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More to Lose? Noise-Risk Perceptions of Young Adults with Hearing Impairment

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Acknowledgment

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- National Health & Medical Research Council, GNT 1033817
Learning Outcomes

After this course, participants will be able to:

- Describe the risk of noise-related hearing loss to young people in evidence-based terms.
- Consider the attitudes and beliefs of young people when advising about hearing loss prevention.
- Discuss the limitations of personal hearing protectors as a protective strategy for young hearing aid wearers, and identify alternative approaches to hearing health promotion.

Carter & Black, 2017, Seminars in Hearing 38(4), 319 - 331

Community and Media Concern

“We may be facing an epidemic of hearing impairment”

Agrawal, 2008

Literature review:

Ear & Hearing Vol 35 (5), 491 - 505

- Based on scientific studies of industrial noise, a cause-effect relationship between leisure noise and hearing threshold level (HTL) shift seems plausible
“A ‘techno freak’ subjecting himself to loud music via a PCP* endangers his ears in the same way as a worker in a steel factory using no ear protection”

Maassen et al., (2001)

* Personal cassette player

Evidence lacking

- Evidence that some leisure noise is comparable in intensity to industrial noise

however...

- the dose-response relationship between leisure noise and hearing injury is undetermined
- contradictions and poor methodology are issues
- quality population HTL data for adolescents are limited
- there were no previous investigations of leisure noise issues for young people with pre-adult hearing impairment (HI)
Suggested reading


Australian Survey – Leisure Noise Overview

- Phase 1: mainstream population:
  - HTL data \( n = 1407 \)
  - Survey data \( n = 1050 \)

- Phase 2: hearing impaired population:
  - HTL data \( n = 260 \)
  - Survey data \( n = 267 \)

Total \( n = 1667 \) (HTL & survey data)
Phase 1 Aims

For young people, metropolitan Sydney (90%) and rural NSW (10%):

- Determine prevalence of hearing loss
- Estimate life-time exposure to leisure noise
- Examine the relationship between audiometric measures and leisure-noise exposure

Quantify the risk

Phase 1 Methods

Testing was conducted onsite in schools, colleges and workplaces

- Audiological tests (PTA, OAE, impedance)
- Otoscopy
- Interview (under 18 yrs)
- Survey (paper or online)
Phase 1 Interview & Survey

- General health / hearing
- Family history
- Demographic information
- Knowledge/beliefs
  - hearing loss,
  - effects of noise
  - risks
- Listening to music (speakers, iPod/MP3)
- Use of hearing protectors/strategies
- Leisure and work activity profile

Phase 1 Main Findings

- Prevalence of hearing loss depends on criterion (“cut off”) used
- HTL data show little difference to statistical population “norms” (ISO 7029)
- Leisure-noise exposure not a predictor of HTL
- Greater estimated exposure associated with higher frequency of tinnitus experience:
  never → sometimes → often → all the time
Phase 1 HTL data

Lack of association – noise & HTL
Phase 1 Conclusion

Findings do not suggest an “epidemic” of pure tone hearing loss

However,

there may be subtle damage that PTA does not reveal

→ Early Indicators of Noise Injury

Knowledge gap → Phase 2

Young people already disadvantaged by HI may have more to lose than their peers with NH, given the impacts of HI on communication, social interaction, educational and vocational progress.

Always found it difficult socially to make friends and follow conversation because of my hearing loss. Sometimes I would not go to school or go out with my friends because I had bad hearing or tinnitus…. Participant comment
Phase 2 Aims

For young people with **hearing impairment**

- Determine incidence of progressive hearing loss
- Estimate leisure-noise exposure
- Examine relationship between HTL shift & noise
- Investigate attitudes and beliefs of young people with HI to noise risk
- Examine parent attitudes to noise risk
- Compare with data for “normal” hearers

Phase 2 Method

- Australian Hearing clinics (NSW)
- Clinical information (PTA, tymps, hearing aids)
- Parent Survey
- Participant Survey
- Parent survey – phase 1 sample
Retrospective HTL Data

- HTL data collected from baseline (5y +) to most recent (final) test
- Differences between final and baseline
- Correlations between noise exposure and HTL shift
- Survival analysis (pattern of shift)
- Magnitude of HTL shift

Audiometric Findings

- HTL shift was observed in almost 50% of cases analysed (NO other factors for progressive loss)
- The magnitude of HTL shift increased gradually over time
- No relationship was found between HTL shift and noise exposure
  
  However, small spread of noise exposures - overall, exposure relatively low
HTL shift - Reference


Comparing HI & NH survey data

- Matched items from participant surveys
- Exclusions
  - “NH” group 4FAHL ≥ 20 dB HL
  - Disability, health issues
  - Missing data
- Age groups
  - (A) 13 to 17 years
  - (B) 18 to 24 years
Leisure survey

Hearing health, attitudes, behaviour

Participation measure

Go to live music (e.g. bands, concerts, musicals) or smaller venues (e.g. hall, theatre, clubs etc.)

