The Health Risks of Noise are Loud and Clear: Investigating the Public Health Significance of Occupational Noise-induced Hearing Loss

Laura E Bogaert, MSc PhD(c)
Division of Epidemiology
Dalla Lana School of Public Health
University of Toronto

OEH Seminar Series, March 4th 2016
Conflict of Interest Declaration

- *I have no relationship with industry and therefore no conflict of interest to declare*
Sound vs Noise

- Sound is pressure change detectable by the ear
- Measured by pitch (Hz) and volume (dB)

- Noise is loud, unexpected, unpleasant/undesirable/unwanted sound
- Noise can be continuous or intermittent (impact or impulse)
Health Risks of Noise

- Temporary and permanent hearing loss (threshold shift)
- Tinnitus (ringing in the ears)

- Possible risks:
  - Stress
  - Anxiety
  - Muscle tension
  - Ulcers
  - Increased blood pressure and hypertension
  - Cardiovascular disease
Non-health Impacts of Hearing Loss

- Impaired communication
- Social isolation
- Frustration, irritability
- Decreased self-esteem and negative self-image
- Decreased awareness and ability to monitor environment (sirens, warning signals, equipment sounds)
- Lost productivity and increased absenteeism
Noise-induced Hearing Loss (NIHL)

- Most common cause of hearing loss after age-related
- 100% preventable and no cure
- Two broad types of NIHL:
  - Acoustic traumatic injury
  - Long-term exposure to high levels of noise

- Hearing losses from different causes are additive and interaction can occur between noise exposure and some solvents/chemicals or antibiotics
- NIHL is often not diagnosed until later in life when it is compounded by age-related hearing loss
Measuring Hearing: Audiometric Data

- Audiograms are completed for the right and left ear
- Graph the audible threshold for standardized frequencies

---

Age-related

Noise-induced
Examples of Approximate Decibel Levels

- 85 - handsaw
- 95 - electric drill, lawn mower
- 100 - factory machinery, music in headphones
- 105 - snow blower
- 110 - power saw, rock concert
- 120 - jet plane (at ramp)
- 130 - jackhammer, percussion section at symphony
- 140 - airplane taking off
- 150 - jet taking off
- 163 - rifle
- 170 - shotgun
Measuring Occupational NIHL

- WHO has identified a gap in information:
  “There is a serious shortage of accurate epidemiological information on prevalence, risk factors and costs of NIHL.”
- Many studies are cross-sectional and do not take into account the longitudinal nature of NIHL
- Difficult or impossible to differentiate between occupational and recreational exposures as the cause of NIHL
- Difficult to collect comprehensive exposure along with longitudinal audiometric data

http://www.who.int/pbd/deafness/en/noise.pdf?ua=1
Burden of Occupational Hearing Loss

- 2005 study estimated the proportion of workers worldwide exposed to noise at moderately high (85 – 90 dB) and high (>90 dB) levels, and the relative risks of hearing loss at those exposure levels

- 16% of the disabling hearing loss in adults (over 4 million DALYs) is attributed to occupational noise, ranging from 7% to 21% in the various subregions

- Heavier burden among males (2.8 million DALYs) compared to females (1.4 million DALYs).

(Nelson et al., 2005)
Global Burden of Hearing Loss

- In 2012, WHO released new estimates (based on 42 population-based studies) on the magnitude of disabling hearing loss:
  - There are 360 million persons in the world with disabling hearing loss (5.3% of the world’s population).
  - 328 million (91%) of these are adults (183 million males, 145 million females)
  - Approximately one-third of persons over 65 years are affected by disabling hearing loss.
  - In developing nations an estimated 40% of workers are exposed to hazardous levels of noise.
### WHO Disabling Hearing Loss Estimates

<table>
<thead>
<tr>
<th>Selected Regions</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>millions</td>
<td>prevalence (%)</td>
</tr>
<tr>
<td>High-income</td>
<td>19</td>
<td>4.9</td>
</tr>
<tr>
<td>Central/Eastern Europe and Central Asia</td>
<td>14</td>
<td>9.0</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>17</td>
<td>7.4</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>6</td>
<td>4.1</td>
</tr>
<tr>
<td>South Asia</td>
<td>52</td>
<td>9.5</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>19</td>
<td>8.7</td>
</tr>
<tr>
<td>Latin America and Caribbean</td>
<td>15</td>
<td>7.6</td>
</tr>
<tr>
<td>East Asia</td>
<td>41</td>
<td>7.4</td>
</tr>
<tr>
<td>World</td>
<td>183</td>
<td>7.5</td>
</tr>
</tbody>
</table>

MBD, WHO, 2012 DHL estimates
Prevalence of Disabling Hearing Loss for adults

- High-income
- Sub-Saharan Africa
- Middle East and North Africa
- South Asia
- Asia Pacific
- Latin America and Caribbean
- East Asia

- Prevalence of Disabling Hearing Loss for adults 15+ years old
- Prevalence of Disabling Hearing Loss for males 15+ years old
- Prevalence of Disabling Hearing Loss for females 15+ years old

*MBD, WHO, 2012, DHL estimates, where DHL adult threshold is ≥41 dB HL
Cross-sectional Canadian Hearing Loss Data

  - Hearing difficulty in adults
    - 4% reported a “hearing problem” (deafness or hearing loss)
    - Self-report

  (Woodcock & Pole, 2007)

