CAOHC
Council for Accreditation in Occupational Hearing Conservation

Update

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The Council for Accreditation in Occupational Hearing Conservation

Introducing a Point-Source Noise Prevention to Increase Use of HPDs Among Farmers

By: Chandran Achutan, PhD

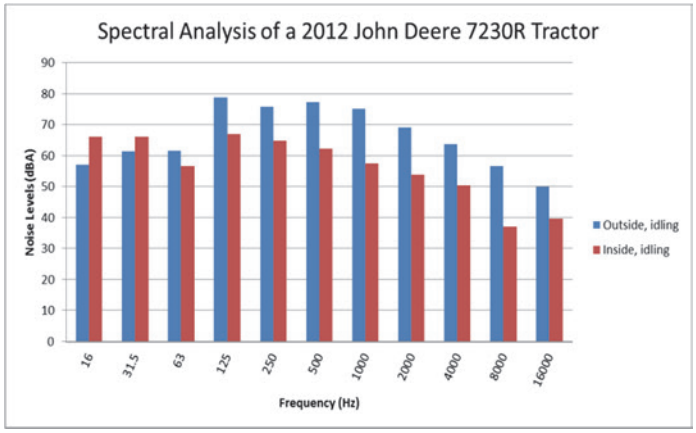
Fall is nearly here, and for the agricultural regions, this means that the harvest season is just around the corner. For farmers, this seasons equates to long hours harvesting corn and soybeans on their combines. They are exposed to hazardous noise from machinery, equipment, and livestock, and experience higher rates of noise-induced hearing loss (NIHL) than non-farmers of similar age (Rabinowitz et al., 2005). Although newer tractors and combines have cabs that block engine noise, farmers are still over-exposed when they step outside of their combines, work on equipment maintenance, and conduct other work-related tasks. Use of hearing protection devices (HPDs) helps prevent NIHL, but HPD use among farmers is low. Carruth et al. (2007) estimated that farmers use their HPDs only 7% of the time when exposed to hazardous noise. Factors that influence use are difficulty communicating and fear of not hearing warning sounds (Ronis et al., 2006), access and availability (Wadud et al., 1998; McCullagh et al., 2002; McCullagh et al., 2010), and interpersonal influences (McCullagh et al., 2002).

One of the barriers to HPD use is that they are not available when workers need them. Rather than taking the time to obtain the Personal Protective Equipment (PPE) from where it is stored (home, office, locker, vehicle), workers may ignore the noise exposure, even if they are aware that they should use PPE. One way to overcome this barrier is to ensure that HPDs are available when and where the workers need them. To overcome inconvenience and work efficiency issues related to HPD use, we designed a box to contain the HPDs close to noisy work stations. This point-source concept can be expanded to include other protective equipment needs in a variety of work settings. The novelty of this idea is that the HPD is now associated with a piece of machinery and not a person.

Noise Exposure Assessments

Full-shift personal noise dosimetry data was collected on 41 farmers to better understand their work practices and to get an idea of how much noise they are exposed to on a daily basis, particularly when operating machinery. More than half of the personal noise dosimetry measures exceeded the National Institute for Occupational Safety and Health (NIOSH) daily allowable dose of 100%. The full-shift time-weighted average (TWA) values for the NIOSH Recommended Exposure Limit ranged from 70.6 to 93.6 decibels on an A-weighted scale (dBA). These dosimetry measurements were taken during the harvest season, characterized as long work periods because farmers typically start early in the day and complete work late at night.

Figure 1. Spectral Analysis of a 2012 John Deere 7230R Tractor



Farm Noise Checklist

We inventoried all major sources of noise on the farm through interviews with the farm operator and by farm walk-throughs, visual observation, and spot noise measurements. We also looked at real-time noise monitoring with spectral analysis. One-third octave bands consisting of center frequencies from 16 Hz to 16 kHz were integrated for 30 seconds and stored in the analyzer. The make, model, and year of equipment were recorded. Farmers were asked about duration and practices when working with noisy equipment or in noisy environments. The equipment most commonly found on the farms were tractors, combines, gravity flow

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Update

Published by the Council for Accreditation in Occupational Hearing Conservation, a not-for-profit organization dedicated to the establishment and maintenance of training standards for those who safeguard hearing in the workplace.

Articles should be submitted with a photograph of the author. Email: info@caohc.org

Message from the Chair: The Risk of Noise Exposure — What is Acceptable?

