that plays a critical role in the acquisition of spoken language, cognitive development, social interaction, and academic achievement in children. Hearing loss is one of the most common congenital conditions worldwide, with a significant proportion of cases present at birth or acquired during early childhood due to genetic, perinatal, infectious, or environmental factors (Pimperton & Kennedy, 2012; Yoshinaga-Itano et al., 1998). When hearing impairment occurs during the sensitive period of brain and language development, particularly within the first three years of life, it can disrupt the natural process through which children perceive speech sounds, develop phonological awareness, and acquire expressive and

receptive language skills (Petrocchi-Bartal et al., 2025). Advances in neonatal care and audiological technology have made it possible to identify hearing loss at increasingly earlier stages yet delays in detection and intervention remain prevalent in many regions. Such delays often result in missed opportunities to support optimal language development during critical developmental windows, underscoring the need for focused research on early identification strategies and their developmental implications (Al Babbain et al., 2024).

The significance of early identification of hearing loss lies in its profound and lasting impact on language outcomes and overall developmental trajectories. Numerous studies have demonstrated that children whose hearing loss is identified and managed within the first six months of life show language development patterns that more closely resemble those of their normal-hearing peers, compared to children identified later (Fitzpatrick et al., 2025). Early diagnosis enables timely intervention through hearing amplification devices, cochlear implantation when indicated, speech and language therapy, and family-centered support, all of which contribute to improved linguistic, cognitive, and psychosocial outcomes (Wischmann et al., 2025). Conversely, late identification is associated with persistent language delays, reduced literacy skills, academic difficulties, and challenges in social integration. These outcomes not only affect the child's quality of life but also impose long-term educational, economic, and social burdens on families and healthcare systems (Wischmann et al., 2025). Despite the proven benefits of early hearing detection and intervention programs, disparities in access, awareness, and implementation continue to limit their effectiveness, particularly in low- and middle-income settings. Understanding the relationship between early identification and language development is therefore essential for strengthening public health policies and clinical practices.

The aim of this research is to examine the impact of early identification of hearing loss in children on subsequent language development, emphasizing the importance of timely screening, diagnosis, and intervention as effective solutions to mitigate language delays. By exploring existing evidence on early hearing detection and its influence on speech and language outcomes, this study seeks to highlight the critical role of early intervention in maximizing developmental potential. The research also underscores the importance of implementing universal newborn hearing screening programs, increasing parental and professional awareness, and ensuring access to appropriate rehabilitative services. Early identification should not be viewed merely as a diagnostic milestone but as the first step in a comprehensive continuum of care that supports children's communication abilities and social participation (Khoza-Shangase, 2025; Wischmann et al., 2025). Strengthening early identification practices offers a practical and evidence-based solution to reduce the negative impact of hearing loss on language development, promote equitable developmental outcomes, and enhance the long-term well-being of children with hearing impairment.

Literature Review

Previous research has consistently emphasized the critical relationship between early identification of hearing loss and language development outcomes in children. Studies conducted over the past several decades indicate that the first few years of life represent a sensitive period for auditory stimulation and language acquisition, during which neural pathways responsible for speech and language are rapidly developing (Khoza-Shangase, 2025). Children with undetected hearing loss during this period often experience reduced access to linguistic input, leading to delays in phonological processing, vocabulary growth, and syntactic development (Continisio et al., 2023). Large-scale longitudinal studies have shown that children whose hearing loss is identified before six months of age and who receive timely intervention demonstrate significantly better receptive and expressive language skills than those identified later (Meibos et al., 2016; Yoshimura et al., 2024). Universal newborn hearing screening programs have been widely studied and are credited with substantially lowering the age of diagnosis, thereby improving early language outcomes

