

The impact of hearing impairment on childhood development and education

Key messages

The known:

- Past studies have reported children with chronic middle ear disease (otitis media) have poorer outcomes in early childhood development, school attendance and academic performance.
- High rates of middle ear disease have been reported among Aboriginal children living in remote communities of the Northern Territory. Many of these children have hearing impairment as the result of middle ear disease.

The new:

- Three studies were conducted under the Hearing Loss in Kids Project to investigate the association between hearing impairment and developmental vulnerability and educational outcomes among Aboriginal children.
- Aboriginal children with hearing impairment had greater developmental vulnerability around age 5 years; lower school attendance in Year 1; and poorer academic performance in Year 3, than Aboriginal children with normal hearing.

The implications:

- Public health and clinical interventions to control middle ear disease are likely to lead to improvements in developmental and educational outcomes in Aboriginal children.
- Policy and practice to improve developmental and educational outcomes for Aboriginal children should incorporate measures to control middle ear disease and support children with hearing impairment.

The ability to hear is crucial to a child's normal development and ability to learn.

Early childhood is a critical period during which the foundations for a child's health, education and emotional wellbeing are established. During this time children are particularly sensitive to influences from their living environment. Hearing is crucial to normal development, because children learn to speak and communicate by imitating the sounds they hear, hearing impairment during this period is likely to reduce children's exposure to sounds and voices and hamper their language development. Delayed or impaired language learning can negatively impact children's physical health and their social and emotional development.

Why is it important to investigate the impact of hearing impairment on Aboriginal children's developmental and educational outcomes?

Past studies have consistently reported extremely high prevalence of middle ear

disease (otitis media or OM), as high as 90%, among Aboriginal children living in remote communities in the Northern Territory (NT). The high prevalence has persisted despite decades of public health and clinical intervention programs.

Studies have also found that OM affects Aboriginal children very early in life (often starting in the first few months of life), is more severe, and persists longer compared with their non-Aboriginal counterparts. If left untreated or not treated adequately, OM often progresses to chronic suppurative otitis media (CSOM) and eardrum perforation or a glue ear (chronic effusion), both of which cause hearing loss.

Given the high prevalence of OM in NT Aboriginal children, the prevalence of hearing impairment (defined as bilateral hearing loss) and its impact on their developmental and educational outcomes can also be expected to be high. We conducted the **Hearing Loss in Kids Project** to investigate this impact. Three studies of the Project are presented in this

Research Brief. Figure 1 presents a conceptual diagram for these three studies.

Why was special about the Hearing Loss in Kids Project?

The proper way to assess a person's hearing is called an audiometry test. Audiometry is usually performed by specially trained health professionals called audiologists. It is difficult to perform audiometry tests on very young children, and other forms of hearing tests are needed for this purpose. Hearing tests are labour intensive and can be expensive in remote settings. Therefore, most previous studies examining the impact of hearing impairment on childhood development and educational outcomes used a diagnosis of OM as a proxy for hearing impairment and not a formal audiometry test.

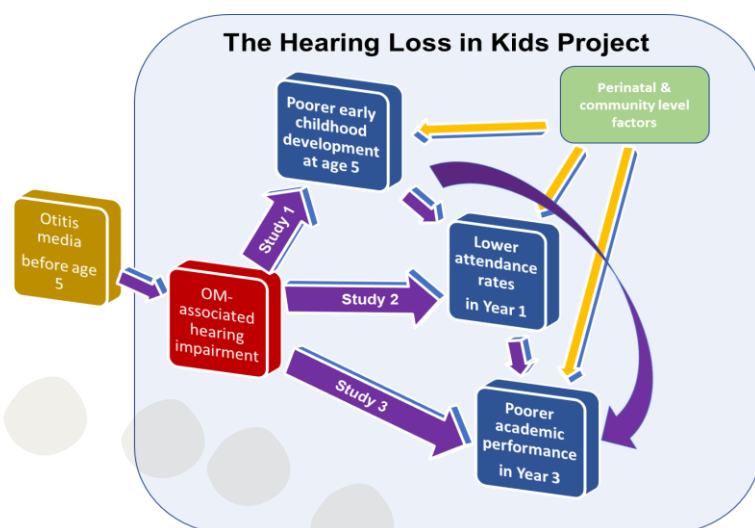


Figure 1: A conceptual diagram for the Hearing Loss in Kids Project

The NT Outreach Hearing Health Program has provided specialist care and services to remote NT communities since 2012. Records of these services, including audiometry test results, have been collected in the Remote Hearing Dataset. De-identified records for children in the Remote Hearing Dataset were linked to records for the same children in a range of other datasets including health and education records. This project was the first in Australia to use audiometrically determined hearing status for this kind of investigation.

