## *NOISE EXPOSURE ESTIMATES OF URBAN MP3 PLAYER USERS*

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## *NIHL: Incidence*

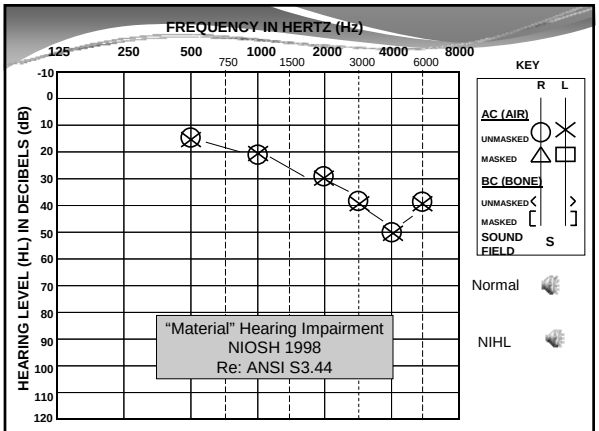
- **Approximately ten percent of Americans aged 20 to 69**
- **One in eight 6-19 year olds (est. 5.2 million in US) (3rd National Health and Nutrition Examination Survey, Niskar et al., 2000)**
- **An increase in 2nd graders and 8th graders with hearing loss over the ten years(Montgomery & Fujukawa, 1992)**

## *The Effects of NIHL*

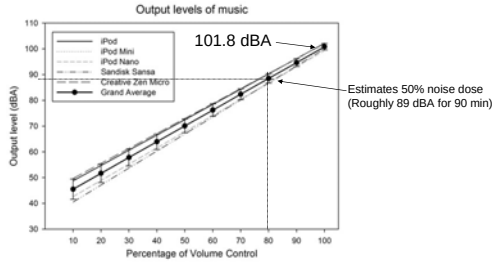
- **Reduced pure-tone thresholds 3 – 6k Hz ("4k Hz notch")**
- **Other injuries: tinnitus, loudness intolerance, abnormal perception of pitch**
- **Renders sounds distorted or muffled**
- **Leading to difficulty understanding speech and appreciating music**

## *The Cause of NIHL*

- **Time + Intensity ("how loud and how long")**
- **Damage Risk:**
  - **85 dBA for 8 hours**
  - **88 dBA for 4 hours**
  - **91 dBA for 2 hours…**
- **Described as "Noise Dose" or Equivalent Continuous Level "Leq"**
  **(Risk > 100% dose; > 85 dBA Leq)**

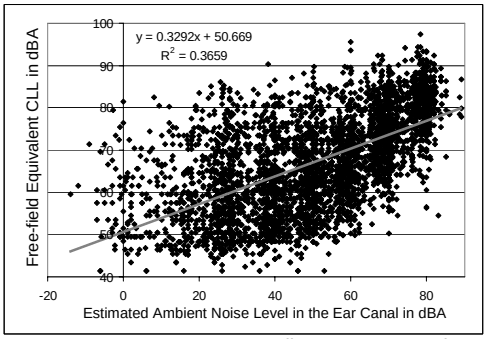



## Guidelines: The "80-90 Rule"




"Output levels of MP3 players" Portnuff and Fligor, NIHL in Children at Work and Play Conference, October 2006

## Effect of ambient noise levels




*Fligor & Ives, In review*

## *Social Factors Associated with Portable Music Players*

- **The sociological aspect associated with portable music players places users at risk for NIHL**
- **The iPod, in particular, has become ubiquitous with its unmistakable white headphones**

- **The iPod has become a symbol of a generation and a marker of social status**
- **Called an *urban Sherpa* -meaning that people rely on the iPod to navigate today's urban world (Bull, 2007)**
- **College students rated listening to their iPods as the coolest free time activity (The Associated Press, 2006)**

**The early onset of NIHL may result in a Minimal Hearing Impairment (MHI)**

- As little as a 10 dB reduction from normal thresholds reduces the subjective loudness sensation of a speech signal by half (Hearing Loss, 2001)
- Children with a MHI loss of 25 dB found to have lower academic skills than children with normal hearing sensitivity (Halligan, 1996)

**MHI correlated with risk for academic success (Goldberg & McCormick Richburg, 2004)**

- Reduced receptive and expressive vocabulary
- Difficulty with multiple meanings (write/right)
- Difficulty with figurative language that requires non-literal interpretation (Culbertson, 2007; Tye-Murray 2007)

- Overall grammatical patterns similar to younger normal hearing children (Elfeinbein, Hardin-Jones, & Davis, 1994)
  - Example: subject-verb-object - even when inappropriate
- Weak consonants: fricatives (e.g., s, z, f, v, h) and stops (i.e., p, b, t, d, k, g)
- Unstressed morphemes

- **May have difficulty with reading comprehension and phonological processing (Moeller, Tomblin, Yoshiaga-Itano, McDonald, & Jerger, 2007)**
- **Poor word reading and decoding skills (Bess, Dodd-Murphy, & Parker, 1998)**
- **A hearing loss of 15-26 dB corrrelated with a 1.2 year delay in language skills (Halligan, 1997)**

- **MHI not as apparent as a more severe hearing loss (Goldberg & McCormick Richburg, 1998)**
- **A MHI may be missed, given that hearing screenings are generally placed at 1000, 2000, and 4000 Hz**
- **Professionals must consider screening hearing at higher frequencies (specifically, 6000 and 8000 Hz)**

