A Descriptive Analysis of Metal/Nonmetal Miners with Reported Hearing Loss, 1999-2010

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Noise

- Interchangeably used with sound
- Sound
  - Oscillations in pressure in a medium that has elasticity and viscosity
  - Characterized by frequency and amplitude
- Sound pressure level
  - Square of SPL = proportional to sound intensity level
  - Most common way to measure sound
The Decibel (dB)

- Dimensionless unit that describes most quantities related to noise
- Defined as
  \[ L = k \log_{10} \frac{A}{B} \]
- A-weighted sound level (dBA) used for most noise regulations

Occupational Noise-Induced Hearing Loss

- Defined as permanent, partial or complete loss of hearing in one or both ears that occurs cumulatively as a result of long-term exposure to noise at work
- Most commonly reported occupational illness in the U.S.
- Major factors:
  - Intensity of sound
  - Duration of exposure
- Caused by irreversible damage to cochlear hair cells in the inner ear
- Begins as a temporary threshold shift \( \rightarrow \) over time, becomes permanent threshold shift
Noise in the Mining Industry

- Major problem due to use of heavy equipment, drilling of rock, and confined workspace

- 1971: USBM reports 73% of underground coal miners exposed to hazardous noise

- Recent studies show 80% of miners exceed TWA exposures of 85 dBA and 25% exceed TWA exposures of 90 dBA

Noise Rule (1999)

- Retained PEL of 90 dBA for 8-hr TWA shift
  - Above PEL, operator must use all feasible engineering and administrative controls to reduce exposure to/or below the PEL and enroll the miner in a Hearing Conservation Program
  - If 8-hr TWA reaches 105 dBA, mine operator must provide miner with dual hearing protection

- Established Action Level at 85 dBA with a 5-dB exchange rate for 8-hr TWA shift
  - Above AL, operator required to enroll miner in a Hearing Conservation Program which includes monitoring exposure, conducting voluntary audiometric testing, and offering hearing protection
Purpose

- Assemble descriptive data on noise exposures among metal/nonmetal miners with reportable hearing loss
- Analyze the cumulative noise exposure among cases

Methods

- Study population
  - M/NM miners with reported hearing loss (1999-2010)
  - Cases reported either through Part 50 Illness Reporting or from Worker’s Compensation awards
### Job Exposure Matrix

<table>
<thead>
<tr>
<th>Case #</th>
<th>Mine ID</th>
<th>Job</th>
<th>Date Reported</th>
<th>Job Experience</th>
<th>Year</th>
<th>MSHA Sample</th>
<th>Sample (dB)</th>
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### Cumulative Exposure Formula

Cumulative exposure = \(10 \log \left( \sum_{j=1}^{k} L_{eqj} T_j \right)\)

- \(k\) = number of average annual noise exposure estimates per case
- \(T_j\) = duration of work history period \(j\)
- \(j\) = 1 year
- \(L_{eqj}\) = estimate mean noise exposure for a job held in work period \(j\)
- Units = dB-years
Results

- # of cases analyzed: n=109
- Cases held 13 unique job titles
- Represented 50 mines
- Years of job experience ranged from 1-41 years
- Many jobs underrepresented

Yearly Noise Estimates for Job Titles Held by Cases
Results

- 18% of cases did not have a single year of exposure above MSHA’s AL of 85 dB
- 67% of cases did not have a single year of exposure above MSHA’s PEL of 90 dB
- Focused on miners with at least 25 years of experience (n=54)

Cumulative Exposure Results

- Highest frequency of miners with reported hearing loss have:
  - 21-30 years of experience
  - Cumulative exposure of 95-99 dB-years
Years of Experience vs. Cumulative Exposure

- Cumulative exposure increases with years of experience
- Small increase may be explained by small sample size or by different yearly noise intensity samples

Summary of Findings

- Mean yearly noise exposures of cases ranged from 26.64 to 111.49 dBA with a mean yearly noise exposure at 80.01 dBA, well below MSHA's AL
- Most frequent category of miners had 21-30 years of experience with a cumulative noise exposure of 95-99 dB-years
**Strengths**

- Quantitative, rather than qualitative, approach to reconstruct miner’s cumulative exposure history
- Very specific exclusion criteria to minimize exposure misclassification
- Working with a cohort of “cases” so minimal outcome misclassification

**Limitations**

- Limited to MSHA’s database
  - Non-uniform selection criteria: some cases reported by Part 50, others from Worker’s Comp. Awards
  - Any mistakes made by inspectors or MSHA employees who enter data into system may have affected results
  - Data are collected to determine compliance, rather than for the purpose of a health study, resulting in a lot of missing information
- Clear that many mines and contractors do not report hearing loss
  - Many noisy jobs, such as drill operators, were underrepresented
Limitations

- Many assumptions due to lack of information
  - Miner worked same job at the same mine for his entire career
  - Noise sample representative of case in study
  - Noise sample represented entire year
  - Interpolated points used for missing years
- No information on other possible factors that may lead to hearing loss
  - E.g. age, use of hearing protection, leisure activities

Conclusions

- 18% of miners with reported hearing loss do not have a single yearly sample above MSHA’s AL and 67% do not have a single yearly sample above the PEL
- Yearly noise exposures below the PEL still add up to a high cumulative noise exposure over a long period of time
- MSHA’s standards are set based on a daily 8-hour TWA but it is important to consider long-term risks to noise exposures that are below the standard
- NIHL continues to be a major issue for M/NM miners despite the enactment of MSHA’s 1999 Noise Rule
- Mine operators and MSHA must continue to collaborate in order to reduce noise exposures and protect workers’ health
References