

## Hearing Test Results from 2009 Audio Engineering Society Convention Testing funded by Shure

### SUMMARY

The 127<sup>th</sup> Audio Engineering Society (AES) convention was held in New York, New York from October 9-12, 2009, and was attended by over 18,000 attendees. The National Hearing Conservation Association (NHCA) was able to conduct free hearing testing on 425 convention attendees through a generous \$10,000 donation from Shure.

Mean hearing levels were within the normal range overall, and no differences were seen between male and female participants. Students had the best hearing levels, and those working in acoustics and “other” jobs had the worst hearing levels. Nearly one-quarter of participants reported difficulty hearing in one of both of their ears, and well over one-third of participants reported experiencing tinnitus (ringing or buzzing) in one or both ears. Hearing levels for participants reporting no hearing difficulties were on average 5-10 dB better than those who reported hearing difficulties in one or both ears. More than one-third of participants reported normally working in a noisy area without hearing protection, and nearly one-quarter reported having regular noise exposures outside work. Average hearing levels among participants who reported using hearing protection during noise work were 1-2 dB better than those who did not use hearing protection. The results of this study suggest that additional hearing measurements and hearing loss prevention efforts are needed among audio engineers.

### INTRODUCTION

Noise-induced hearing loss (NIHL) resulting from excessive noise exposure is a completely preventable disease. However, exposure to high levels of noise is one of the most common occupational hazards faced by American workers, with an estimated 22 million noise-exposed workers in the U.S. Consequently, NIHL is one of the most common occupational diseases in the U.S. Audio engineers, represented professionally by the Audio Engineering Society (AES), represent an occupation with potentially high exposures to noise, and subsequently high potential for NIHL. NHCA received a \$10,000 donation from Shure in Fall 2009 to test the hearing of a sample of attendees of the 2009 AES convention at the Jacob Javits Convention Center in New York City. This audiometric testing was overseen by three volunteers from the NHCA Music Induced Hearing Loss (MIHL) Task Force.

### TESTING DETAILS

NHCA contracted with Enviromed Corporation to conduct testing. All testing was provided at no cost to AES attendees on a first-come, first-served basis. Enviromed used a 6-person mobile hearing test unit parked on the floor of the Javits Center Exhibition Area to deliver pure tone air conduction audiometric tests from October 9-11, 2009. Participants were visually isolated from each other inside the mobile hearing test unit. Tests were administered using Benson CCA-200 Microprocessor Audiometers (acoustically calibrated in August 2009) and supra-aural TDH-39 earphones.

NHCA MIHL Task Force volunteers scheduled groups of six participants for testing at 15 minute intervals. Subjects’ right and left ears were tested at the frequencies on 500, 1000, 2000, 3000,

4000, 6000, and 8000 Hz. Background noise in the mobile hearing test unit was continuously monitored to insure that the test environment did exceed the permissible background sound levels set by the US Occupational Safety and Health Administration. All audiometric testing was conducted by a technician certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC) and supervised by an occupational audiologist holding an AuD degree.

Participants completed hearing history forms developed by the NHCA MIHL Task Force prior to their hearing tests. The hearing history form questions were divided into two categories of information: hearing health, and hearing behavior. Data from the hearing history form were input during the hearing test process. The hearing history form questions are shown below.