Study 1: Impact of hearing impairment impact on childhood development at age 5 years

What question did the study investigate?

Do Aboriginal children with hearing impairment have poorer developmental outcomes, at age 5 years, than Aboriginal children with normal hearing?

How did we do it?

Developmental outcomes were measured with information from the Australian Early Development Census (AEDC). The AEDC provides a snapshot of how well children have developed at about age 5 in five domains: physical health and wellbeing; social competence; emotional maturity; language and cognitive skills; and, communication skills and general knowledge.

In addition to hearing and AEDC data (from 2009, 2012 and 2015) the study also included birth-related data for children, community-level data on relative remoteness of residential locations, housing crowdedness and socio-economic status.

We then conducted statistical analyses to estimate the risk of poorer outcomes associated with hearing impairment, while adjusting for the influence of the other included factors.

What did we find?

After controlling for other factors, children with a record of moderate or worse hearing impairment had about 70% higher risk of developmental vulnerability in two or more domains, compared with their normal hearing peers. In terms of the total AEDC score, they averaged 2.4 points lower (compared with the average score sum of the study cohort of 31.7 points). More detailed results are displayed in Figure 2, which includes estimates for the influence of other factors, such as community-level housing crowdedness and gender on AEDC score. Children with hearing impairment were at higher risk of developmental vulnerability in the 'language and cognitive skills', 'communication skills and general knowledge' and 'physical health and wellbeing' domains.

Conclusions and implications

Hearing impairment plays a role in Aboriginal children's being developmentally vulnerable. Prevention and early treatment of OM will reduce both OM prevalence and developmental vulnerability. Interventions and policies to improve developmental outcomes in this population should also address the needs of children with hearing impairment.

Source: Su J-Y, Guthridge S, He VY, Howard D, Leach AJ. Impact of hearing impairment on early childhood development in Australian Aboriginal children: A data linkage study. *J Paediatr Child Health* 2020;56(10):1597-606.

Study 2: Hearing impairment's impact on Year 1 school attendance

What question did the study investigate?

Do Aboriginal children with hearing impairment have poorer school attendance in Year 1 than Aboriginal children with normal hearing?

How did we do it?

We linked individual-level records for children about hearing assessments, school attendance and birth-related factors with community-level information on remoteness of school locations, housing crowdedness and socio-economic status. We then conducted statistical analyses to estimate the impact of hearing impairment on attendance rates in Year 1, adjusted for the other included factors.

What did we find?

Children with "unilateral hearing loss", "mild hearing impairment" and "moderate or worse hearing impairment" had lower Year 1 attendance than those with normal hearing, attending 5.6, 4.0 and 6.1 days (out of the usual 200 school days per year) fewer, respectively. More detailed results are displayed in Figure 3.

Conclusions and implications

Aboriginal children with hearing impairment, including those with unilateral hearing loss, are at higher risk of lower school attendance in Year 1 than their normal-hearing peers. Given the high prevalence of OM and hearing impairment in Aboriginal children, it is important that hearing screening is conducted on entry into primary school and that support is provided for the learning needs of students with hearing impairment.

Source: Su J-Y, He VY, Guthridge S, Howard D, Leach A, Silburn S. The impact of hearing impairment on Aboriginal children's school attendance in remote Northern Territory: a data linkage study. *Aust N Z J Public Health* 2019;43(6):544-50.

Study 3: Hearing impairment's impact on academic performance in Year 3

What question did the study investigate?

Do Aboriginal children with hearing impairment have poorer academic performance in Year 3 than Aboriginal children with normal hearing?

How did we do it?

Students' academic performance was measured with their National Assessment Program – Literacy and Numeracy (NAPLAN) results. NAPLAN tests are held annually in all Australian schools for students in Years 3, 5, 7 and 9. The tests assess student's performance in five domains: reading, writing, spelling, grammar and punctuation, and numeracy. The test is designed to assess a student's understanding of the core elements of the national curriculum and is an aid in identifying those students who may not have attained the skills required to progress to the next year of schooling.

In addition to hearing data and NAPLAN data, we also linked birth-related data, school attendance data (for Year 2) as well as community-level data for socio-economic status, remoteness of school locations and housing crowdedness. We then conducted statistical analyses to estimate the impact of hearing impairment on children's NAPLAN results, while controlling for other included factors.

What did we find?

Children with mild hearing impairment scored lower in Writing and Spelling by 15.0 points and 5.0 points, respectively which were equivalent to 7.3% and 2.1% of the mean score. Children with moderate or worse hearing impairment scored lower in Writing and Numeracy by 13.4 points and 15.2 points; both were equivalent to 6.3% of the mean score in the respective domain. Results for the Writing domain are displayed in Figure 4.

