



Longitudinal Outcomes of Children with Hearing Impairment (LOCHI) study (www.outcomes.nal.gov.au)

The LOCHI study is the most comprehensive, population-based study that provides a solid evidence base showing that earlier cochlear implantation and hearing aid fitting is key to significantly better language outcomes.

PROBLEM Statement

Permanent childhood hearing loss, which occurs in ~2/1000 livebirths, has major negative impacts on children's development, at high personal and societal costs. Universal newborn hearing screening (UNHS) has been implemented with the goal of improving long-term outcomes, *at a population level*. Despite large-scale adoption of UNHS, serious evidence gaps remain. The long-term effectiveness of early intervention for improving outcomes, including employability, educational attainment, mental health, and quality of life, is uncertain. Additionally, the cost-effectiveness of early intervention is unproven.

What is LOCHI?

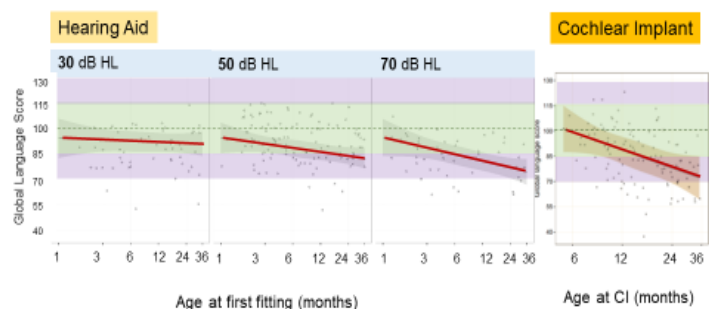
The Longitudinal Outcomes of Children with Hearing Impairment (LOCHI) study aims to address these evidence gaps. The study is a population-based, prospective study that directly compares the outcomes of children with hearing loss who received early or later intervention. About 450 children with hearing loss born in Australia between 2002 and 2007 have been enrolled in the study, 53% of whom first received intervention before 6 months of age. Despite variations in timing of intervention, all children received the same post-diagnostic free, expert audiological services from Australian Hearing, the government-funded hearing service provider in Australia. This means that the results of children can be fairly compared, whenever and wherever their hearing loss was discovered. The LOCHI study is the most comprehensive in the range of predictors and outcomes measured prospectively, the duration of the longitudinal study and the number and separation of measurement points, the range of hearing loss included, the cohort size and the sampling from across an entire population. The combination of these attributes provides data with unprecedented potential to examine effectiveness and cost-effectiveness of early intervention.

We evaluated outcomes at 6- and 12-months after intervention, and again at ages of 3, 5 and 9 years. The findings at 3 and 5 years have been published, and we are currently analyzing data at 9 years.

Key outcomes at 5 years

1. The LOCHI findings at 5 years revealed a significant effect of early cochlear implantation, showing that on average, 5-year language score was 1.4SD higher for a child who received an implant at 6 months, compared to the child who received an implant at 24 months. In a similar vein, there was a significant effect of early hearing aid fitting. Language scores were 0.8 SD higher in children who received hearing aids at 3 months, compared to children who received hearing aids at 24 months. Preliminary analyses of 9-year data showed a similar trend of the benefits of early intervention.

Fig. 1. Early hearing aid fitting or cochlear implantation improved language. Benefits were greater for more severe hearing loss



2. The effects of hearing aid prescription and nonlinear frequency compression in hearing aids of children have been evaluated through randomized controlled trials within the LOCHI study, showing that on average, neither had significant effects on language development.
3. The study also found that the presence of auditory neuropathy spectrum disorder or additional disabilities benefited from early amplification or cochlear implantation.
4. Importantly, the study found that early parent reports on auditory behavior (measured using the PEACH scale) was a significant predictor of 5-year language and psychosocial development.

Impact / Importance of findings: Our paper published in *Pediatrics* was the first to report population-based data that provides evidence on the effectiveness of early fitting or implantation for improving child language outcomes. Factors influencing outcomes have been published in *Ear and Hearing*, the *International Journal of Audiology* and the *Journal of Deaf Studies and Deaf Education*, among others. The evidence has been translated into clinical practice:

1. Australian Hearing national protocols for best-practice guidelines for pediatric amplification have streamlined clinical pathways for evaluating the effectiveness of amplification and for pediatric referral for cochlear implantation candidacy evaluation, so that children who need implants can get them before 12 months of age.
2. Australian Hearing has enhanced its program for management of children who have auditory neuropathy spectrum disorder so that children receive early amplification or cochlear implantation.
3. Australian Hearing has incorporated in its national protocols the use of the parent report tool known as PEACH and early cortical assessments for evaluation and monitoring auditory abilities.
4. Western Ontario and British Columbia in Canada have incorporated the use of the PEACH scale in their respective state-based programs for monitoring and evaluating the effectiveness of amplification for young children with hearing loss.
5. The LOCHI findings have contributed to the American Academy of Audiology Guidelines for Pediatric Amplification, 2013. UNHS is mandated in all 50 states in the US.

WHAT NEXT?

The LOCHI Wave III leverages on the measured outcomes data of the large population-based cohort that have already provided a solid evidence base for the effectiveness of early intervention for improving early language abilities to examine the *long-term effectiveness* of early intervention. Combining the measured data with outcomes at 18 years and healthcare resource use to be prospectively collected in Wave III (2019-2024), this study will address the evidence gaps on long-term effectiveness and cost-effectiveness of early intervention.

We will investigate

- the impact of early intervention on educational outcomes, mental health and quality of life; and
- the societal and economic impact of hearing loss. We will calculate the incremental cost-effectiveness ratio of early vs later intervention.

The findings will provide important evidence to guide hearing healthcare roadmap across the lifespan, and generate the much-needed evidence for healthcare workers, professionals and policy-makers to optimize outcomes of children with hearing loss.