- About how much do you go to these events?
  - Never
  - Less than once a year
  - 1-2 times a year
  - Once every few months
  - Once a month
  - Once every 3-4 weeks
  - Once a week
  - More than once a week

- How long do you stay for the activity each time?
  - ____ hours each time

- How old were you when you first did this activity?
  - ____ years of age

- How many times a week?
  - ____ times

- How many years have you been doing this activity?
  - ____ years in total

- Hearing protection used?
  - Never
  - Some of the time
  - Mostly/always


Noise profiles - Limitations

- Current methods for estimating noise risk based on adult data and industrial noise
- Effects of leisure noise, music, industry may differ
- Susceptibility varies among individuals
- Relative effect for HI vs. NH currently unknown
- Contribution of amplification (if any) unknown
- Exposure not measured directly (substituted data)
Whole-of-life noise exposure

Acceptable Daily Exposure = $L_{\text{eq}}$, 8h of 85 dB(A) daily = 1.01 Pa$^2$h

ISO 1999 (2013); Williams (2008)

Acceptable Yearly Exposure

Acceptable Whole-of-life exposure

$1 \text{ ADE} \times 220 \text{ days}$

ACCEPTABLE ≠ RISK FREE

Noise Exposure: whole-of-life profile

Based on dosimetry database

- Fitness class: 92 dB - 45 min
- Rugby league match: 93 dB - 2 hrs
- Pub with music: 92 dB - 2 hrs
- Nightclub: 96 dB - 4 hrs
Results

Whole-of-life exposure

13 to 24 year olds

Acceptable whole-of-life exposure

Results (A) 13 to 17
Results (B) 18 to 24

Key Findings

- Participation and exposure HI vs. NH

  Teenagers = No difference in exposure

  Young adults = HI lower exposure than NH
  almost 10% vs 25% “at risk”

- Lower exposure = lower risk

  = social disadvantage?
Noise profiles - Reference


Dilemma

“Without adequate opportunities to participate, people are unable to explore their social, intellectual, emotional, communicative and physical potential and are less able to grow as individuals”.

King et al., (2003, pg.65)
Parent Survey
Self-report, 40 questions

Hypotheses:
- Risk perception NIHL
  parents of HI children > parents of NH children
- Tolerance of everyday risks
  parents of HI children < parents of NH children

Parent Attitudes & Beliefs

Survey example:

23. In terms of hearing damage from loud sound exposure:
How risky do you think your son/daughter’s (the participant’s) leisure activities are? (circle one)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very low risk</td>
<td></td>
<td></td>
<td>Very high risk</td>
<td></td>
</tr>
</tbody>
</table>

### Tolerance of everyday risk

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>YOUR FEELING ABOUT THE ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very Uncomfortable</td>
</tr>
</tbody>
</table>

| Use a personal stereo (e.g., iPod or MP3 player) | 1  | 2 | 3 | 4 | 5 |

### Results

<table>
<thead>
<tr>
<th>Leisure activity</th>
<th>HI % comfortable</th>
<th>NH % comfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water sports</td>
<td>81.1</td>
<td>97.1</td>
</tr>
<tr>
<td>Sing in choir</td>
<td>69.8</td>
<td>88.6</td>
</tr>
<tr>
<td>Play other instrument</td>
<td>69.8</td>
<td>85.7</td>
</tr>
<tr>
<td>Small music venue</td>
<td>52.8</td>
<td>72.9</td>
</tr>
<tr>
<td>Play loud instrument</td>
<td>30.2</td>
<td>57.1</td>
</tr>
<tr>
<td>Use PC for fun</td>
<td>73.6</td>
<td>55.7</td>
</tr>
<tr>
<td>Play contact sports</td>
<td>20.8</td>
<td>47.1</td>
</tr>
</tbody>
</table>
Parent Attitudes - Conclusions

- No significant difference in general sense of noise risk
- Child’s leisure-noise risk perceived as lower than peers
- Some activities, HI group parents less comfortable
- Many parents expressed positive attitudes to participation

*We never stop our child from participating in life - we always find a way to communicate*

Parent comment

Parent Attitudes - Reference

Comparing young adult attitudes

- Detailed surveys, matched items
- Data selected for analysis:
  - (B) 18 – 24 y  \( n = 79 \) HI  \( n = 131 \) NH

