



## **NIHL and its prevention: getting youth to listen and act to preserve their hearing**

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### **ABSTRACT**

1.1 billion young adults are at risk for Noise-Induced Hearing Loss (NIHL) from damaging levels of sound with one in five U.S. teens having permanent hearing damage by age 19. This worldwide epidemic of NIHL has serious short- and long-term consequences for health. Unfortunately, young people associate hearing loss with illness and old age, causing them to discount its danger for them. Since 2020-2021 is “The International Year of Sound,” it’s the perfect time for international education and outreach about NIHL and to advocate for action regarding this public health crisis. How can we change how young people think about noise exposure, hearing loss, and prevention? We’ll discuss key ways to spread the message about NIHL and hearing preservation such as safe listening practices, motivating young people, use of social media (e.g., Instagram, YouTube, etc.); reaching children early; integration of safe-hearing education into school curriculums (e.g. Ear Peace Foundation’s Protect-a-Band program); promotion of the WHO’s Make Listening Safe partnership program with the ITU; and, especially, recruiting young advocates to spread the word about hearing. When young people speak, kids listen!

### **OVERVIEW**

2020 started out as ‘The International Year of Sound’ but thanks to the global Covid-19 pandemic, 2020-2021 became the quietest period since the start of the Industrial Revolution—the perfect time to evaluate the impacts of noise and quiet on health, and to plan youth-oriented programs to address the growing public health crisis of NIHL.

### **The Importance of Hearing Preservation**

Twenty percent of U.S. teens have NIHL by age 19 [1]. One study showed that from 1979-1989, the percentage of 2nd graders diagnosed with hearing loss increased almost three times and for 8th graders, increased four times [2]. Children with even a minimal hearing loss show lower performance in school compared to their peers with normal hearing, are more likely to fail at least one grade, and exhibit a higher frequency of learning difficulties and behavior problems [3]. Thus, even minimal hearing loss has been associated with negative academic and social outcomes [4].

Young people do not often understand the consequences of NIHL and its devastating side effects including tinnitus and hyperacusis. In addition to consequences for health, education, and social well-being, it has also been associated with future economic difficulties [5], disqualification for military service [6], and major problems such as cardiovascular disease [7], dementia [8], anxiety, and depression [9]. Sadly, most young people will not have any idea they have damaged their hearing until it is too late.

### **Young People Lack Awareness of the Danger of Loud Sound**

Young people live their daily lives oblivious to the dangerously loud sound that endangers their hearing. The use of smartphones and other portable devices to listen to music on a 24/7 basis, combined with new earbud technology which produces sound nearly twice as loud as headphones in past decades results in large numbers of young people at high risk for hearing damage from an early age. Between the ages of six and 19, 12.5% of all U.S. children have noise-induced threshold shifts in one or both ears [10]. Personal audio devices are a great concern for young people, since headphones tend to be turned up above safe volumes, especially when listening in already noisy environments.

In addition to the increased exposure to loud music, many venues have also gotten much louder in recent years, including sporting events, concerts, restaurants, gyms, movie theaters, bowling alleys, and even some churches. The fitness industry is either unaware of or ignores the dangers of loud music in gyms and fitness classes. One study of fitness classes found that (1) an average class length of 52.8 minutes had sound levels reaching 98.9 dB and (2) the average time an instructor spent giving a fitness class per week was 9.8 hours, exceeding the weekly workplace noise standard by 57% [11]. Loud music, intended to energize the participants, can lead to permanent hearing damage. Some sports venues even pride themselves on how loud they can be, competing for 'loudest crowd noise.' The current record held by an NFL team is 142.2 decibels – a sound level that exposes every person in the stadium (including fans of all ages, players, cheerleaders, and stadium workers) to permanent hearing damage. Again, fans are typically unaware of the progressive and permanent hearing damage that can incur.

About 40-50 million people in the U.S. have tinnitus including children [12]. One study of third graders found that 97% of them had been exposed to hazardous noise levels during their early lives [3]. Daily exposure to loud sound often begins in infancy and early childhood, yet young people continue to significantly underestimate the extent to which they are exposed [3]. To effectively reduce the numbers of people with hearing damage due to noise exposure, children must be taught that loud sound can be harmful and learn the simple skills necessary to protect their hearing.