<b>HEARING HISTORY FORM</b>	
Name _____	
Gender <input type="checkbox"/> M <input type="checkbox"/> F	
Job title _____	
<b>HEARING HEALTH INFORMATION</b>	
Do you have any difficulty with your hearing?	<input type="checkbox"/> No <input type="checkbox"/> Left ear <input type="checkbox"/> Right ear <input type="checkbox"/> Both ears
Do you have a family history of permanent or progressive hearing loss from a young age?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Have you had past ear infections that affected your hearing?	<input type="checkbox"/> No <input type="checkbox"/> Left ear <input type="checkbox"/> Right ear <input type="checkbox"/> Both ears
Have you had past ear surgery that affected your hearing?	<input type="checkbox"/> No <input type="checkbox"/> Left ear <input type="checkbox"/> Right ear <input type="checkbox"/> Both ears
Have you had past head injury that affected your hearing?	<input type="checkbox"/> No <input type="checkbox"/> Left ear <input type="checkbox"/> Right ear <input type="checkbox"/> Both ears
Do you experience any ringing or buzzing in your ears?	<input type="checkbox"/> No <input type="checkbox"/> Left ear <input type="checkbox"/> Right ear <input type="checkbox"/> Both ears
<b>HEARING BEHAVIOR INFORMATION</b>	
Have you ever done any recreational shooting or hunting?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Have you ever served in the military exposed to loud sounds?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Do you have regular noise exposures outside of work?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Do you normally work in an area of loud sounds or music w/o hearing protection?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Do you use audio type headphones/earphones at work?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Do you use in-ear monitors in your work?	<input type="checkbox"/> Yes <input type="checkbox"/> No

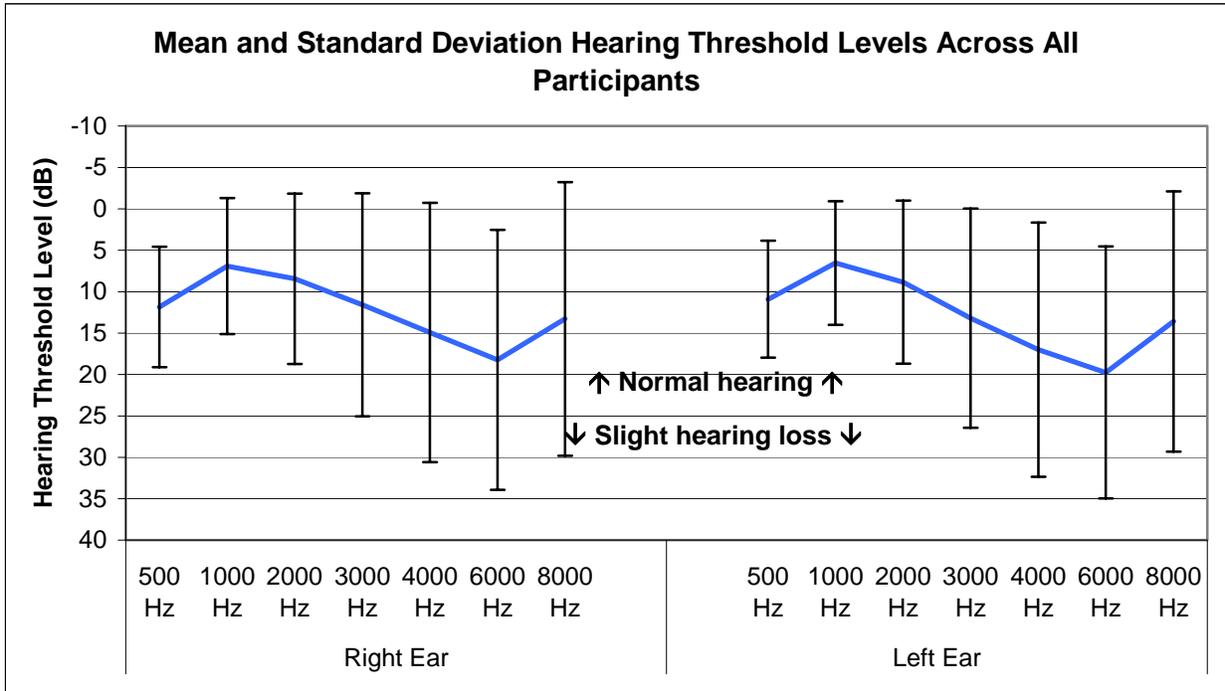
Immediately after completing their test, participants received a printout explaining their audiometric test results. This printout described how to read a hearing test, showed the participants' own test results, and described how to interpret the test results. NHCA volunteers and Enviromed staff greeted participants as they exited the mobile hearing test unit for a more detailed explanation and counseling (as needed) regarding test results.

