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- Email customerservice@AudiologyOnline.com
Personal Listening Devices and Hearing Health – The Who, What, When, and Wear

Presented by Megan Gilliver
National Acoustic Laboratories, Australia

Learning Outcomes

After this course, participants will be able to:

- Describe Personal Listening Device usage in Australia.
- Characterize risk profiles and Hearing Health of PLD users in Australia.
- Name ways to encourage appropriate PLD listening behaviors.
Personal Listening Devices (PLD)

- Iphone
- Tablet
- Walkman
- Smartphone
- iPod
- Mp3 player
- Discman
- Earbuds
- Transducers
- Headphones
- Noise-cancelling headphones

The Growth of PLDs

Ipod Sales ('000 000)

Smartphone Sales ('000 000)
The Growth of PLDs

Worldwide Smartphone Sales ('000 000)

Popular Media

Reports are often negative

Young iPod users risk permanent hearing damage, warns expert

Many MP3 players produce noise intensity of an airplane, says Yale’s associate professor of medicine

Sarah Bowsley, health editor
Wed 31 Apr 2013 08:25
AEST

Generation Deaf: Doctors Warn of Dangers of Ear Buds

Smartphones can blast your hearing, health report warns

Loud music at street volume can cause permanent hearing loss

Christopher Latos, CBC News - Posted: April 30, 2015 5:00 AM ET | Last Updated: April 4, 2015
Academic Journals

“Alarmist reports began to be issued as soon as rock concerts became popular”

Hetu & Fortin 1995 (p382)

“A "techno freak" subjecting himself to loud music via a PCP [personal cassette player] endangers his ears in the same way as a worker in a steel factory using no ear protection.”

Maasen et al (2001, p4)

WHY…Look at Leisure Noise?

Meet Tom & Richard

Current exposure at work and leisure

Personal Responsibility?

Employer’s Responsibility?

Are they at risk?
Which exposure needs managing?
Meet Harriet & Harry

Current exposure at work and leisure

Are they at risk?
Which exposure needs managing?

Let’s look again at those exposures...
Noise, PLDs, & Risk

LAeq, 8h of 85 dB(A)
Acceptable Daily Exposure = 85dB averaged over 8 hours

Who Controls Loudness & Duration?

Volume:
- Externally controlled
- Individually controlled

Duration:
- Externally Controlled
- Individually Controlled
PLD Volumes

Influenced by:

- Device type
- Transducer (headphone) type
- Headphone fit

Average Max volumes

~ 100dBA
### PLD Listening levels (Williams, 2009)

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>Age Range</th>
<th>Listening Level</th>
<th>Listening Time</th>
<th>At Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>55</td>
<td>15-48 years</td>
<td>79.8 dB</td>
<td>2.38 hours</td>
<td>25%</td>
</tr>
<tr>
<td>2005/6</td>
<td>38</td>
<td>13-54 years</td>
<td>77.6 dB</td>
<td>2.19 hours</td>
<td>26%</td>
</tr>
<tr>
<td>2008</td>
<td>47</td>
<td>14-59 years</td>
<td>74.7 dB</td>
<td>2.21 hours</td>
<td>17%</td>
</tr>
</tbody>
</table>

### Other Risk Estimates

- **Portnuff et al (2013)**
  - 14.3% exceeded noise-dose based on self report (n=52)
  - 16.7% exceeded noise-dose based on dosimetry (n=24)

- **Levey et al (2011)**
  - 189 College students
  - 51.9% exceeded noise dose
Factors Influencing Listening Levels

- Listening Environment
- Device – Transducer
- Age & Gender?

What else do we need to know?

Previous Studies limited by:

- Smallish sample size
  - Representativeness of sample
- Only “snap shot” data collected
  - Data restricted to single listening environment
- Lacking user-profile data
Study Aims

People who wear headphones/earbuds:

- **Who** are they?
- **When** (& How) do they listen?
- **What** proportion are at-risk, and how does this relate to their hearing health?

Citizen Science Projects

- Harnessing “non-scientists” to assist with the conduct of research projects

Data Analysis

*And/or*

Data Collection

Sound Check Australia
Participants

Who are the participants?

