Shaping auditory-linguistic experiences for children who are hard of hearing: the role of intervention and amplification on speech and language outcomes

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NIDCD Working Group: Research Gaps

NHANES II & III Prevalence: Ages 6-19 yrs

Severe & profound
61,000

Mild & moderate
907,000

Donahue (2007); Eisenberg et al. (2007); Tomblin & Habibeler (2007)
Goal: Explain individual variability

Domains of study

- Speech Production
- Language Skills
- Academic Abilities
- Hearing & Speech Perception
- Psychosocial and Behavioral
- Background characteristics of child/family
- Interventions (clinical, educational, audiological)

Child and Family Outcomes

- Degree of HL (PTA)
- Audibility
- Auditory Hearing aid use
- Linguistic input
- Outcomes
- Educational Intervention
- Audiological Intervention
Accelerated Longitudinal Design

Inclusion criteria:
- English spoken in home
- No significant cognitive or motor delays
- Permanent bilateral mild to severe HL (25 – 75 dB HL)
- No cochlear implants

Participants

<table>
<thead>
<tr>
<th></th>
<th>CHH</th>
<th>CNH</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>317</td>
<td>117</td>
<td>Matched on income &amp; maternal education</td>
</tr>
<tr>
<td>Gender</td>
<td>173 male, 144 female</td>
<td>54 male, 63 female</td>
<td>Higher than typical US sample</td>
</tr>
<tr>
<td>Hearing</td>
<td>M= 48.68 dB HL, 7 without amplification, 76% identified from NHS</td>
<td>&lt; 20 dB HL</td>
<td>9.78% attrition</td>
</tr>
</tbody>
</table>
Language Outcomes by Age

* p < .0001 CHH differed significantly from SES-matched age mates.

Conclusion: CHH are at risk for depressed language development

Risk increases with severity of hearing loss

- All subgroups were significantly different than control group (p < 0.0001).
- Controlling for maternal education, relationship between degree of hearing loss and language levels.
Best practice: JCIH guidelines

Best Practice Benchmarks:
- 1 month: hearing screen
- 3 months: confirmation of HL
- 6 months: entry into early intervention

JCIH, 2007; Yoshinaga-Itano et al. 2017

What happens after NHS?

Only 32% of 193 children who referred UNHS met all benchmarks on time.


Follow-up age by ID group & PTA

Walker, et al. 2017
Mother’s level of education → follow-up timing

Mean Ages at Follow-up by Maternal Education


Causes of delays: confirmation of HL

### Common reasons for delay from UNHS to diagnostic test

- Multiple re-screenings
  - Family chose to wait before scheduling diagnostic test
  - Family was assured that the failed screening was likely due to something other than hearing loss
  - Delayed due to treatment of middle ear problems
  - Family was not told to get a diagnostic ABR
  - Difficulty getting an appointment quickly

### Reasons for delay from diagnostic test to confirmation of HL

- Multiple ABRs
  - Recurrent middle ear infections
  - ABR was normal or near normal

One failed screening merits diagnostic follow-up. Multiple screenings and diagnostic tests emphasizes a need for specialized pediatric audiologists and educated physicians.

Causes of delays to HA fitting

<table>
<thead>
<tr>
<th>Common reasons for delay from confirmation to HA fitting</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing aids were not initially recommended</td>
<td>11</td>
</tr>
<tr>
<td>Difficulty obtaining clinic appointment for hearing aid fitting</td>
<td>10</td>
</tr>
<tr>
<td>Family decided not to proceed with hearing aid fitting right away</td>
<td>12</td>
</tr>
</tbody>
</table>

On average, these children received early intervention for over one year (14.17 months) before receiving a hearing test. (Walker, et al. 2014)

Reasons for delays: later-ID

- HL suspicion to first evaluation
  - Wait for apt 12%
  - Told HL not a concern 12%
  - Medical issues 33%
  - Additional

HL confirmation to HA fitting
- Unsure 10%
- Obtain medical clearance 5%
- Wait for apt 14%
- Insurance approval 14%
- Chose to wait 5%

Big picture findings: Age at service delivery

- Children of less educated mothers at-risk for later dx, confirmation, HA fit.
- Later-identified children with mild HL receive services at older ages.
- Early intervention could reduce delays to HL identification & HA fitting.
How can these delays be addressed?