### **AUDIOMETRIC TEST RESULTS**

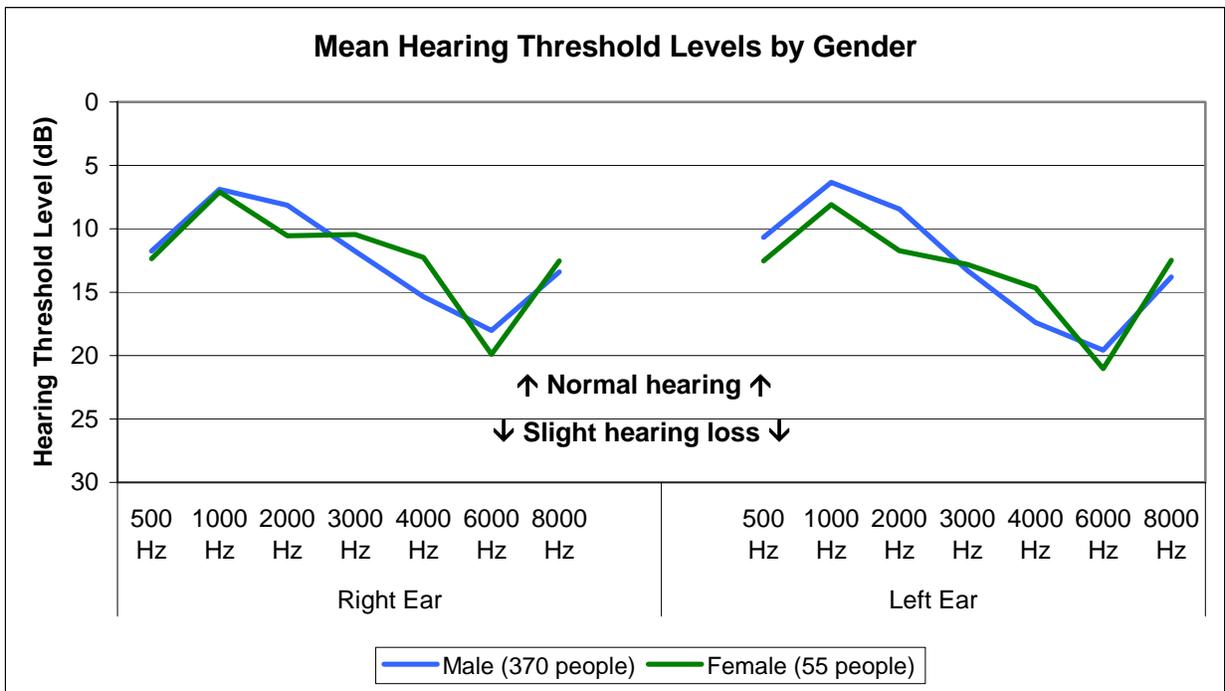
Four-hundred twenty-five AES convention attendees received free hearing tests over the three days testing was provided. Hearing test results are given as hearing threshold levels (HTLs) in decibels (dB) for each test frequency. Seven frequencies were tested: 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz. Larger HTLs indicate that more sound is required to perceive a test tone. HTLs under 25 dB indicate hearing within the "normal" range at each test frequency; higher HTLs indicate the presence of some hearing loss.

The graph below shows the mean HTLs across the test frequencies for both right and left ears across all participants. The standard deviation (a measure of variability) of HTLs at each test frequency is also displayed via error bars. On average, HTLs were the same for both right and left ears. Mean HTLs were within the normal range, but the wide standard deviations at each

