Prevention of Recreational Hearing Loss

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<table>
<thead>
<tr>
<th>Duration/Day</th>
<th>Noise Level (slow response) *</th>
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<tbody>
<tr>
<td>8 hours</td>
<td>90 dBA</td>
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<tr>
<td>6 hours</td>
<td>92 dBA</td>
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<td>4 hours</td>
<td>95 dBA</td>
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<td>3 hours</td>
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<td>2 hours</td>
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<td>1.5 hours</td>
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<td>1 hour</td>
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<td>0.5 hour</td>
<td>110 dBA</td>
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<td>&lt; 0.25 hour</td>
<td>115 dBA</td>
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* all levels documented at concerts and in nightclubs

Noise/Music Induced Hearing Loss:

- Recreational activities posing risk of hearing loss
  - Sporting events
  - Music induced hearing loss
  - Activities involving noise
- Patients at risk for recreational hearing loss: Assessment
  - History
  - Test battery
- Patients at risk for recreational hearing loss: Prevention
  - Management follows history and diagnostic findings
  - Monitoring auditory function
Prevention of Recreational Hearing Loss:
Recreational Activities Posing Risks (1)

- Sporting events
  - Football games
  - Soccer games
  - Automobile racing
- Exposure to gunfire
  - Hunting
  - Target shooting
- Power equipment
  - Power tools
  - Chainsaws

Prevention of Recreational Hearing Loss:
Recreational Activities Posing Risks (2)

- Motor vehicles
  - Motorcycles
  - Off-road vehicles
- Computer games
- Music sound exposure
  - Performers
    - Symphony music
    - Popular music
  - Workers at venues
  - Audio engineers
  - Patrons at concerts
- Personal audio players

Prevention of Recreational Hearing Loss
American Football (NFL)

Seattle Seahawks
CenturyLink Field
Guinness Record for Noise Level = 136.6 dB
(9/15/2013)
Prevention of Recreational Hearing Loss

American Football (NFL)

Kansas City Chiefs
Arrowhead Stadium

New Guinness Record for Noise Level = 14226 dB
(9/29/2014)

Prevention of Recreational Hearing Loss:
Sporting Events ... College Football in USA

Top seven stadiums for sound intensity levels (9/12/14)

7 = University of Michigan (110 dB)
6 = University of Florida (115 dB)
5 = Penn State University (122 dB)
4 = University of Oregon (127 dB)
3 = LSU (130 dB)
2 = Clemson University (132.8 dB)
1 = University of Washington (133.6)

Prevention of Recreational Hearing Loss:

Sporting Events ... Soccer

Vuvuzela Noise
World Cup Soccer
South Africa

> 130 dBA at 1 foot
Prevention of Recreational Hearing Loss: Sporting Events …Soccer

DPOAE Amplitudes Pre- versus Post-Match

Fig. 4. Distribution of dyad post-match DPOAE amplitude-22 crest

No change in pure tone thresholds
Prevention of Recreational Hearing Loss: Recreational Activities Posing Risks

Motorcycle Noise (Pierce, Hall & Gerhardt, 2007)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Father</th>
<th>Mother</th>
<th>Older Siblings</th>
<th>Younger Siblings</th>
<th>Friends</th>
<th>Other</th>
<th>Motorcycle</th>
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Prevention of Recreational Hearing Loss: Recreational Activities Posing Risks

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Prevention of Recreational Hearing Loss: Recreational Activities Posing Risks

NASCAR Spectator Noise Exposure

Maximum noise levels of 140 dBA

Average noise exposure = 96 dBA

Recreational Sound Induced Auditory Dysfunction: Music Exposure

- Meyer-Bisch (1996). Epidemiological evaluation of hearing damage related to strongly amplified music (personal cassette players), discotheques, rock concerts; High definition audiometric survey on 1384 subjects. Audiology, 35, 121-142
Prevention of Recreational Hearing Loss: Music Sound and Hearing Loss
(www.nlm.nih.gov => 500 publications)