Range: 15-91 years
Mean = 31 years
53% Male
47% Female

PLD usage

Activities
- Commuting
- Working
- Exercising
- Going to sleep

Device Type
- Mp3
- Phone
- Computer
- Tablet
- Gaming console

Additional
- Hours
- Transducer
- Volume (%)
Results:

Device hours

- Mp3 (39%)
- Phone (24%)
- Computer (25%)
- Ereader/console/tablet (11%)
- Other (5%)

Results:

Transducers
Results:
*Listening Volume (%)*

- No significant gender difference

- Age difference:
  - 15-19 years
  - 20-29 years
  - 30-39 years
  - 40-49 years
  - 50-59 years
Results:

*Listening Duration (hours/month)*

- No significant gender difference

- Age differences

- 15-19 years
  - 20-29 years
  - 30-39 years
  - 40-49 years
  - 50-59 years

Mean 68 hours
Results: Listening Environments

Where does the listening happen?

- Leisure time at home
- Working in quiet...
- Commuting
- Working in busy...
- Going to sleep
- Working around the house
- Gym
- Other (Including sports)

Hours in listening environment

Total number of PLD listening hours

1
Results
Listening Environment Volumes

- Going to sleep: 8
- Working in a quiet environment: 4
- Leisure time at home: 2
- Watching sports: 9
- Working in a busy environment: 6
- Commuting: 1
- Working around the house: 5
- Exercising outdoors: 3
- Exercising at a gym: 7

Implications

- As a group:
  - Majority of PLD hours occur in quiet environments – where listening volumes are also generally lower.
  - Listening in noisier environments often shorter, but listening volumes higher

- General trends only
  - What about individual risk?
Participants

- SCA • n = 9,904
- Regular PLD users • n = 5,371
- Cleaned Sample • n = 4,185
- Volume/Duration Available • n = 3,578

Risk Quantification

Exposure: PLD DND
- Personal Listening Device
- Daily Noise Dose

- 8 hours
  - 0.5 PLD DND
  - DND

- 85 dBA
Risk Quantification

- Volume estimates converted to dB
- Duration estimates converted to hours/day

Individual exposures calculated based on all reported activities as percentage PLD DND

---

**Results**

*Risk Categorisation*

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Low Risk</th>
<th>High Risk</th>
<th>Very High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLD DND</td>
<td>Less than 0.5</td>
<td>0.5 - 3</td>
<td>3+</td>
</tr>
<tr>
<td>Proportion of participants</td>
<td>85%</td>
<td>9%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Over 10% (401) of participants’ exposures exceeded 1 PLD DND.
Mean PLD DND, by Risk Group

<table>
<thead>
<tr>
<th>Risk Status Group</th>
<th>Mean PLD DND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0.05</td>
</tr>
<tr>
<td>High</td>
<td>1.24</td>
</tr>
<tr>
<td>Very High</td>
<td>11.26</td>
</tr>
</tbody>
</table>

**Implications**

- Majority of PLD usage occurring at “safe” levels.

- However, PLD users still represent a large population overall.

- NB: Risk status here only references PLD usage, not overall listening patterns.
### Hearing Health Items

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you feel you have a HL?</td>
<td><strong>YES = 41%</strong></td>
</tr>
<tr>
<td>Over time have you noticed any change in your hearing ability?</td>
<td><strong>No = 46%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Worsened a little = 48%</strong></td>
</tr>
<tr>
<td>Have you ever experienced tinnitus?</td>
<td><strong>Never =29%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Occasion./Sometimes=52%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Frequently/Always = 19%</strong></td>
</tr>
<tr>
<td>In general, how would you describe your hearing ability?</td>
<td><strong>Positive = 72%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Negative =11%</strong></td>
</tr>
<tr>
<td>Are you ever bothered by feelings that your hearing is poor?</td>
<td><strong>Never = 44%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Frequently/Always = 7%</strong></td>
</tr>
<tr>
<td>When several people are talking in a room, do you have difficulty hearing a conversation?</td>
<td><strong>Never =24%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Occasionally/Sometimes= 51%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Frequently/Always=21%</strong></td>
</tr>
<tr>
<td>Can you follow the conversation when you are at a large dinner table?</td>
<td><strong>Never =2%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Occasionally/Sometimes= 21%</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Frequently/Always=77%</strong></td>
</tr>
</tbody>
</table>
Analysis-focus on 18-35 years