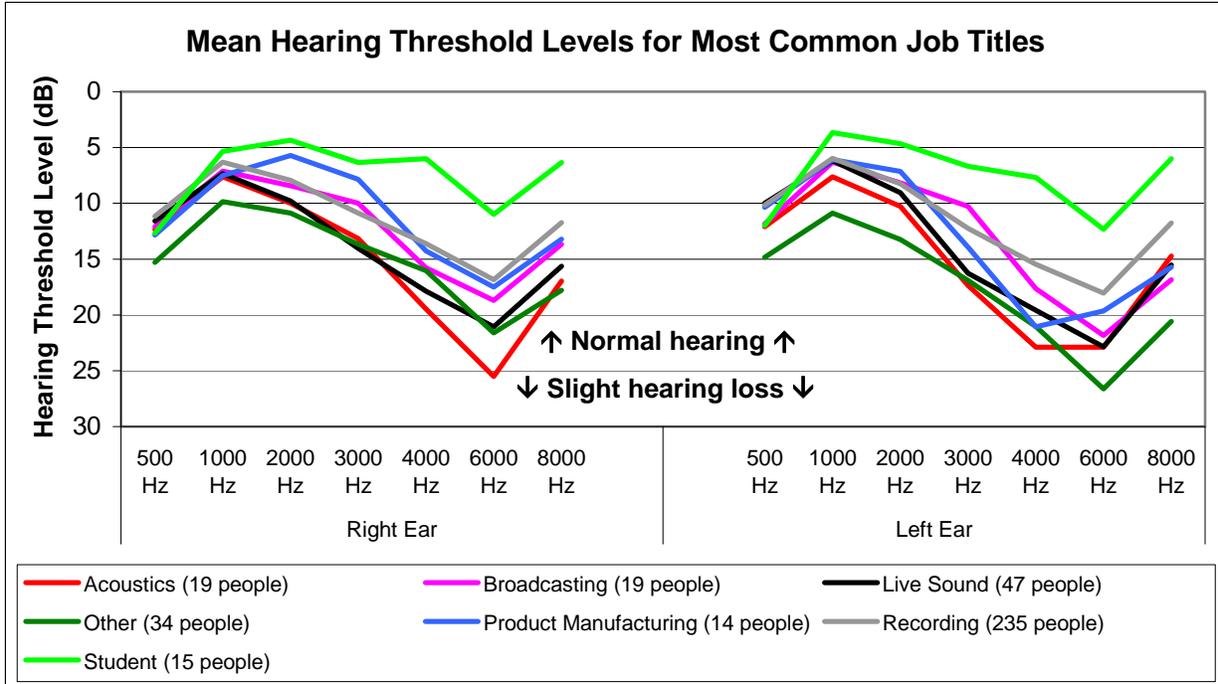
test frequency indicate large variability among test subjects, especially at the higher test frequencies of 6000 and 8000 Hz.



The graph below shows the mean HTLs for both right and left ears by gender. Mean HTLs for male and female participants were very similar for both right and left ears, and were within the normal range.