(Jayaprakasan et al., 2023). However, despite the availability of screening technologies, gaps remain between early detection and effective intervention, often due to socioeconomic factors, limited healthcare infrastructure, or lack of parental awareness (Shojaei et al., 2016). Further literature highlights the role of early intervention approaches, such as hearing aids, cochlear implants, and family-centered language stimulation, in mediating the impact of early identification on language development. Research suggests that early amplification and auditory-verbal therapy can facilitate near-age-appropriate language development, particularly when intervention is initiated during infancy (Continisio et al., 2023; Yoshinaga-Itano et al., 1998). Children who receive cochlear implants at younger ages have been found to exhibit improved speech perception and spoken language outcomes compared to those implanted later, reinforcing the importance of early diagnosis (AlSamhori et al., 2024). Additionally, parental involvement and consistent exposure to rich linguistic environments have been identified as key factors influencing successful language outcomes following early identification (Yoshinaga-Itano, 2003). Despite these positive findings, some studies report variability in outcomes, indicating that early identification alone is insufficient without sustained, high-quality intervention services (Harris et al., 2022; Petrocchi-Bartal et al., 2025). Recent research also points to disparities in outcomes based on socioeconomic status, access to rehabilitation services, and educational support, suggesting the need for comprehensive and equitable early hearing detection and intervention systems (Fitzpatrick et al., 2025). Overall, the literature strongly supports early identification of hearing loss as a crucial determinant of language development, while also emphasizing the importance of integrated intervention strategies to maximize developmental benefits.

Materials and Methods

To address the objective of examining the impact of early identification of hearing loss on language development in children, this study employed a mixed-methods approach combining quantitative assessment of language outcomes with qualitative evaluation of intervention experiences. The study population included children aged 6 months to 5 years diagnosed with permanent hearing loss, identified either through universal newborn hearing screening programs or later clinical referral. Participants were stratified into two groups based on the age at diagnosis: early identification (≤ 6 months) and late identification (> 6 months). Inclusion criteria required children to have no additional neurological or cognitive impairments that could independently affect language development. Data on demographic characteristics, type and degree of hearing loss, age at amplification or cochlear implantation, and details of intervention programs were collected from medical records and parental interviews. Standardized language assessment tools, including the Preschool Language Scale, Fifth Edition (PLS-5), and the MacArthur-Bates Communicative Development Inventories (CDI), were administered to evaluate expressive and receptive language abilities. Additionally, auditory performance was measured using age-appropriate hearing tests, such as aided audiometry and speech perception in quiet and noise, to correlate auditory access with language outcomes.

The methodology further incorporated qualitative interviews with caregivers and clinicians to capture perspectives on intervention adherence, therapy frequency, and family engagement, which are recognized as influential factors in language development following early identification. Data analysis involved comparing language scores between early and late identification groups using independent t-tests and regression models to control potential confounders such as socioeconomic status, parental education, and type of intervention. Thematic analysis of qualitative interviews was conducted to identify recurring patterns in family and professional experiences that facilitated or hindered effective language development. Ethical approval was obtained from the institutional review board, and informed consent was secured from all participants' parents or guardians. This approach allowed for a comprehensive assessment of both the direct effects of early identification

on language outcomes and the contextual factors that mediate these effects. By integrating quantitative and qualitative data, the study aimed to provide evidence-based recommendations for optimizing early hearing detection programs and subsequent interventions, ensuring that children with hearing loss receive timely, effective, and family-centered support to maximize language development potential.

Results and Discussion

The study included a total of 120 children diagnosed with permanent hearing loss, with 65 children in the early identification group (≤ 6 months) and 55 children in the late identification group (> 6 months). Demographic characteristics, including gender, socioeconomic status, and parental education, were comparable between the two groups shown in Table 1. Children in the early identification group received amplification devices or cochlear implants significantly earlier (mean age 4.2 ± 1.1 months) compared to the late identification group (mean age 18.5 ± 4.3 months). Intervention programs included auditory-verbal therapy and family-centered language stimulation sessions, with comparable frequency across both groups. Language assessments conducted using the Preschool Language Scale-5 (PLS-5) and MacArthur-Bates Communicative Development Inventories (CDI) demonstrated marked differences in expressive and receptive language outcomes between the groups shown in Table 2.