By:Bruce Kirchner, MD MPH CPS/A

I recently taught a risk communication course. This training stresses good principles in communication, which allow the receiver to make thoughtful decisions on how they manage risks in their day-to-day lives. In this course, we emphasize that an individual's perception **is** their reality. Sometimes, an individual's perception of how hazardous a risk is may align very well with the perceptions of others; however, in other circumstances, their perception may be very much at odds with facts.

Our course explains what perceived risks are considered "acceptable" and which ones are considered "unacceptable". For instance, if a certain risk is considered acceptable by an individual, he or she may elect to do nothing about it. As an example, if we believe the community pollution remediation team has demonstrated its quick response to contain a water pollutant release, many people would find that risk to be more acceptable than a release where the pollutant will surely enter the drinking water. Therefore, in this situation, **trust** can make the potential for pollutant release more acceptable. Another factor in acceptability could be that although there may be a perceived risk, such as a small amount of electromagnetic radiation being emitted by a cellphone, the **benefits** of the device outweigh the exposure. Additionally, when people **voluntarily** expose themselves to risk, they will generally find this situation more acceptable than if they were forced to do the same activity.

So what does this mean in the context of noise exposure? Unfortunately, many people seem to accept the risk rather than take steps to protect themselves. Why? One factor may be that noise is **familiar** in that we seem to exist quite well with it, as opposed to a potential hazard we do not know enough about. People tend to accept noise because it is **fair**, in that everyone seems to have exposures versus having noise imposed on a small group of people. Noise may be more acceptable because we **voluntarily** expose ourselves to it in many very loud recreational activities and hobbies; yet, we would not accept it if our neighbor's same recreational activities were disturbing our afternoon siesta. Additionally, there may be a **benefit** from exposure to noise if it causes enough noise-induced hearing loss for an individual to claim worker's compensation!

Unfortunately, when a person perceives the risk from noise-exposure to be acceptable, and this perception is continually reinforced, they develop an ingrained belief system, which is often difficult to change without intensive effort. This involves on-going education focused on countering all their incorrect perceptions with facts. For every reason people express for not wearing hearing protection, the occupational hearing conservationist (OHC) must be prepared to counter that argument with facts. The OHC must understand what is important to the individual's well-being, and then discuss the deteriorating audiogram in the context of how that will impact their current and future quality of life. Changes in one's belief system often take a long time, so the OHC must continue to deliver the true nature of the risk, even when the effort seems hopeless.

Above all, the OHC must always take a positive and caring attitude. Being a hair cell defender is hard work!

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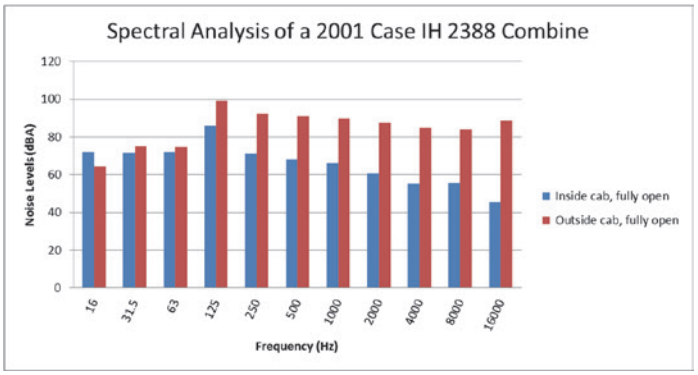
augers, portable augers, riding mowers, skid steers, and chainsaws. Other equipment included leaf blowers, weed eaters, sprayers, utility vehicles, forklifts/bulldozers, planters, grain vacuums, excavators, portable air compressors, and semis/dumpster trucks. Farmers commented that the cabbed vehicles were significantly quieter than the non-cabbed vehicles. Many of the pieces of equipment had noise levels exceeding 85 dB in the high frequencies associated with communication. Data showed that the inside of cabs is quieter than the outside, except at low frequencies (Figure 1).

This may be because of reverberation inside the cabs. In the combine and the tractor, the noise levels associated with the higher frequencies (2000-8000 Hz) are well below 85 dB. However, many participants report that they work outside of the cab on a regular basis where noise levels are higher (Figure 2).

Figure 2. Spectral Analysis of a 2001 Case IH 2388 Combine



Point-Source Intervention

We designed a hinged weatherproof aluminum box in which we placed on pair of earmuffs and several ear plugs (Figure 3).