- Justification:
  - Significant proportion of PLD users
  - PLD “natives”
  - Lowered risk of HL confounds

Results:

18-35 years

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Low Risk</th>
<th>High Risk</th>
<th>Very High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLD DND</td>
<td>Less than 0.5</td>
<td>0.5 - 3</td>
<td>3+</td>
</tr>
<tr>
<td>Proportion of participants</td>
<td>82%</td>
<td>10%</td>
<td>7%</td>
</tr>
</tbody>
</table>
Results:  
Hearing Health

Do you feel you have a hearing loss?

LOW RISK
- **No**: 61%
- **Yes**: 39%

HIGH RISK
- **No**: 46%
- **Yes**: 54%

VERY HIGH
- **No**: 49%
- **Yes**: 51%

Over time, have you noticed any change in your hearing ability?

- Worsened a little
- No change
- Improved

LOW RISK
- **Worsened a little**: 53%
- **No change**: 45%
- **Improved**: 7%

HIGH RISK
- **Worsened a little**: 53%
- **No change**: 45%
- **Improved**: 7%

VERY HIGH
- **Worsened a little**: 45%
- **No change**: 50%
- **Improved**: 5%
Results: 
Hearing Health

In general, how would you describe your hearing ability?

- Perfect
- 6
- 5
- Neither good nor poor
- 3
- 2
- Very Poor

Results: 
Hearing Health

Have you ever been bothered by feelings your hearing is poor?

- Never
- > Occasionally
- > Frequently
Implications

- Higher risk PLD users self-report higher level of hearing difficulties.
- This may result from....

Association with PLD usage?  

Increased Awareness?

High risk listening patterns

Hearing Difficulties

Results:

Have you ever experienced tinnitus?

Hearing Health
Implications

Motivator for noise reduction

Age of sample

Intensity of PLD exposure

Tinnitus Results

Results: Hearing Health

When several people are talking in a room, do you have difficulty hearing an individual conversation?

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Never</th>
<th>Occasionally</th>
<th>Sometimes</th>
<th>Frequently</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very High Risk</strong></td>
<td>25</td>
<td>28</td>
<td>24</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td><strong>High Risk</strong></td>
<td>29</td>
<td>24</td>
<td>20</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td><strong>Low Risk</strong></td>
<td>14</td>
<td>23</td>
<td>28</td>
<td>23</td>
<td>4</td>
</tr>
</tbody>
</table>
### Results: Hearing Health

**Can you follow the conversation when you are at a large table?**

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Always</th>
<th>Frequently</th>
<th>Sometimes</th>
<th>Occasionally</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High Risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>High Risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Low Risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

### Results: Hearing Health

**Overall, I would judge my ability to make out speech or conversations to be:**

<table>
<thead>
<tr>
<th>Overall Ability</th>
<th>Good</th>
<th>Average</th>
<th>Slightly below average</th>
<th>Poor</th>
<th>Very poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High Risk</td>
<td>10</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Risk</td>
<td>20</td>
<td></td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Low Risk</td>
<td>14</td>
<td></td>
<td></td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>
Self-reported speech perception

- Results from three items highly correlated
- Composite score created for analysis

Very High Risk
High Risk
Combined self-reported difficulty for speech perception
Low Risk

Implications

- Higher risk PLD users reporting higher level of speech perception difficulties

Early warning sign of NIHL
High risk listening patterns

Speech Difficulties
Association with PLD usage?
Limitations

- Sample Bias
- Self-selected
- Calculations based on assumptions
- DND Estimates
- Report Accuracy
- Reliance on participants’ recall abilities

Summing Up

- PLD users are a large and diverse group
- Some users may be experiencing warning signs of hearing damage
- Different listening patterns may require different exposure reduction strategies
Implications for Hearing Health Professionals

- Promoting healthy listening habits

- Consider PLD listening environments
  - Volume
  - Duration
  - Transducers

- Consider other sources of exposure

PLD use in context
References