- Avoid multiple re-screens or ABRs.
- Priority for children’s 1-3-6 audiology visits.
- Communication about family’s progress along the EHDI timeline.
- Educational resources & emotional support.
- Unique support for at-risk families:
  - Lower SES
  - Later-identified
  - Mild HL

Speech & Language Over Time

Age: 3 Years, 6 months

Audibility: Speech Intelligibility Index

How much I can hear through my hearing aids depends on:
- Degree of hearing loss
- Distance, noise
Children's HAs could be better fit

McCreery, et al. 2013

Audibility over time influences language

Tomblin, et al. 2015

Big picture findings: Audibility

EI providers should regularly support parents with checks of HA function.

May not see immediate results after HA fitting!

AuDs should optimize SII with best practice HA verification.
OCHL model: HA use

Degree of HL (PTA) → Audibility → Hearing aid use → Linguistic input → Outcomes

HA use improves over time, but still variable

- Maternal education level influenced longitudinal trends in HA use
- Degree of hearing loss influenced use in school-age children

Data logging

Walker et al. (2015); Tomblin et al. (2015)

What family factors relate to HA use?

- SES (Walker 2013)
- Issues with managing hearing aids (Munoz 2014)
  - frustration
  - confusion
  - lack of confidence
  - Perception of benefit with hearing aid

Malleable!

More efficacious parents → more HA use!
Lower use consistency for mild HL

Language scores as a function of degree of HL and amount of HA use

Full-time HA users with mild HL have better vocabulary than non-users
Full-time HA users with mild HL have better morphology than non-users

Hearing aids are beneficial, right?

Alternatively, mild hearing loss could represent ‘overdiagnosis’, defined as identification of a real condition for which treatment does not actually benefit an individual’s outcomes (Goon et al. 2014). This would imply that these children’s developmental deficits might not be attributable solely to their hearing acuity. If so, the decision to amplify mild losses early could represent not only overtreatment (i.e. treatment that cannot deliver benefit) but also active harm (costs, burden, stigmatization).

HA use affects language growth

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Big picture findings: HA use

Summary: Protective Factors

- Milder degree of hearing loss
- Better audibility
- Well-fit amplification
- Early hearing aid fitting
- Amplification worn consistently
- Higher quality language input
- More resourced homes

Collaboration supports auditory access

Use consistency
- 30% did NOT receive from audiologist
- 31% received from B-3 provider
- 15% not given any information

HA mgmt
- 40-50% were NOT taught by audiologist
- ~25% taught by B-3 provider
Families participate more at home

At home (n=165)
- 87% Always
- 2% Some of the time
- 66% Never or Not very often

Not at home (n=56)
- 29% Always
- 2% Some of the time
- 70% Never or Not very often

χ² = 112, p <.001

Access to specialized services

970 SLPs and 80 Audiologists in Nebraska

HH caseload of Birth-3 providers

- Ranged from 1-60 children
- Average was 20 children
How can providers become more comfortable managing HAs?

- Learn along with the family.
- Hands-on continuing ed:
  - Inserting earmolds
  - Daily hearing aid checks
  - Using Ling sounds
  - Troubleshooting hearing aids
- Ask an audiologist lots of questions!
- Go to YouTube!

OCHL model: Linguistic input

- We know that children's language outcomes are shaped by the input to which they are exposed, but how do we measure it and how do we coach parents to change their behaviors?
What our research tells us

- As hearing gets worse and audibility decreases, adult talk and conversational turns decrease (Van Dam, et al., 2012).
- For every 1% increase in electronic media, number of conversational turns decreased by 2.5 turns (Ambrose et al., 2014).
- More conversational turns = stronger language outcomes (Ambrose et al., 2014).
T = Talk, Talk, Talk

A = Auditory Environment

R = Reciprocity
Optimizing cumulative auditory experience

- Shorten delays to HA fitting & EI.
- Ensure optimal audibility—use best practice verification & monitor function at home.
- Encourage full-time HA use with parents & service providers.
- Stay close when talking & turn off the TV!

Thank you!

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- www.ochlstudy.org
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References


References, cont’d


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