Table 1. Demographic characteristics of study participants

Characteristic	Early (n=65)	Identification Late (n=55)	Identification p-value
Male (%)	53.8	50.9	0.72
Socioeconomic status (low)	26.2	29.1	0.68
Parental education (\geq high school)	61.5	58.2	0.75
Mean age at amplification (months)	4.2 ± 1.1	18.5 ± 4.3	<0.001

Table 2. Language outcomes by age at identification

Assessment	Early Identification	Late Identification	p-value
PLS-5 Receptive Language	88.5 ± 6.3	74.2 ± 8.1	<0.001
PLS-5 Expressive Language	85.3 ± 7.1	70.8 ± 9.0	<0.001
CDI Vocabulary Score	110 ± 12	85 ± 15	<0.001

Quantitative analysis indicated that children diagnosed early achieved significantly higher scores in both receptive and expressive language domains compared to those identified later. Regression analysis controlling socioeconomic status and parental education confirmed that age at identification remained a strong independent predictor of language outcomes ($\beta = -0.61$, $p < 0.001$), suggesting that earlier auditory stimulation directly supports language acquisition. Auditory performance measures further demonstrated that children in the early identification group had better aided hearing thresholds and speech perception in noise, supporting the link between auditory access and language development. Qualitative interviews with parents and clinicians reinforced the quantitative findings. Families of children identified early consistently reported higher satisfaction with intervention outcomes, citing improved communication, easier integration into social and educational environments, and reduced parental stress. Themes emerging from these interviews emphasized the importance of timely amplification, consistent therapy attendance, and active parental involvement in reinforcing language skills at home. In contrast,

families in the late identification group highlighted challenges including initial frustration, delayed language comprehension, and additional therapy requirements to compensate for lost developmental time. These findings align with previous research demonstrating that early auditory access combined with structured language support fosters more age-appropriate language skills (Awan et al., 2024; Fitzpatrick et al., 2025).

The results also highlight the critical importance of universal newborn hearing screening programs and follow-up protocols. Despite comparable intervention programs across groups, the timing of identification alone significantly influenced language outcomes, confirming that early diagnosis is a key determinant in reducing developmental delays (Continisio et al., 2023; Yoshinaga-Itano et al., 1998). While intervention quality and family engagement remain essential, the data suggests that interventions initiated after the critical early months of life may not fully compensate for initial language exposure deficits, supporting findings from (AlSamhori et al., 2024; Pimperton & Kennedy, 2012). Additionally, the observed variability within the late identification group underscores the role of socioeconomic and environmental factors in mediating intervention effectiveness, echoing previous reports highlighting disparities in access and outcomes (Khoza-Shangase, 2025; Wischmann et al., 2025). Overall, the study confirms that early identification of hearing loss significantly enhances language development, both in receptive and expressive domains, while improving auditory performance and facilitating positive family experiences. These findings provide strong evidence for expanding and enforcing early hearing detection programs, ensuring timely intervention, and promoting parent-centered strategies to maximize developmental outcomes. Implementing comprehensive early detection and intervention frameworks not only mitigates the adverse effects of hearing loss on language acquisition but also supports long-term academic, social, and cognitive success, highlighting a practical solution to a pervasive public health challenge.

Conclusion and Recommendations

The findings of this study underscore the critical importance of early identification of hearing loss in children for optimizing language development outcomes. Children diagnosed and provided with intervention within the first six months of life demonstrated significantly higher receptive and expressive language skills, better auditory performance, and more positive family experiences compared to those identified later. These results highlight that early detection is not merely a clinical milestone but a pivotal determinant of developmental trajectories, reinforcing the need for universal newborn hearing screening programs and timely, family-centered intervention strategies. Despite the benefits of early identification, disparities in access, intervention adherence, and socio-environmental support continue to influence outcomes, indicating that early diagnosis alone is insufficient without comprehensive follow-up services. Future research should focus on evaluating long-term academic, social, and cognitive outcomes of early-identified children, exploring cost-effective strategies to enhance accessibility in resource-limited settings, and developing personalized intervention models that integrate family engagement, technology, and community resources. By addressing these areas, healthcare systems can ensure equitable developmental opportunities, minimize the impact of hearing loss on language acquisition, and support the full potential of children with hearing impairment.

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