- Hutchison et al (2014). College students’ personal listening device usage and knowledge. *Int J Audiology*
- Fuentes & Morales (2014). Construction and validation of questionnaire to assess recreational noise exposure in university students. *Noise Health*

Increased Prevalence in Sound Induced Auditory Dysfunction Among US Youth


Prevalence of Hearing Loss Among US Youth
Prevention of Recreational Hearing Loss:
Personal Audio (Music) Players
Flurry of Interest and Concern Since 2007

- Hodgetts et al (2007). The effects of listening environmental and earphone style on preferred listening levels of normal hearing adults using an MP3 player. Ear & Hearing, 28
- Epstein, Marozeau & Cleveland (2010). Listening habits of iPod users. JSHR, 53, 1472-1477
- McNeill et al (2010). MP3 player listening habits of 17 to 23 year old university students. JASA, 128, 644-653
Prevention of Recreational Hearing Loss

**Personal Audio Players**

Extended High-Frequency Thresholds in College Students: Effects of Music Player Use and Other Recreational Noise

(LePrell et al, 2013)

3 to 6 dB decrease in thresholds for 13K to 16K for participants with use > 5 years

**Prevention of Recreational Hearing Loss**

- Recreational activities posing risk of hearing loss
  - Sporting events
  - Music induced hearing loss
  - Activities involving noise
- Patients at risk for recreational hearing loss: Assessment
  - History
  - Test battery
- Patients at risk for recreational hearing loss: Prevention
  - Management follows history and diagnostic findings
  - Monitoring auditory function
Patient history includes specific questions about exposure to various types of recreational noise
  - Checklist of types of recreational noise
  - Follow up questioning during counseling sessions

Test battery for patients at risk for recreational noise exposure
  - Otoscopic inspection
  - Acoustic immittance measurement
    - Tympanometry
    - No acoustic reflexes for patients with tinnitus complaints

Prevention of Recreational Hearing Loss
History and Test Battery (1)

Prevention of Recreational Hearing Loss
History and Test Battery (2)

Test battery for patients at risk for recreational noise exposure
  - Distortion product otoacoustic emissions
    - 500 to 8000 Hz or higher frequencies
    - 5 to 8 frequencies/octave
    - Analyze data RE: normative region
  - Pure tone audiometry
    - Air conduction only if no indication of middle ear disorder
    - High frequency audiometry as indicated
  - Speech audiometry
    - Consider speech-in-noise test if indicated

OAEs: Early Detection of Auditory Dysfunction in Patients with Noise/Music Exposure
Prevention of Recreational Hearing Loss

- Recreational activities posing risk of hearing loss
  - Sporting events
  - Music induced hearing loss
  - Activities involving noise
- Patients at risk for recreational hearing loss: Assessment
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- Patients at risk for recreational hearing loss: Prevention
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Audiograms:
3 Audio Engineers

<table>
<thead>
<tr>
<th>Frequency in Hz</th>
<th>Right Ear</th>
<th>AC</th>
<th>Left Ear</th>
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<tr>
<td>.50</td>
<td>1K</td>
<td>2K</td>
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<td>4K</td>
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<tr>
<td>dB HL</td>
<td>0</td>
<td>20</td>
<td>40</td>
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<tr>
<td>60</td>
<td>80</td>
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Audiograms:
3 Musicians (Professional Drummers)

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Audiograms:
3 Musicians (Professional Guitarists)

Music Induced Auditory Dysfunction:
Audiogram versus DPOAE
(N = 37 Professional Musicians)

OAEs Can Play an Important Role
in Prevention of Recreational Hearing Loss

- Rationale for OAEs
  - Highly sensitive to cochlear deficits
  - Objectively and quickly administered
  - Easily administered by non-audiology personnel

- Possible protocol
  - Baseline audiologic assessment with OAEs
  - Monitor auditory status with OAEs
  - Pure tone audiometry only with change in OAEs

- New research (Universities of Michigan and Florida)
  - Early detection of cochlear dysfunction with OAEs (including iPod users)
  - Immediate preventive treatment with micronutrients
    - Magnesium
    - Vitamins
Music Induced Auditory Dysfunction and Hearing Conservation: Selected Publications


