Adult-Onset Hearing Loss: A Public Health Perspective

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Hearing Loss & Public Health

Basic Questions

1) What do we know about hearing loss and hearing health care at a national level?

2) What do we know about hearing health care for minority and low-income adults?

3) What are the consequences of hearing loss for adults?
Principles of Auditory Physiology

Hearing depends on *peripheral transduction* & *central processing* of sound

“Hello”

Peripheral Transduction

Central Processing

Listen by Mister Pixel from The Noun Project
Brain by Marek Polakovic from The Noun Project
Audio Spectrum by useiconic.com from The Noun Project
Principles of Auditory Physiology

Hearing can be measured at multiple levels

Peripheral Cochlear Function

- Otoacoustic Emissions
- Pure Tone Audiometry

Central Auditory Measures (Speech in Noise, Dichotic Listening)

Subjective Hearing & Communicative Function

Central Cortical Function

Listen by Mister Pixel from The Noun Project
Brain by Marek Polakovic from The Noun Project
Principles of Auditory Physiology

“Hearing Loss” = Changes in peripheral cochlear function that can be assessed with audiometry

PTA = Pure tone average of 0.5, 1, 2, & 4 KHz tones
## Definitions of Audiometric Hearing Loss

### WHO Grades of Hearing Loss

<table>
<thead>
<tr>
<th>Grade</th>
<th>Audiometric ISO Value</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>25 dB or better</td>
</tr>
<tr>
<td>1</td>
<td>Slight</td>
<td>26-40 dB</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
<td>41-60 dB</td>
</tr>
<tr>
<td>3</td>
<td>Severe</td>
<td>61-80 dB</td>
</tr>
<tr>
<td>4</td>
<td>Profound</td>
<td>81 dB or greater</td>
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</tbody>
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Datasets for Epidemiologic Analyses

Objective Audiometric Data

**NHANES**: National Health and Nutritional Examination Surveys
- Cross-sectional
- Representative sample of U.S. population

**HealthABC**: Health, Aging, & Body Composition Study
- Prospective, population-based study
- ~3,000 adults 70 years and older
- Biracial cohort
Prevalence of **Hearing Loss** in the United States, 2001-2008

Hearing loss defined as a better-ear PTA of 0.5-4kHz tones > 25 dB

NHANES

Arch Int Med, 2011

Total = 30 Million US Adults

NHANES

Arch Int Med, 2011
Hearing Loss & Hearing Aid Use
Prevalence in the U.S., 1999-2006

Prevalence

Age (in years)

50-59
60-69
70-79
80+

NHANES

Arch Int Med, 2012

Total = 3.8 Million Hearing Aid Users

NHANES

Arch Int Med, 2012
Hearing Screening & Hearing Aid Use
Prevalence in the U.S., by Race/ethnicity

- Recent Hearing Screening:
  - White Older Americans: 38%
  - Black Older Americans: 35%
  - Older Mexican Americans: 36%

- Regular Hearing Aid Use:
  - White Older Americans: 9.53%
  - Black Older Americans: 10.22%
  - Older Mexican Americans: 20.5%

**p value 0.41**
**p value 0.002**

NHANES

J Aging Health, 2015
Rates of Hearing Aid Use by Race/ethnicity & SES

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Education</th>
<th>Total Assets</th>
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<tbody>
<tr>
<td>Blacks n=398</td>
<td>10.8</td>
<td>10.47</td>
</tr>
<tr>
<td>Whites n=894</td>
<td>25.62</td>
<td>19.44</td>
</tr>
<tr>
<td>Less than HS n=296</td>
<td>12.84</td>
<td>30.07</td>
</tr>
<tr>
<td>HS n=421</td>
<td>21.14</td>
<td></td>
</tr>
<tr>
<td>More than HS n=574</td>
<td>25.26</td>
<td></td>
</tr>
<tr>
<td>None n=296</td>
<td>1-2 assets n=360</td>
<td></td>
</tr>
<tr>
<td>3-7 assets n=449</td>
<td>30.07</td>
<td></td>
</tr>
</tbody>
</table>
Hearing Loss & Healthy Aging

Mechanistic Pathways

Hearing Loss

Cognitive Load
Changes in brain structure
Reduced Social Engagement

Common Cause (e.g., aging, microvascular disease)

Cognitive & Physical Functioning
Cognition & Dementia
- Accelerated cognitive decline in older adults 70+ (Arch Int Med 2013)
- 2-5x increased risk of incident dementia (Arch Neuro 2011; Neurology 2012)

Avoiding injury
- Increased falls (JGMS 2009; Arch Int Med 2012)
Physical mobility
- Reduced walking speed (JAGS 2009; Gait & Posture 2012)
- Accelerated decline in physical functioning (JGMS 2014)

Health economic outcomes/mortality
- Increased risk of hospitalization (JAMA, 2013; JAGS 2015)
- Increased mortality (Ann Epi 2010; Age & Ageing, 2013; JGMS 2014)
Social & Emotional Health

- Emotional distress & social engagement restriction (Gopinath et al., 2011)
- Increased rates of depression (JAGS, 2013; Li et al., 2014)
- Social isolation (Pronk et al., 2011; Pronk et al., 2014)
- Increased caregiver burden (Kuzuya & Hirakawa, 2009)
- Use of community supports (Schneider et al., 2010)
Hearing Loss & Healthy Aging

**Mechanistic Pathways**

- **Hearing Loss**
  - Changes in brain structure
  - Reduced Social Engagement
  - Common Cause (e.g., aging, microvascular disease)

**Intervention**

- **Cognitive Load**

**Cognitive & Physical Functioning**

**HL intervention** could plausibly reduce the cognitive load of processing degraded auditory signals, provide increased auditory stimulation, and improve social engagement.

- Role of HL as potentially modifiable risk factor (Aging Ment Health, 2014)
Addressing Hearing Health Care

- Awareness & Understanding
- Cost & Affordability
- Access to Services & Technology
- Technology Design & Utility