Figure 3. Hinged weatherproof aluminum box containing HPDs

The base of the box has levers on which the earmuffs fit snugly. Each time the earmuffs are removed and returned to the box, an electronic counter advances in increments of "1." We divided the counts by two to determine the number of times the earmuff was taken out of the box to be used. Earplugs were counted before being placed in the box and during follow-up. We found that the farmers had all used the earmuffs at least once, with a median usage of 7.5 times. Farmers mentioned that the HPD boxes serve as a reminder to them to wear hearing protectors, and that they were more likely to use HPDs because they are conveniently located next to the noisy equipment.

Conclusion

The primary noise sources identified in this study were farm equipment. Our findings suggested that supplying HPDs at the point-source of noise provides farmers ready access to appropriate PPE, and, as a result, they are more likely to make use of it. We recommend that agricultural workers limit their noise exposures as much as possible. This can include standing away from a noise source, purchasing quieter equipment, or using hearing protection devices when they are exposed to loud noise.

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Chandran Achutan, PhD is an associate professor in the Department of Environmental, Agricultural, and Occupational Health at the University of Nebraska Medical Center. He represents the American Industrial Hygiene Association on CAOHC.

Ten Years Aboard the CAOHC Council

By: Thomas Hutchison, MA MHA FAAA CCC-A

As a civilian occupational audiologist working for the US Navy in the early 1980s, I was certainly familiar with CAOHC. Whenever hosting an Occupational Hearing Conservation certification course, like all course directors (CDs), I dutifully applied for course authorization through the CAOHC Administrative Office in Milwaukee. Every 5 years, in order to continue teaching those courses, I faithfully renewed my CD certification. Every few months I would read the CAOHC *Update* publication and, if I ever had a question or needed a resource for a hearing conservation question, I would call CAOHC.

Beyond that however, I was not overly familiar with the inner workings of organization. As I continued in the hearing conservation field and became more involved in the Military Audiology Association (MAA), I was fortunate enough to routinely come in contact with both current and former CAOHC Council Members that had represented MAA. People like Colonel Dick Danielson, Colonel Dave Chandler, and Lt. Colonel Theresa Schulz come to mind immediately. I learned more about how CAOHC functioned and began to understand how important CAOHC is to the field of Hearing Conservation. With representation and active participation on the Council from not only audiologists, but acoustical engineers, industrial hygienists, occupational health professionals (both nursing and physicians), otolaryngologists, and safety professionals; CAOHC obviously was an organization that took a truly multifaceted approach to the issues surrounding hearing conservation. I became more and more interested in participating.

In 2003, as Theresa Schulz was nearing her end-of-term as one of two MAA representatives, I was fortunate enough to be nominated as her replacement. I subsequently attended my first Council meeting in 2004. Since then I have been privileged to associate with some of the finest, most knowledgeable people in their respective fields. This of course would include the Executive Director and support staff of CAOHC.

Now that my "stint" has come to an end, I look back with a bit of nostalgia and pride knowing that, at least in some small way, I have been a part of this great organization.

CAOHC's mission is to promote hearing loss prevention by enhancing the quality of occupational hearing loss prevention practices, focusing on: *"Providing oversight and support to those who train hearing conservationists (Course Directors), those who practice hearing loss prevention (occupational hearing conservationists [OHCs]), and those who supervise OHCs and interpret problem audiograms (Certified Professional Supervisors of the Audiometric Monitoring Program),* as well as *increasing quality and consistency among hearing loss prevention programs."*

There are many highlights from the past 10 yrs. which stand as testimony in support of that mission. For example, the establishment of the Professional Supervisor (PS) course, the refining of the curricula for Course Director (CD), the development and implementation of a standardized examination procedure for OHCs, and, closest to my interest, the rewriting of the Hearing Conservation Manual. Participation in these projects, to a greater or lesser amount, has been an extremely rewarding experience.

I look forward to staying in touch with the many friends I have made while serving on the Council and hopefully can stay involved with some of the current and future projects that CAOHC is pursuing.

UPDATE Call for Articles

CAOHC® Council for Accreditation in Occupational Hearing Conservation

CAOHC Wants to *HEAR* from you!

CAOHC is currently accepting articles for 2014 *UPDATE*, our publication offered at no charge to the entire hearing conservation community. Each edition is posted on our new website, reaching over 22,000 occupational hearing conservationists. Writing for *UPDATE* is your chance to reach thousands of colleagues within the hearing conservation industry who are committed to occupational Hearing Conservation, just like you!