- CHMS Cycle 3 (2012-2013):
  - Hearing loss in adults
    - 20% of adults 19 to 79 years had at least mild hearing loss in at least one ear
    - Measured

  (StatsCan, 2015)
Cross-sectional American Hearing Loss Data

- **NHANES III:**
  - Hearing difficulty in adults 18–65
    - 11% reported hearing difficulty
    - 24% of this hearing loss attributed to occupational noise
    - Self-report
  
    *(Tak & Calvert, 2008)*

- **US Current Population Survey 2010:**
  - Severe hearing impairment among ≥17 years
    - 2.5% (2.3-2.6) non-veterans
    - 10.4% (9.8-11.0) of veterans (all service periods)
    - Measured

    *(Groenewold, CDC MMWR, 2011)*
NIHL in High-Risk Occupational Groups

- Musicians
- Industrial workers
- Miners
- Construction workers
- Military personnel
Occupation-specific Hearing Loss

  - 18% of workers 18-69 years had hearing loss
    - Mining, Manufacturing, and Construction industries need better engineering controls for noise and stronger hearing conservation strategies
    - Unexpectedly high risk of hearing loss among real estate workers

  - 1,872 general population compared to Army Active Duty (AD) (n = 9,096), National Guard (n = 3,842), and Reservists (n = 2,025) and by gender
    - No difference between hearing thresholds of civilian and military females
    - No difference between hearing thresholds of civilian and Army Active Duty males
    - Poorer hearing among male National Guard and Reservists compared to civilians (Sobieraj, et al, 2009)
Hearing Loss: A Public Health Issue

- WHO has identified NIHL as a public health priority:
  “...as populations live longer and industrialization spreads, NIHL will add substantially to the global burden of disability.”

- Whose responsible for prevention?
  - Regulatory bodies
  - Industry
  - Workplaces
  - Workers
  - Individuals during leisure time

http://www.who.int/pbd/deafness/en/noise.pdf?ua=1
Workplace Noise Regulations

- In Canada, there are provincial/territorial variations (85-90 dB; some regions have max. peak of 140; some regions have max. number of impacts (90-100).
- Federally
  - Noise limit is 87 dB over an 8-hour work period
- Ontario
  - Noise limit is 85 dB over an 8-hour work period
- In the United States
  - Noise limit is 90 dB over an 8-hour work period
Public Health Implications

- Potential for population-level increase of health issues
  - Isolation, frustration, depression
- Potential increase of workplace accidents
  - Reduced awareness and ability to monitor environment

- Potential Occupational Implications:
  - Reduced communication among workers
  - Lost productivity
  - Increased absenteeism
  - Reduced employability
Hearing Loss in the Canadian Military

- For my dissertation, I am examining the epidemiology of hearing loss among Canadian Armed Forces personnel.
- No comprehensive data on noise exposure in Canadian military environments.
- There are electronic audiometric data and matched self-report questionnaires since 2010.
  - Tested at least at recruitment, and every 5 years for those under age 40 and every 2 years for those aged 40 and over.
- My proposed research will examine occurrence and severity of hearing loss, and will identify high-risk occupational subgroups and key risk factors for NIHL.
Hearing Loss in the Canadian Military

- Although there is no current information on the burden of hearing loss in the Canadian military, it is one of the most commonly compensated service-related conditions.

- Top five service-related conditions for which compensation is paid by VAC (FY 2012/2013):
  - Tinnitus: 29%
  - Hearing loss: 21%
  - PTSD: 7%
  - Osteoarthritis - knee: 2%
  - Lumbar disk disease: 2%
Hearing Loss in the American Military

- Hearing loss is the most common injury of war
- Hearing loss is the most common service-related disability among veterans
- Roughly 30% of all claims to Veteran Affairs are for hearing loss
- Veteran Affairs buys one in five hearing aids sold annually in the U.S.
Looking Forward

- Need for more comprehensive exposure and audiometric data from occupational subgroups and non-exposed counterparts

- Need to focus on prevention – hearing conservation programs in workplaces
  - Noise assessments
  - Noise controls (administrative, engineered, PPE)
  - Audiometric monitoring of workers’ hearing
  - Worker education
  - Record keeping
  - Program evaluation
Happy (Belated) World Hearing Day!

- March 3rd - annual advocacy event which aims to raise awareness and promote ear and hearing care across the world. Previously ‘International Ear Care Day’.

- However…Occupational NIHL not yet identified as a priority:
  - 2016: ‘Childhood Hearing Loss: Act now, here is how!’
  - 2015: ‘Make Listening Safe’
  - 2014: ‘Ear Care Can Avoid Hearing Loss’
  - 2013: ‘Health Hearing, Happy Life – Hearing Health Care for Ageing People’
Final Remarks

- Take responsibility for your own hearing
  - Reduce exposure to loud environments and wear protection
  - Seek medical advice if you experience changes in your hearing

- How can you tell if you are exposed to hazardous noise?
  - If you have to raise your voice to talk to someone who is an arm's length away
  - If your ears are ringing or sounds seem dull or flat after leaving a noisy place

Thank you! Questions? laura.bogaert@mail.utoronto.ca
Prevalence of disabling hearing loss for all population by selected regions*
(threshold $\geq 41$ dB for adults 15 years of age or more, and threshold $\geq 31$ dB children under 15 years of age, WHO 2011 estimates)