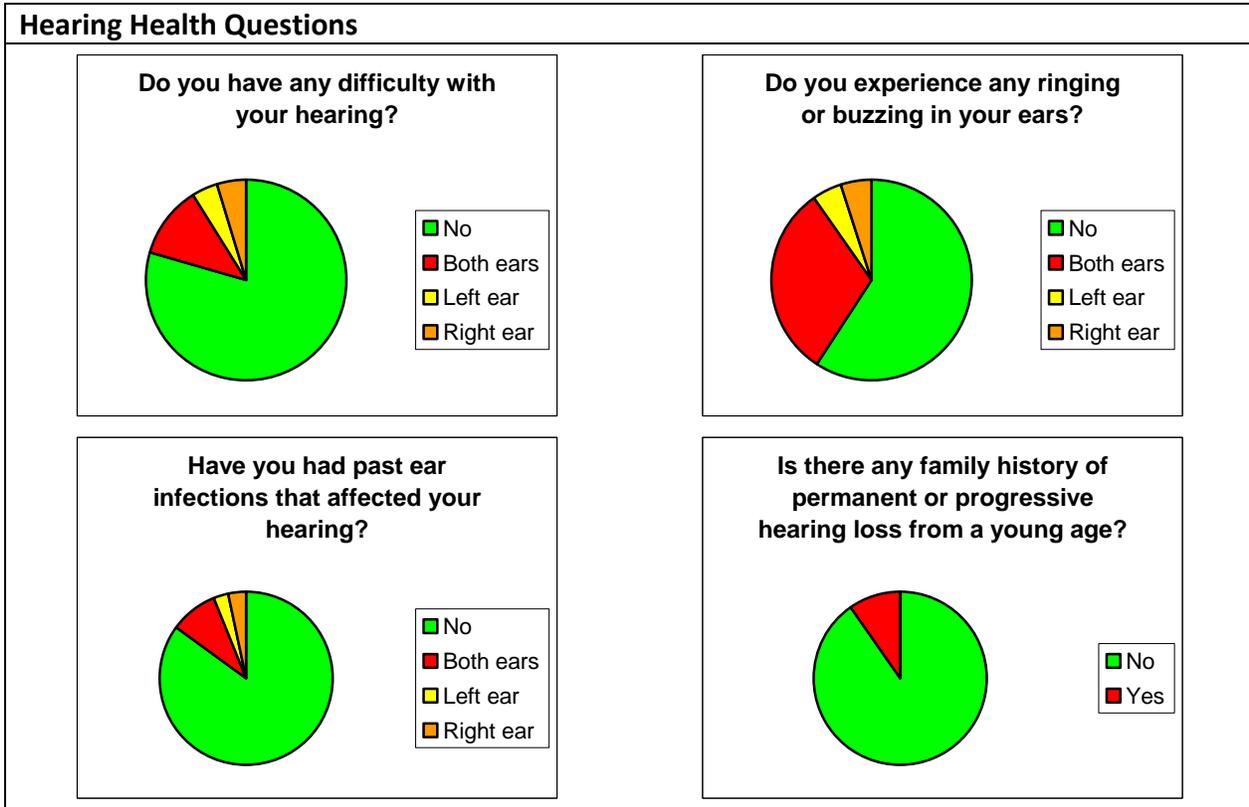
The graph below shows the mean HTLs for both right and left ears for the most commonly reported job titles. On average, students had the best HTLs for both right and left ears. The worst HTLs in the right ear were associated with participants working in acoustic jobs, and the mean right ear HTL at 6000 Hz indicated a slight hearing loss on average at that frequency. The worst HTLs in the left ear were associated with participants working in “other” jobs, and these participants also showed a slight hearing loss for HTLs at 6000 Hz. The remaining job titles all had mean HTLs within the normal range across all test frequencies.