Articles that will be selected must complement CAOHC's mission and goals, as well as be relevant. We are interested in hearing about innovative hearing loss prevention programs, new innovations in training employees to be hearing conservation compliant, your challenges and your successes.

In addition, *UPDATE* places the "spotlight" on an outstanding Occupational Hearing Conservationist, Course Director, or Professional Supervisor. If you know of someone in your company deserves the "spotlight" for their commitment to hearing conservation, please craft a brief testimonial (approximately 75-100 words or less) and include that person's name, your company name and a recent head-shot photo. Your "spotlight" candidate will be added to our next issue, as well as, posted to the CAOHC website.

Submit your article or your "spotlight" testimonial along with your contact information to Kim Breitbach at kbreitbach@caohc.org, or our *UPDATE* Editor, Dr. Antony Joseph, at earsafety@yahoo.com. Also, please let us know what you would be interested in reading in future issues of *UPDATE*. You may send your comments or questions to the CAOHC Administrative Office at info@caohc.org. Thank you again for your interest in *UPDATE*!

Rewind

To celebrate CAOHC's 40th Anniversary, we are presenting a special section called *Rewind.* This section will appear within our social media outlets and online publication, *Update*. *Rewind* will feature articles from previous issues of *Update* that contain information relevant for today's readers. As a follow-up to each article, a discussion thread will be started that invites readers to comment on the featured *Rewind* article.

Fall 2004

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UPDATE

The Newsletter of the Council for Accreditation in Occupational Hearing Conservation

VOLUME 16 • ISSUE 3

Thoughts on the Noise "Notch" and the Importance of Testing 8 kHz

By Mark R. Stephenson, PhD
Representative for the American Academy of Audiology
with Christa L. Themann, MA CCC-A and William J. Murphy, PhD

The primary purpose of audiometric monitoring is to identify hearing changes while they are still small. Hopefully, these changes can be identified before they represent permanent changes, i.e., while they are temporary threshold shifts. The susceptibility to developing a hearing loss is not the same at all frequencies. Assuming that a worker's ears are otherwise healthy, that there is no excess build-up of cerumen, and that appropriate audiometric test methods are followed, hearing changes due to noise are first detected and grow most rapidly at the higher frequencies. The American National Standards Institute (ANSI) provides data estimating expected hearing loss as a function of noise level, years of exposure, and audiometric frequency (ANSI, 1996). Table 1 below illustrates the predicted noise-induced hearing loss for workers exposed to time-weighted average levels of 95 dBA.

Years of Exposure to Time Weighted Average of 95 dBA

Frequency (Hz)	10	20	30	40
500	0	0	1	1
1000	2	3	3	3
2000	5	9	12	14
3000	16	19	22	23
4000	20	23	25	26
6000	14	16	18	19

TABLE 1. Predicted noise-induced hearing loss from daily time-weighted average exposure to 95 dBA for 10, 20, 30, and 40 years (ANSI S3.44-1996).

Plotting the data in Table 1 illustrates how noise-induced hearing loss is primarily observed in the higher frequencies

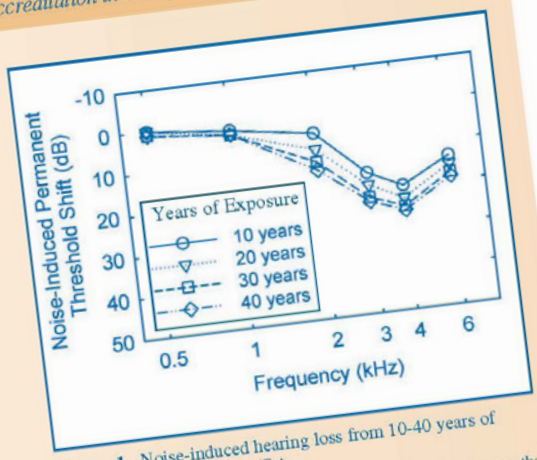

Figure 1 - Noise-induced hearing loss from 10-40 years of exposure at a TWA of 95 dBA

Note: these levels represent only the amount of hearing change that would be attributable to noise. An actual audiogram would reflect changes due to noise, plus any other factors that affect hearing, such as aging.

