Promoting optimal outcomes for children who are hard of hearing

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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

EHDI CI UNHS Sign Lang Speech Language

Donahue (2007); Eisenberg et al. (2007); Tomblin & Hebbeler (2007)

Goal: Explain individual variability
Domains of study

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

Child and Family Outcomes

Approaches to understanding outcomes

+ = ?
Factors that influence relationship between PTA and outcomes.
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= 48.88 dB HL 7 without amplification 76% identified from NHS</td>
<td>&lt; 20 dB HL</td>
<td>9.78% attrition</td>
</tr>
</tbody>
</table>

![Graph showing distribution of hearing levels for CHH and CNH groups.](image)
Language Outcomes by Age

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

Conclusion: CHH are at risk for depressed language development

Tomblin et al. 2015
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.

181 CHH, and 79 CNH

Tomblin et al. 2015

Best practice: JCIH 1-3-6 guidelines

Universal Newborn Hearing Screening (UNHS) and state Early Hearing Detection and Intervention (EHDI) systems are in place to help ensure that children who are hard of hearing are identified, fit with amplification, and enrolled into early intervention in a timely manner.

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

JCIH, 2007
What happens after NHS?

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

Mother’s level of education → follow-up timing

Mean Ages at Follow-up by Maternal Education

- High School or less (n=34)
- Some college (n=65)
- Bachelors (n=50)
- Post Graduate (n=43)

Ages at follow-up by NHS status & PTA

![Box plot showing ages at follow-up by NHS status & PTA](image)

Walker, et al. in preparation

Causes of delays to HL confirmation

<table>
<thead>
<tr>
<th>Common reasons for delay from UNHS to diagnostic test</th>
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<tbody>
<tr>
<td>Multiple re-screenings</td>
</tr>
<tr>
<td>Family chose to wait before scheduling diagnostic test</td>
</tr>
<tr>
<td>Family was assured that the failed screening was likely due to something other than hearing loss</td>
</tr>
<tr>
<td>Delayed due to treatment of middle ear problems</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Reasons for delay from diagnostic test to confirmation of HL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple ABRs</td>
</tr>
<tr>
<td>Recurrent middle ear infections</td>
</tr>
<tr>
<td>ABR was normal or near normal</td>
</tr>
</tbody>
</table>

One failed screening merits diagnostic follow-up. Multiple screenings and diagnostic tests emphasizes a strong need for qualified 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>N</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>


Ages at follow-up by NHS status & PTA

Walker, et al. in preparation
Later-ID: intervention before hearing test

“On average, these children received early intervention for over one year (14.17 months) before receiving a hearing test.”

Reasons for delays: later-ID


Walker, et al. 2013
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
Social support = less parent stress

- Hands & Voices
- AG Bell

Luterman & Kurtzer-White, 1999

Speech & Language Over Time

Age: 3 Years, 6 months
Audibility over time influences language

Tomblin, et al. 2015

Audibility: Speech Intelligibility Index

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

McCreery, et al. 2013

Big picture findings: Audibility

- May not see immediate results after HA fitting!
- AuDs should optimize SII with best practice HA verification.
- EI providers should regularly support parents with checks of HA function.
OCHL outcomes model

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

HA use over time affects language growth

Tomblin et al., 2015
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

Consistency of use lower for mild HL

Audibility has similar relationship with outcomes for children with mild and moderate-to-severe HL.

Walker et al., 2013
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

Tomblin et al., 2015

Walker, et al., 2015
Full-time HA users with mild HL have better morphology than non-users

![Graph showing comparison between non-users, part-time, and full-time HA users. The graph indicates a significant difference with a 2.5 SD difference.](image)

Walker, 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

More efficacious parents → more HA use!
**Big picture findings: HA use**

- **Fitting hearing aids early matters!**
- **Greatest benefit from hearing aids with consistent, high use.**

*Tomblin et al., 2015*

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**Family participation by service site**

- "Serving children exclusively in a childcare setting does not provide the opportunity to model, coach, or support parents in any way."

*Harrison, et al., 2015*

\[X^2 = 112, p < .001\]
HH caseload of Birth-3 providers → comfort managing HAs

- 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!
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

Thank you!

- Meredith.Spratford@boystown.org
References


References, cont’d