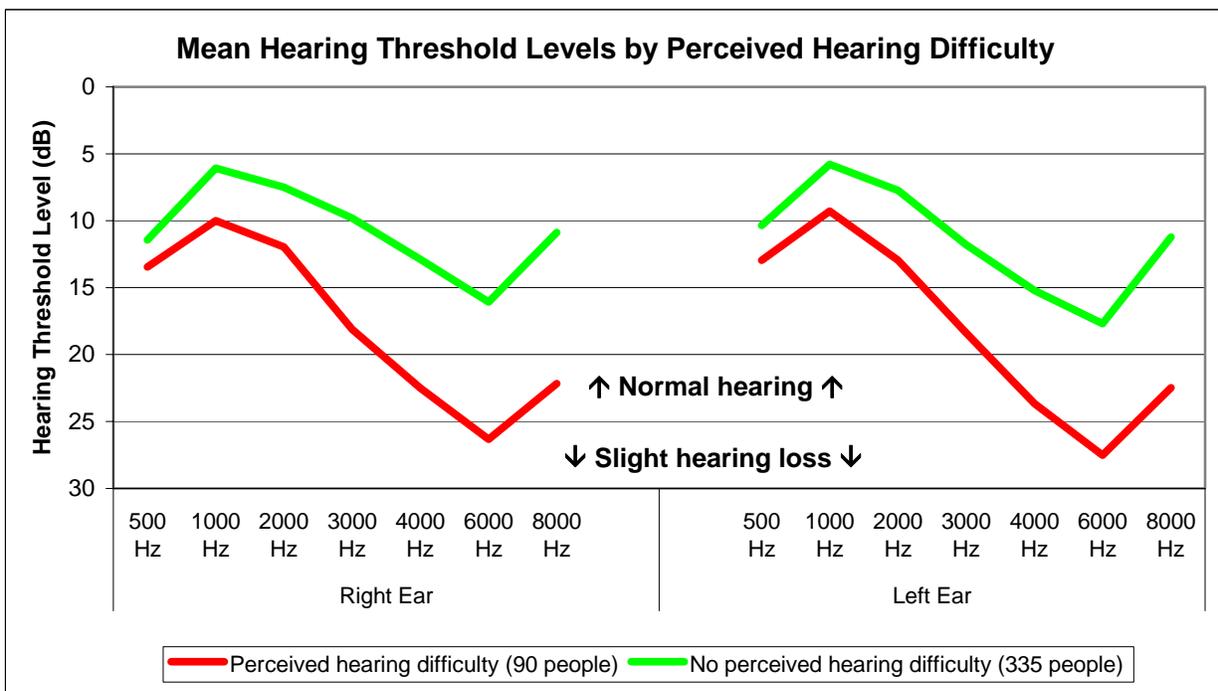
**HEARING HISTORY SURVEY RESULTS**

Only six of 425 subjects reported having had ear surgery that might have affected their hearing, and only 14 reported having had a head injury that might have affected their hearing.

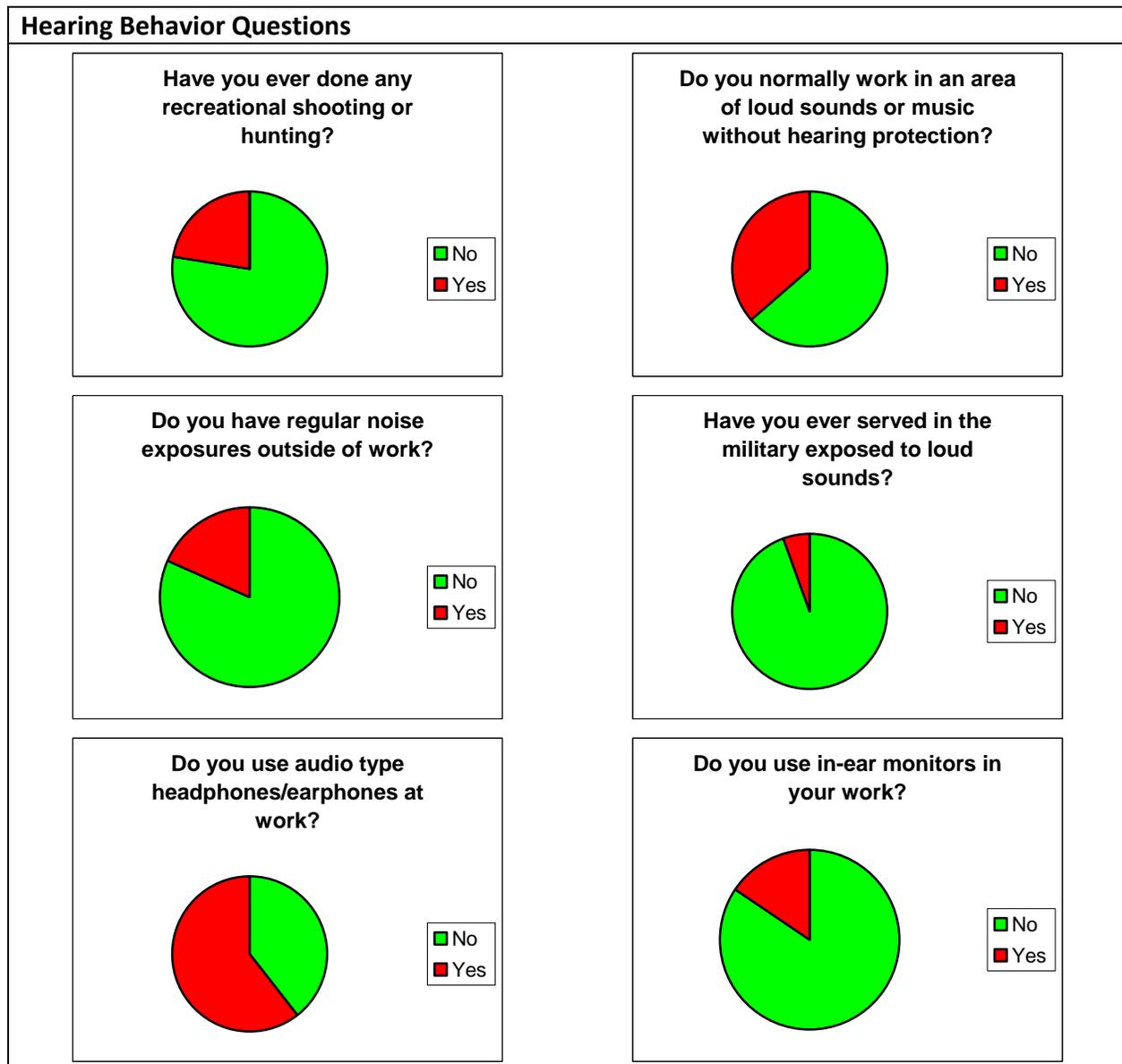
The results of the Hearing Health questions on the hearing history form are shown below. Nearly one-quarter of participants reported difficulty hearing in one of both of their ears, and well over one-third of participants reported experiencing tinnitus (ringing or buzzing) in one or both ears. About one in seven participants reported having had past ear infections that affected their hearing, and about one in ten reported a family history of hearing loss.