(Figure 1). Note also that the greatest hearing loss is observed at 4 kHz, giving rise to what is commonly referred to as the 4-kHz "notch." While these data are illustrative of the 4-kHz notch, they also demonstrate the presence of considerable noise-induced hearing loss at 3 and 6 kHz.

Although noise-induced hearing loss is typically characterized by a 4-kHz notch, the possibility of a notch at other frequencies, particularly at 6 kHz, is well-known (Monley, et al. 1985, Dempsy, 1995). Because of the recen OSHA rule on recording occupational hearing loss (OSHA 2002), the ability to determine the presence or absence of a "noise notch" must be reexamined (Rabinowitz and Dobie, 2003). OSHA's new rule includes a provision for determining whether or not a hearing loss is work-related. Consider how a 6-kHz notch would affect the interpretation of a worker's audiogram. Presently, OSHA (29 CFR 1910.95) does not

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Rewind

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require testing at 8 kHz. Without testing 8 kHz, a worker with a substantial 6-kHz notch would exhibit an audiometric configuration indistinguishable from hearing loss due to presbycusis. Although even one missed diagnosis is one too many, is this a scenario occupational hearing conservationists, audiologists, and physicians are likely to encounter? How common is a noise notch at frequencies other than 4 kHz? New data are emerging that can shed additional light on these issues.

These data are part of the current National Health and Nutrition Examination Survey (NHANES) conducted by the National Center for Health Statistics with collaboration from the National Institute for Occupational Safety and Health (NIOSH) and the National Institute on Deafness and Other Communication Disorders (NIDCD). As part of the NHANES study, hearing thresholds from 500 Hz to 8 kHz are being collected on adults aged 20 – 69. From data collected during 1999 and 2000, 1660 hearing tests have been evaluated for the presence or absence of a notch. Of the audiograms reviewed to date, 474 represented persons reporting a history of occupational noise exposure. From this group, notches were identified in 317 ears. From these data a 4-kHz notch was clearly not the frequency of most common occurrence. Instead, if a notch was present, it was more likely to occur at 6 kHz, particularly in females. Figures 2 and 3 illustrate the results of this analysis for females and males, respectively.

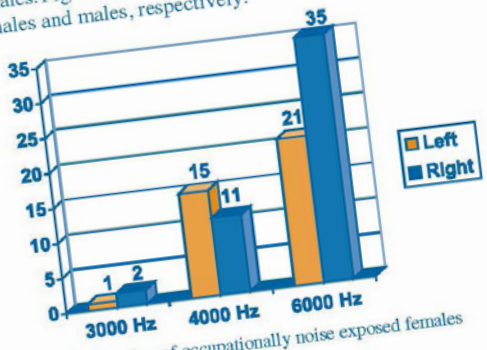

Figure 2 - Number of occupationally noise exposed females having notches at selected frequencies.

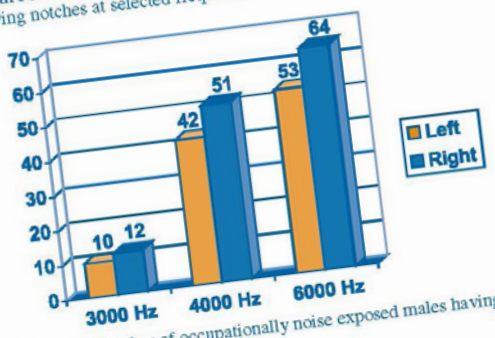

Figure 3 - Number of occupationally noise exposed males having notches at selected frequencies.

Although the above data represent unweighted, preliminary findings from the first two years of the NHANES data set, occupational hearing conservationists (OHCs) should be alert to the likely presence of a notch at frequencies other than 4 kHz. If a worker presents with a sloping high frequency hearing loss and 8 kHz is not tested, determination of the presence of a 6-kHz notch is not possible. In fact, a 6-kHz notch is so common that OHCs may wish to reconsider which audiometric frequencies they wish to test.

Thus, the question remains: if the OHC is not already doing so, should he/she start testing 8 kHz? NIOSH (1998) and the American Academy of Audiology (2003) have recently published guidelines that recommend including 8 kHz when performing audiometric monitoring in support of a hearing conservation/hearing loss prevention program. While this represents "best practice," OHCs may find it is nearly as effective to include 8 kHz only on certain hearing tests. For example, all audiograms that provide reference hearing threshold levels, i.e., baseline and exit audiograms, should include 8 kHz. Also, when an STS is suspected, any subsequent retest or confirmatory audiogram should include 8 kHz.