Conclusions and implications

Aboriginal children with hearing impairment had poorer academic performance compared with their normal hearing peers.

Interventions to improve academic performance for Aboriginal children should incorporate actions to address hearing impairment through early detection, effective treatment and ongoing support for affected children.

Source: Su J-Y, Guthridge S, He VY, Howard D, Leach AJ. The impact of hearing impairment on early academic achievement in Aboriginal

children living in remote Australia: a data linkage study. BMC Public Health 2020;20(1):1521.

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Figure 2: Study 1 – Average difference in domain score sum of AEDC, for factors in the final statistical model

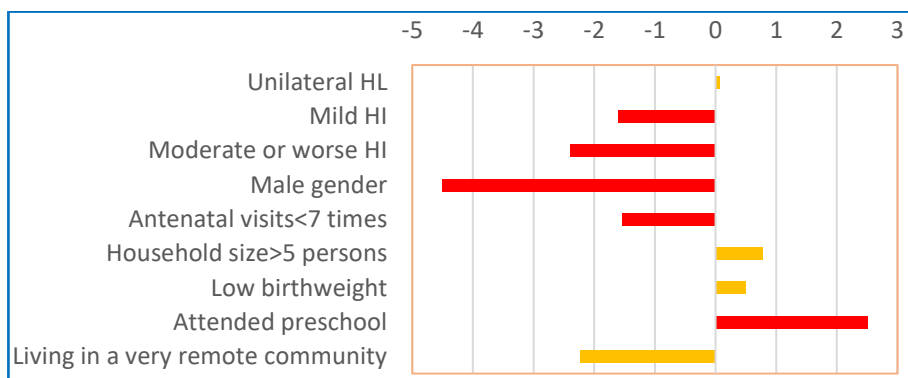


Figure 3: Study 2 – Average difference in attended school days, for factors in the final statistical model

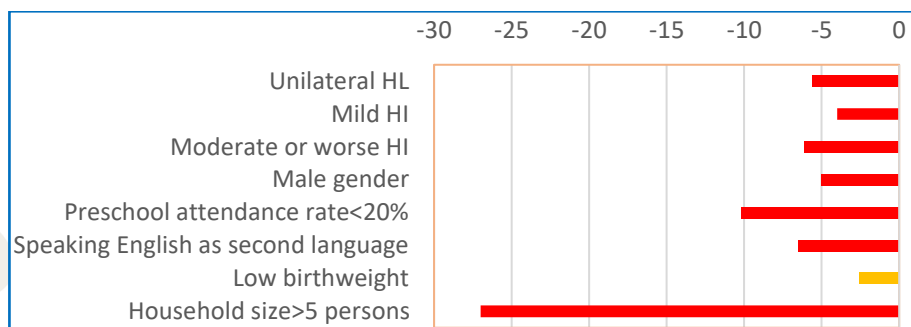
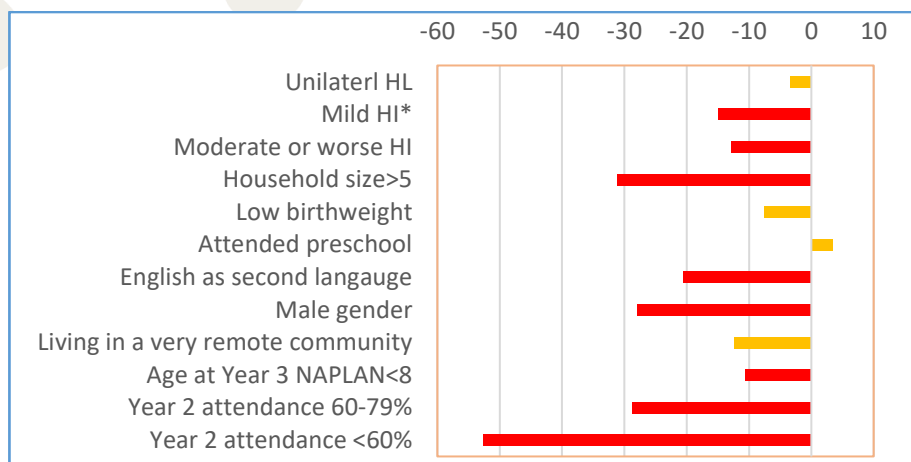


Figure 4: Study 3 – Average difference in scale scores for the Writing domain of NAPLAN, for factors in the final statistical model



Notes: 1. Differences are shown compared with the reference category for each factor: for Year 2 attendance, the reference is attendance $\geq 80\%$; 2. HL: hearing loss; HI: hearing impairment. 3. Red bars indicate statistical evidence for difference while gold bars indicate insufficient statistical evidence for difference.