- Hearing loss ranged from mild to profound
- Mainly regular hearing aid wearers
- Pearson’s \( \chi^2 \) test used to compare HI and NH data

Hypothesis

Young people with hearing impairment (HI) would

- have more negative perceptions of noise exposure
- engage more in hearing protective behaviours than their peers with NH
Results

- In general, perceived as a risk (HI & NH)

<table>
<thead>
<tr>
<th>Personal Music Players</th>
<th>Night-clubbing/loud concerts</th>
</tr>
</thead>
<tbody>
<tr>
<td>~ 75%</td>
<td>~ 85%</td>
</tr>
</tbody>
</table>

However

- only 21.5% of HI and 32.6% of NH respondents believed themselves to be at risk
- similar to parents, risk to others seen as greater than risk to self
Attitudes to noise risk

How risky are activities of peers?

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Low</th>
<th>Neutral</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>

How risky are your own activities?

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Low</th>
<th>Neutral</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>

Own hearing concerns

Concern about hearing deterioration

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Low</th>
<th>Neutral</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>

Belief hearing will change in future

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Unlikely to change</th>
<th>Likely to change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>

* Statistically significant $\chi^2 = 23.235, df = 2, p < 0.001
Leisure activity profile

- Protectiv behaviour

Hearing Impaired group

- Wearing hearing aids OFF
- Earplugs
- Earmuffs
Protective behaviour – NH group

Normal hearing group

Wearing hearing aids…..where?

Devices switched ON during activity
18 to 24 year olds (total n= 79)

- play in orchestra (10)
- watch live sport (47)
- pub/club (61)
- live music large venue (51)
- live music small venue (57)
- do motor sports (17)
- watch motor sports (16)
- electronic games (53)
- gym/dance class (46)
- sing in choir (18)
- outdoor music festival (24)
- power tools (35)
- outdoor music festival (24)
- play in rock band (6)
- nightclub (66)
- shooting (12)

Percentage of participants

- mostly/always
- sometimes
- never
I wear my hearing aids at all times. When it comes to loud sounds or metal work/wood work at school when I need to use the earmuffs, I still leave my hearing aids on.

Participant comment

Do you avoid noise?

Do you prefer to avoid some places (e.g., clubs, dance parties), or activities (e.g., motor sports) because they are too loud?

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes-somewhat</th>
<th>Yes-very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI group</td>
<td>48.1%</td>
<td>35.4%</td>
<td>15.2%</td>
</tr>
<tr>
<td>NH group</td>
<td>46.6%</td>
<td>41.2%</td>
<td>11.5%</td>
</tr>
</tbody>
</table>

~ 50% = Yes
Research hypothesis – refuted

HI group did NOT
- demonstrate more negative perceptions
- report more hearing protective behaviour

- Many wear amplification during noisy activities
- Prioritise need to hear conversation?
- Manage social situations

Conclusions - Prevention

- Personal hearing protector use is LOW (HI & NH)
- Hearing aids ARE worn in noisy places
- It is unclear how much “protection” signal processing of current hearing aids provides
- Reducing noise in leisure venues may be a more effective approach – and more inclusive
Overall Summary

- There is no evidence of an “epidemic” of pure tone hearing loss among teenagers or young adults.
- Hearing deterioration will occur for many young adults with HI, regardless of noise exposure.
- Young adults with HI participate less than their peers with NH in a number of social activities.
- Young people are aware of the risks of noise, but few take steps to protect their hearing.
- Hearing aids are frequently used in noisy situations because hearing speech is essential to social interaction.
- Parents of teens with HI vary in risk tolerance.

IMPORTANT: Interaction of hearing loss, noise exposure, and hearing aid use is still unknown.

What can we do for young people with HI?

- Listen, find out in detail.
- Provide up-to-date evidence.
- Be honest about knowledge gaps.
- Avoid over-conservative messages.
- Explore parent beliefs.
- Discuss tinnitus and TTS experiences.
- Talk about participation and barriers.
- Encourage young adults to stay in hearing services program.
- Encourage self-advocacy.

Limitations

- Relatively small numbers with HI
- Test-retest reliability of survey?
- Recall bias
Be an advocate for change

- Promote greater access to hearing services, including hearing aids
- Give feedback on hearing aid design and other assistive technology
- Take a multi-disciplinary approach
- Be involved in research

Special Thanks

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- Research audiologists: Denise Macoun, Monica Gibian, Katrina Freeston, Jermy Pang, Jenny Rosen
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Publications

Thanks for listening