CONCLUSION. The current data represent preliminary results from the National Health and Nutrition Examination Survey. When the six-year NHANES data collection period is complete at the end of 2004, approximately 6000 hearing tests will have been administered. A more definitive analysis examining the effects of other variables (e.g. age, gender, and ethnicity) on the prevalence of 3, 4, and 6-kHz notches will be forthcoming following the collection period. In the meantime, OHCs should be aware that the noise notch is very likely to occur not just at 4 kHz, but at 6 kHz as well.

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Christa L Themann, MA, CCC-A is a Research Audiologist at the National Institute for Occupational Safety and Health, Division of Applied Research and Technology (Engineering and Physical Hazards Branch) Hearing Loss Prevention Team in Cincinnati, OH.

William J. Murphy, PhD, is a Senior Research Biophysicist at the National Institute for Occupational Safety and Health, Division of Applied Research and Technology (Engineering and Physical Hazards Branch), Hearing Loss Prevention Team, Cincinnati, OH.

To celebrate CAOHC's 40th Anniversary, we are presenting a special section called *Rewind.* This section will appear within our social media outlets and online publication, *Update*. *Rewind* will feature articles from previous issues of *Update* that contain information relevant for today's readers. As a follow-up to each article, a discussion thread will be started that invites readers to comment on the featured *Rewind* article.

Beliefs, Attitudes, and Knowledge on Hearing Protection Devices Among Farmers

By: Andrea Mulvenon, MS

High noise exposure is common in agriculture largely because of the frequent use of noisy machinery such as tractors, power take-off-driven implements, combines, and loaders. Significant noise exposures also occur in raising livestock, from the animals, as well as, from the ventilation fans, feeding mechanisms, and cages (Frank et al., 2004; Achutan & Tubbs, 2007a; Achutan & Tubbs, 2007b). Farming has often been associated with hearing loss (Langley et al., 1997). A recent study found average noise levels exceeding 85 dB from farm equipment (Navarrette et al., 2014). It has been shown that farmers have significant hearing loss (Beckett et al., 2000). This loss of hearing may begin at an early age since children raised on farms have been found to have poorer hearing than urban children (Renick et al., 2009).

Unlike workers in general industry, farmers work in a non-regulated environment and are not commonly served by work-based health programs. Other challenges related to the use of hearing protection in the farm-work environment include the intermittent noise exposure and diversity of work activities. Although the best way to prevent noise-induced hearing loss (NIHL) is to eliminate noise whenever possible, noise elimination is often not technically or economically feasible. Use of hearing protection devices (HPDs) helps prevent NIHL, but such use among farmers is low (Jenkins et al., 2007). Factors influencing use of HPDs among farmers have been identified as functional barriers, including interpersonal influences, such as family support for HPD use (McCullagh et al., 2002).

Conducted in Iowa and Nebraska, this study aimed to identify what farmers thought about hearing protection devices. Through a beliefs and attitudes questionnaire, participants had the opportunity to rate their personal degree of agreeability regarding HPD use. Researchers created a 31-item questionnaire adapted from a study by Svesson et al. (2004) that was organized into 10 content areas to address perceived issues with HPD use. The content areas included perceived barriers to preventive actions, self-efficacy, behavioral intentions, social norms, perceived susceptibility to hearing loss, perceived benefits to preventive action, and perceived severity of consequences of hearing loss.

Susceptibility to hearing loss is an indicator of participants' knowledge of the effects of loud noise. For example, if participants believe that HPDs should be used around all loud noises as opposed to just sometimes, and if they believe that daily exposure to loud noise will eventually damage their hearing, this indicates that participants believe that exposure to loud noise is accumulative. A majority of the workers indicated that exposure to daily noise could lead to hearing damage.

Less than 5% of participants reported that they believe that loud noise cannot hurt their hearing and that they have the ability to acclimate to loud noise and would therefore not be susceptible to hearing damage.

Perception of the importance of hearing and the ability of HPDs to protect was also measured. Over 90% of the study participants either *strongly agreed* or *agreed* that losing their hearing would be problematic. All participants either *strongly agreed* or *agreed* that HPDs could be used to protect hearing. Although, most participants only agreed that loud noise present a risk to their hearing and that HPDs can be used to protect hearing only 31% of the workers *agreed* or *strongly agreed* that they currently wear HPDs when working around loud noise. The majority of participants either *strongly agreed* or *agreed* that they know when to use HPDs. This suggests that there may be a disconnect between the participants' perceived risk, ability to use HPDs, and willingness to use HPDs. Participants may not be currently invested in protecting their hearing or there may be other obstacles that need to be determined and investigated.

