Interaction of age and noise-exposure in hearing thresholds

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Susan Strauss Ph.D.
INVESTIGATORS

Susan Strauss, Ph.D.
Department of Communication Pathology, University of Pretoria, South Africa

De Wet Swanepoel, Ph.D.
Department of Communication Pathology, University of Pretoria, South Africa; Ear Sciences Centre, School of Surgery, the University of Western Australia, Nedlands, Australia; Ear Science Institute Australia, Subiaco, Australia

James W Hall III, Ph.D.
Department of Communication Pathology, University of Pretoria, South Africa

Piet Becker, Ph.D.
Biostatistics Unit, Medical Research Council, Gauteng, South Africa and Faculty of Health Sciences, University of Pretoria

Zahan Eloff, MD
Occupational Health Department, AngloGold Ashanti, Carletonville, South Africa
BACKGROUND

- World’s 4th largest gold producer - Largest industry in SA
- Underground operations, depths of over 3.8 km (2 miles)
- Ore reserves estimated at 6,000 t
- Witwatersrand Basin
- 5.1% of all workers in the formal sector of economy
- 357,000 employees in 2012
- Noise exposure levels <113.6 dBA
- 73.2% exposed to levels >85 dBA (Legislated OEL)
- Rate of NIHL (2011) 3.1/1000 employees

AGE AND NIHL

• Several similarities between ARHL and NIHL
• Mechanism of damage
• Effect of noise on hearing in the early years versus the later years
• Interaction between ARHL and NIHL

METHODOLOGY AND STUDY POPULATION

• **Retrospective** record review design
• Audiogram data of **57,714 gold miners** collected between 2001 and 2008
• Mine database, **Everest**
• Participants divided into different noise groups, underground noise exposure >85 dB A (n=33,961), Surface noise exposure >85 dB A (n=7496), control group (no noise exposure) (n=6194)
METHODOLOGY AND STUDY POPULATION (continue)

- Underground Noise Exposure Group and Control group divided into 4 different age groups
  - 16-30 years
  - 31-40 years
  - 41-50 years
  - 61-65 years

- Also divided into 2 subgroups with homogenous noise exposure, drillers and administrative workers

- Descriptive statistics (median thresholds) and inferential statistics where possible
### Number of participants per age group—Underground Noise Group and the Control Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>16 to 30 Years</th>
<th>31 to 40 Years</th>
<th>41 to 50 Years</th>
<th>51 to 60 Years</th>
<th>61 to 65 Years</th>
<th>Total n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Underground Noise Group</strong></td>
<td>7568</td>
<td>11,190</td>
<td>11,058</td>
<td>3683</td>
<td>250</td>
<td>33,961</td>
</tr>
<tr>
<td></td>
<td>22.3%</td>
<td>32.9%</td>
<td>32.6%</td>
<td>10.9%</td>
<td>0.8%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Control Group</strong></td>
<td>1623</td>
<td>2327</td>
<td>1696</td>
<td>492</td>
<td>24</td>
<td>6194</td>
</tr>
<tr>
<td></td>
<td>26.4%</td>
<td>37.8%</td>
<td>27.4%</td>
<td>7.9%</td>
<td>0.4%</td>
<td>100%</td>
</tr>
</tbody>
</table>
RESULTS AND DISCUSSION

Median thresholds (in dB HL) per frequency for each age category for the Underground Noise Group (N=33,961)

- **16-30 Years**, n=7568
- **31-40 Years**, n=11190
- **41-50 Years**, n=11058
- **51-60 Years**, n=23683
- **61-60 Years**, n=250
Median comparisons between different age groups:

- A notch observed in younger age groups at 6 kHz (Notch criteria of Coles, Lutman & Buffin, 2000).

A high-frequency notch with the hearing threshold at 3, 4 and/or 6 kHz at least 10 dB greater than at 1 or 2 kHz and at least 10 dB greater than at 6 or 8 kHz.

- Greatest differences in hearing loss between the noise-exposed and control group were observed at 3 and 4 kHz (10 dB) in the age group between 31 to 40 years of age.

95th Percentile values for thresholds in dB HL per frequency for participants in Underground Noise Group categorised by race and gender (Black Male, n=17933; White Male, n=2687)
Race:

• After correcting for age through ANCOVA pairwise comparisons indicated a significant difference between black and white males (p=0.0) for low and high frequency thresholds:

  – High frequency thresholds significantly better for black males compared to white males

  – Low frequency thresholds significantly worse for black males compared to white males

Median thresholds per frequency for the age group 51 to 60 years categorised by their working years (Underground Noise Exposure)
Within age groups comparisons for different years of exposure to noise:

• In all age groups, more years of exposure to noise presented worse hearing across the frequency range.

• Changes more pronounced after 10 years of noise exposure.

• The greatest decline in hearing across age groups with longer working years was at 3 kHz.
Median values for thresholds (in dB HL) across the frequency range for black, male participants in the Driller and Administration (admin) groups, for ages 31 to 40 years, 41 to 50 years, and 51 to 60 years.
Threshold changes with age for black driller versus admin groups:

- Deceleration of HL true for frequencies typically affected by NIHL (3, 4 and 6 kHz) but accelerated rate of loss over time at 2kHz
- Not seen in the larger group, but in HEG (Homogenous exposure groups)

SUMMARY OF CONCLUSIONS

• 2 kHz showed more decline than 4 kHz with age in the black noise-exposed group compared to the control group.

• Hearing deteriorated more across age groups with more noise-exposed years with changes more pronounced after 10 years.

• The greatest decline in hearing across age groups with longer working years was at 3 kHz.

• NIHL affects hearing thresholds differently for black versus white men.
QUESTIONS
Susan Strauss Ph.D.
Email: susan@phonak.co.za