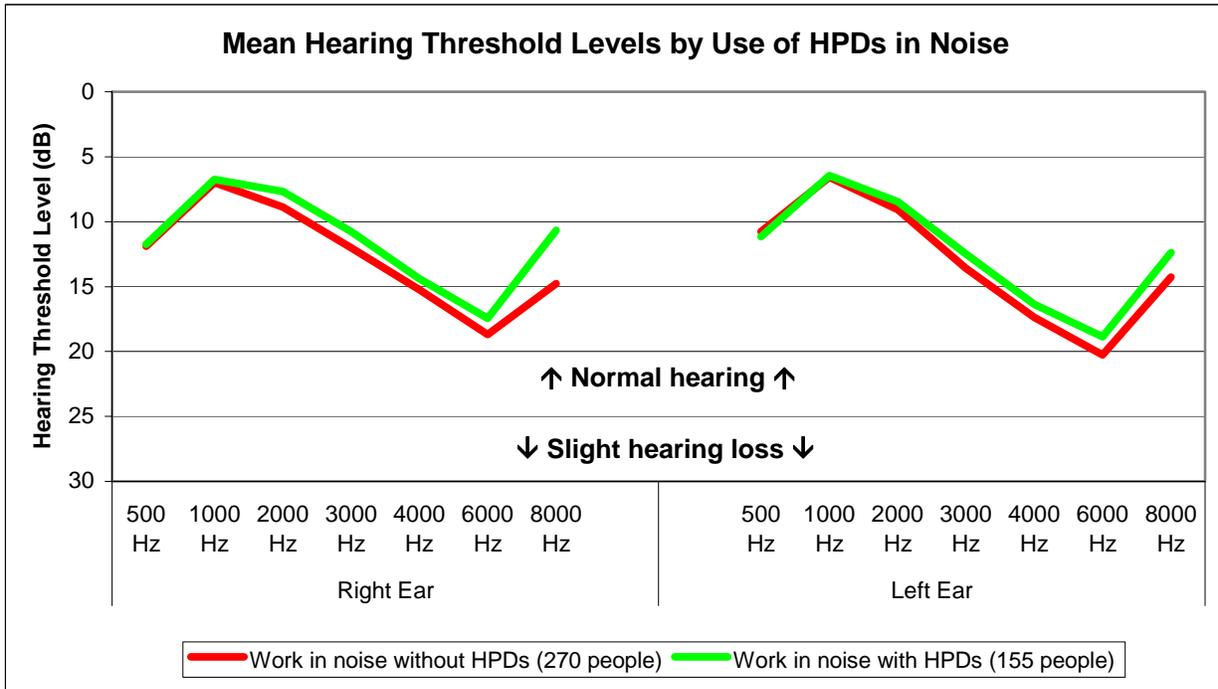
The graph below shows the mean HTLs for those who reported hearing difficulties in one or both ears, compared to those who reported no difficulties. HTLs for both groups were on average within the normal range (with the exception of 6000 Hz for those reporting difficulty), but HTLs for the group reporting no hearing difficulties were generally 5-10 dB better.