The survey results on perceived barriers to preventive actions indicated that discomfort while wearing HPDs may have a large impact on the current use of HPDs in the study population. Approximatley half of the participants agreed that HPDs are uncomfortable to wear either by causing uncomfortable pressure or sweating. Another major barrier to HPD use may be the muffling of other sounds. Again, approximatley half of the participants *strongly agreed* or *agreed* that using HPDs would prevent them from hearing warning signals or other important sounds.

Preliminary findings from this study show that there is a need to educate farmers on the proper use and disposal of HPDs, hazards associated with noise, importance of noise control and use of hearing protection devices.

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Andrea Mulvenon, MS, is a doctoral student at the Department of Environmental, Agricultural, and Occupational Health at the University of Nebraska Medical Center. Ms. Mulvenon's research interests include occupational exposure assessment and education of workers. She is also a CAOHC-certified Occupational Hearing Conservationist.

OHC Spotlight, Gigi Talley: Why I Love Hearing Conservation

By Gigi T. Talley, BA COHC

At first glance, if not familiar with the term, one may think this title reads "Why I Love Hearing Conversation" and wonder who in their right mind would not love hearing conversation. I mean, that is the whole point of conversation, right? To be able to hear it? In reality, Hearing Conservation is exactly that; teaching people to protect their hearing so that they can hear conversation and other important sounds. Often we do not think of it in those terms, however hearing conservation programs in the workplace are designed with just that goal in mind.

The Occupational Safety and Health Administration (OSHA) has specific guidelines in place to protect workers who are exposed to noise levels above 85 decibels over an 8 hour period. The guidelines for protection against the effects of noise exposure also include that the employer have an effective hearing conservation program in place for workers exposed to high levels of noise. Such a program should include noise monitoring, annual audiometric testing, hearing protection and education on the effects of noise exposure.

According to the Department of Labor, every year thousands of workers suffer from hearing loss due to high occupational noise levels. The Centers for Disease Control and Prevention (CDC) cites occupational hearing loss as "the most common work-related illness in the United States." Noise-induced hearing loss is not considered reversible, but it is 100% preventable. Engineering controls, administrative controls and hearing protection devices are at the heart of a well-designed hearing conservation program. Using these controls to reduce hazardous noise exposure can prevent permanent hearing loss and the psychological stress that accompanies the inability to effectively communicate.

This is why I love hearing conservation. Through education and training, both the employer and the employee benefit. As employees learn about the effects of noise on hearing they become more conscious of the serious implications hearing loss can have not only on communication, but on the ability to socialize and enjoy their children or grandchildren. The Council for Accreditation in Occupational Hearing Conservation (CAOHC) certifies occupational hearing conservationists (OHC) to provide quality occupational hearing loss prevention practices in the workplace. Many certified OHCs are the head of their employee conservation programs. OHCs are instrumental in teaching employees about noise induced hearing loss and hearing protection. When employees learn how hearing loss can be prevented they may become motivated about wearing their hearing protection correctly or sharing creative ideas for effective engineering controls. With this, employers may not only observe more compliant employees, but, in time, may begin to see less noise related workplace accidents or injuries.

So, it does all start and end with "conversation" about the physiology of the ear, how hearing works, what causes hearing loss and how to prevent noise induced hearing loss. By having those conversations, we enable our workers to hear conversations about fishing with a grandson, what to do on a family vacation, the affection expressed on an anniversary from one's spouse or just the sweet sound of laughter at a family dinner. The truth is, an effective hearing conservation program enables conversations to happen.

References:

https://www.osha.gov/SLTC/noisehearingconservation/
http://www.cdc.gov/niosh/topics/noise/

Gigi T. Talley is the Marketing Manager for the Industrial Health Council, a mobile medical testing company in Birmingham, Alabama. Talley is a CAOHC certified Occupational Hearing Conservationist who has worked in the field of Occupational Health and Safety for 10 years. She conducts audiometric tests in the field with the Industrial Health Council. Talley graduated with honors from the University of Alabama at Birmingham with a BA in Social Psychology.

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555 E. Wells St.
Suite 1100
Milwaukee, WI 53202
(414) 276-5338
www.caohc.org

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