Prevention of Recreational Hearing Loss: Education About Hearing Protection Options

- Sporting events
  - Football games
  - Soccer games
  - Automobile racing
- Exposure to gunfire
  - Hunting
  - Target shooting
- Power equipment
  - Power tools
  - Chainsaws

Prevention of Recreational Hearing Loss: Generic Earplugs
Prevention of Recreational Hearing Loss: Hunters and Sound Cancelling Earmuffs

Prevention of Recreational Hearing Loss: Strategies for Musicians

Prevention of Recreational Hearing Loss: ER-20 (20 dB attenuation) Earplugs ($10 - $12)
Preventing Music Induced Hearing Loss: Musician’s Earplugs and Ear-Level Monitors

Preventing Music Induced Hearing Loss: Musician’s Ear-Level Monitors

CASE REPORT: Music exposure

- 62 year old female
- Professional violinist and violin teacher
- Bothersome tinnitus bilaterally, left > right ear
- Hyperacusis (LDLs = 70 to 80 dB HL)
- Sound level measurements when playing violin
  - Right ear = 81- 86 dBA SPL
  - Left ear = 91 - 97 dBA SPL (peak > 100 dB SPL)
Case Report: 62 year old female violinist

Music Induced Hearing Loss and OAEs:
62 year old violinist and violin teacher (right ear)

Music Induced Hearing Loss and OAEs:
62 year old violinist and violin teacher (left ear)
CASE REPORT: Music exposure

- Management
  - Counseling about hyperacusis and hearing
  - Musician earplugs
    - Documented attenuation in sound booth
    - Verified no effect on performing quality
    - Recommended use during practice
  - Close monitoring of hearing and auditory dysfunction

Prevention of Recreational Hearing Loss
Personal Audio (Music) Players

7 Tips to Avoid iPhone & iPod Hearing Loss

- Avoid loud music
- Use noise-cancelling headphones
- Set a daily limit for exposure
- Take breaks when using devices
- Use hearing protection

The Dangerous Decibels Program
www.dangerousdecibels.org

Jolene
The Dangerous Decibels Manniken
Introduction
- WHO estimates that North American children are exposed to more noise at school than workers from an 8-hour day at a factory.
- 97% of children in 3rd grade are exposed to hazardous noise levels.
- 30% of children said they have participated in noise activities.
- Only 5.5% ever use ear protection at the time.
- 94% of youth (adolescents) use personal music players.
- 28% use personal music players at levels putting them at risk.

Subjects
- 1120 4th grade students in Oregon and southwest Washington.
- Randomized into 5 groups:
  - Classroom participation by high school students presenting Dangerous Decibels Program (DDP)
  - Health professional educators presenting DDP
  - On-site museum experience involving an exhibition on NIHL and tinnitus prevention
  - Internet-based virtual museum experience
  - No intervention comparison group matched for age, gender, and ethnicity.

Interventions
- Activities were based on health communication theory principles.
  - Dangerous Decibels Classroom Program:
    - A 45-minute, interactive presentation with demonstrations and images.
    - Students participate in one or more hands-on activities.
- Three educational messages:
  - Sources of dangerous sounds.
  - Consequences of exposure to dangerous sounds.
  - Methods for protection from dangerous sounds.

Content
- Physics of sound
- Normal auditory function
- Pathophysiology
- Consequences of noise exposure
- Recommended exposure limits
- Hearing protective strategies
- Peer-pressure issues related to use of hearing protection

Figure 1. Self-reported sound exposure during the past year.

Figure 2. Baseline questionnaire answer to the question: “How often do you wear ear plugs or ear muffs when you are around loud sound?”.
Conclusions

- Classroom educational program presented by school nurses or high school students was most effective
- “The highly visible museum exhibition, while disappointing in terms of its effectiveness as a stand-alone program, has great potential to directly, albeit minimally, influence large numbers of the public in a cost-effective manner.”
- Internet-based interventions may serve multiple roles
  - Introduce the topic of hearing health to young people
  - Serve in limited capacity as primary educational tool
  - Serve as an adjunct to a classroom program