The results of the Hearing Behavior questions on the hearing history form are shown below. Nearly one-quarter of participants reported that they had ever done any recreational shooting or hunting, which represents one of the most noise hazardous exposures to the ear. More than one-third of participants reported normally working in a noisy area without hearing protection, and nearly one-quarter reported having regular noise exposures outside work. Only a small fraction of subjects reported ever having served in a noisy military job. Nearly three-quarters of participants reported using audio type headphones/earphones at work, while only about one-fifth reported using in-ear monitors.



The graph below shows the mean HTLs for those who reported using HPDs when working in noise versus those who did not reported HPD use. Although hearing levels for both groups were on average within the normal range, the HTLs for the group reporting HPD use were 1-2 dB better at most frequencies.



**CONCLUSIONS**

The results of this study suggest that hearing loss prevention efforts are needed among audio engineers. Differences in hearing levels were noted among the different job titles surveyed, suggesting that some types of audio engineering work may present a greater risk of NIHL than others. Nearly one in four participants reported difficulty hearing in one of both of their ears, and well over one in three reported experiencing tinnitus in one or both ears. Hearing levels for participants reporting no hearing difficulties were on average 5-10 dB better than those who reported hearing difficulties in one or both ears. More than one in three participants reported normally working in a noisy area without hearing protection, and nearly one-quarter reported having regular noise exposures outside work. Average hearing levels among participants who reported using hearing protection during noise work were 1-2 dB better than those who did not use hearing protection.

**NEXT STEPS**

The study results indicate that hearing assessment efforts at future AES conventions are warranted. Future assessments should attempt to obtain repeated measurements on subjects who received a hearing test at the 2009 AES convention, as repeated measurements on individuals allow for evaluation of changes in hearing over time. In addition, the hearing history form should be expanded to include information about participants' ages and years of audio engineering experience. These questions will allow for evaluation of the effects of years of exposure on measured hearing levels. Finally, future testing efforts at the AES convention would benefit from an additional day of hearing testing, which would allow for the collection of more data. However, this additional day would add to the cost of the testing effort.

**About the National Hearing Conservation Association**

The mission of the National Hearing Conservation Association is to prevent hearing loss due

to noise and other environmental factors in all sectors of society. NHCA provides networking, resources and professional development opportunities to improve skills, practices and services for over 600 members. NHCA's membership includes audiologists, researchers, students, industrial hygienists, educators, professional service organizations, safety professionals, medical professionals, engineers, audio professionals and others who have dedicated their work to the advancement of hearing loss prevention. For more information about the National Hearing Conservation Association, visit us online at [www.hearingconservation.org](http://www.hearingconservation.org).

*A number of individuals contributed to the creation of this report. From the National Hearing Conservation Association: Richard Neitzel, Michael Santucci, Cory Portnuff, Brian Fligor, and Renee Bessette. From the National Institute for Occupational Safety and Health: Brad Clevenger and Mark Stephenson. From Enviromed Corporation: Richard Stepkin. Data analysis was conducted primarily by Brad Clevenger.*