## *The Current Study*

**Participants**

- **Sixty subjects (30 male, 30 female),**
  - **average 20.5 years of age (range: 18-32)**
- **Walked onto a college campus in New York City, adjacent to NYC subway station exit, were asked to:**
  - **Have their earphone levels measured**
  - **Fill out a questionnaire requesting demographic information**
- **Ambient sound levels at measurement location average 60.5 dBA (range 56-68)**

***They were also asked*:**

- **Whether or not they commuted using the subway**
  - **(Gershon, et al 2006: subway = 83-106 dBA)**
- **Whether they adjusted the volume of their PMP after leaving the subway**
- **The type of PMP and earphones they used**
- **The duration and frequency of PMP use: average hours per day and times per week**

## INTRODUCING JOLENE

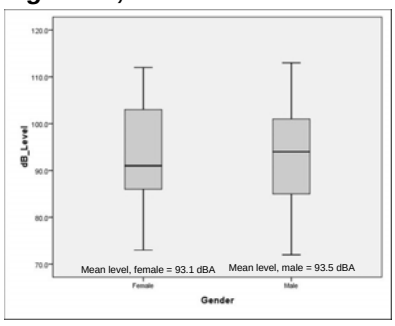

- **Levels were measured using a mannequin built according to "The Jolene Cookbook" (Oregon Health and Sciences University, 2007)**
- **Calibrated by investigators using Microphone-in a Real Ear technique (ISO 11904-1, 2002) to determine a coupler to free-field correction factor to report free-field equivalent levels**

## *Results*

- **Average measured level from PMP earphones was 93.2 dBA (SD = 9.82) with a range of 72-113 dBA**
- **Average hours of use per week were 20.8 hours (SD = 19.1) with a range of 1-105 hours per week**
- **Keep in mind:**
  - **The combination of level over time defines risk**
    - **Noise Dose > 100% = Risk**
    - **Leq (8-hour, weekly) > 85 dBA = Risk**

- **Noise exposure by *listening session* and by *week* estimated on reported duration of use *per session* and *days per week* of use**
- **Findings: the average noise dose was**
  - **2322% per listening session**
  - **2071% per week**
- **Findings suggest the average subject was exposed to twenty times the allowable noise exposure from his or her PMP on a weekly basis**

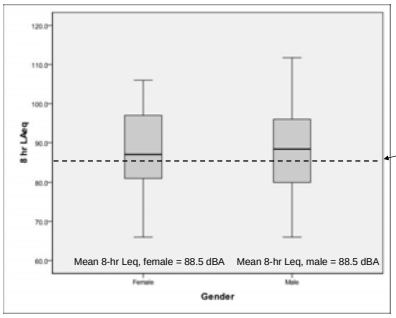
## *Listening Level, dBA*




No significant difference for gender (p>0.05)

Box-and-whisker plot showing listening level median, interquartile range, and maximum and minimum

## *Single-session sound exposure (8-hr LAeq)*

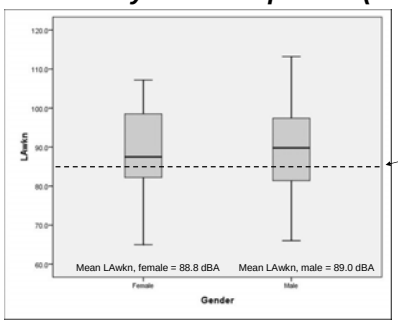



"Risk"

No significant difference for gender (p>0.05)

Box-and-whisker plot showing 8-hr Leq median, interquartile range, and maximum and minimum

## *Estimated weekly sound exposure (LAwkn)*




"Risk"

No significant difference for gender (p>0.05)

Box-and-whisker plot showing weekly average exposure median, interquartile range, and maximum and minimum

## *Descriptive Statistics*

- **A majority (60%) of subjects exceeded the maximum NIOSH recommended exposure level on a weekly basis**
- **Over half of subjects at risk for NIHL from PMP use alone**
- **Men had markedly higher weekly noise dose than women (2486% vs. 1655%) - although this trend did not reach statistical significance**

## *Descriptive Statistics*

- **At least 39% of PMP users reported adjusting the volume control of their devices when leaving the subway**
- **The average measured level (dBA) of the PMP users who reported adjusting their volume after leaving the subway (*M* = 90.50, *SD* = 9.67) was lower than the level of those who reported *not* adjusting their volume (*M* = 94.56, *SD* = 11.56), although this difference was not statistically significant**

## *Comparative Statistics*

- **No difference in listening levels or duration of use per week between male and female subjects**
- **No difference in listening level or duration of use between subjects who used the subway to commute compared to those who did not**
- **No significant correlation between chosen listening level and duration of use**

## *Conclusions*

- **Estimates of noise exposure based on measured listening levels and reported listening duration suggests that the *average* PMP user commuting in NYC is at risk for NIHL**
- **Ten percent exceeded 102 dBA for exposures normalized over a *week***
- **The exposure estimates indicate a similar percent of both sexes are at risk for NIHL**

- **Implications for hearing, language, and sociological aspects of misuse of PMP**

- **While further research is needed to assess the accuracy of these estimates, these findings warrant efforts to provide targeted education and technological solutions for people using mass transit**

## *Collaboration*

- **We need better partnerships between the professions of audiology and speech-language pathology as well as between clinicians and scientists**

  - **Moore, M. (2009, Jan. 20). 2009 ASHA President Sue T. Halle: A Clinician, a Teacher, and a Leader. *The ASHA Leader, 14*(1), 20-23.**

- **Stronger and more formal collaboration between members of the professions (Smiley & Threats, 2006).**

- ***…Given that the goal of both professions is to establish and maintain good health***

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