Today's generation of young people spend much of their recreational time attending sporting events, school pep rallies, parties, concerts of favorite bands and artists, and music festivals that last for days. It seems that hearing alone is not enough – young people want to feel the sound as well. Most young people do not perceive loud sound as dangerous because loud sound levels often cause hearing damage without causing pain. While overexposure to sound levels above average 70 decibels can cause permanent damage, the pain threshold typically begins at <70 dB for people with hyperacusis and varies from 100 dB to 120 dB depending on the individual [13]. By the time they experience any discomfort, significant hearing damage has likely already occurred. It is critical that young people have access to the information that explains this and provides them with simple actions they can take to protect their hearing.

The Covid-19 pandemic of 2020 caused many schools to turn to remote learning and virtual classroom settings resulting in preschool through college-age students spending a vast majority of their day learning online using personal computers and other audio devices. This is in addition to time spent on recreational listening. Neither the volume of the sound nor the length of daily use is routinely being considered or assessed though it places students at increased risk for long-term hearing damage.

### **Ear Peace: Save Your Hearing Foundation: We Focus on Youth**

Ear Peace: Save Your Hearing Foundation, an educational non-profit organization, was established in 2010 with the goal of raising awareness of Noise-induced hearing loss (NIHL) and encouraging its prevention, particularly among our youth. Ear Peace Foundation's mission is to educate young people about (1) the dangers of loud sound and (2) the simple behaviors necessary to protect hearing. The Foundation's focus on youth education and prevention has motivated them to find and utilize effective ways to reach children and young adults.

## **YOUTH-ORIENTED PROGRAMMING**

### **Youth Ambassador Program to Recruit and Train Young Hearing Health Advocates**

Peer-to-peer education is one of the most effective ways to help young people learn and can be used applied to the topic of NIHL and to promote hearing health [14]. In its effort to reach students to serve as hearing health advocates, Ear Peace Foundation has established relationships with public and private schools, ranging from elementary schools to graduate level programs. Often focusing on young people with an interest in music, health and/or community service work, the Foundation has taught these students about NIHL and its prevention and then trained them to present this information to their peers and other groups (in schools, at their places of worship, in extra-curricular clubs, at community programs, and to their friends and families.) These young educators can then become Ear Peace Foundation Youth Ambassadors.

Ear Peace Foundation recruits teen advocates willing to dedicate time to learning about hearing health and spreading the word among their peers. Young people listen to other young people. Studies have shown that young students possess positive views on peer-led health education when compared to teacher-led health education [15]. Young people have shown "improved knowledge, attitude, self-efficacy, and social norms" regarding peer-led health education [16].

### **Work with Girl Scouts and other Youth Organizations**

Today, in the United States, there are approximately 2.7 million members of Girl Scouts of the USA (GSUSA) [17], 10 million members in the World Association of Girl Guides and Girl Scouts (WAGGGS) [18], and 2.2 million youth members of Boy Scouts of America (BSA) [19]. These youth scouting organizations have a common mission to provide young people with the life skills they need to enjoy a lifetime of healthful living, positive relationships, leadership, and service. Since NIHL impacts all young people, it is imperative for hearing loss prevention

information to be incorporated into programming for these youth service organizations at all age levels.

Over the last decade, Ear Peace Foundation has worked together with Girl Scouts troops to educate young women about NIHL as well as empower them to spread the word. As a high school student, Kelly Culhane chose this topic and worked with the Foundation to reach her peers with this critical health information. She completed her Girl Scout Gold Award Project titled *Hearing Loss in Teens: An Alarming Trend* to educate students about NIHL and encourage them to utilize hearing conservation practices [20]. To create as wide a reach as possible, Kelly developed brochures, posters, and multiple educational videos including a 13-minute video specific to at-risk band students (*Band Together to Protect Your Hearing*) [21]. In 2018, she was honored by the GSUSA as a National Gold Award Girl Scout for her work to raise awareness of NIHL and its prevention.

In her ongoing work with Ear Peace Foundation and consistent with the Girl Scout mission to prepare its young people for a lifetime of healthy living, Kelly is currently developing a badge program that would make hearing health information accessible to scouts of all ages so they can grow up understanding how to protect their own hearing and how to share that health information with others.

### **Protect-a-Band Program for Music Directors and Student Musicians**

Young musicians are at high risk with 45% of participants in band, orchestra, jazz band, marching band or chorus suffering from NIHL by the age of 25 [22]. They are particularly at risk for NIHL due to the many hours they spend practicing their instruments and performing. Ear Peace Foundation's Protect-a-Band program educates performing music teachers (Band, Orchestra, Choir, Jazz Band, etc.) with the expectation that they will then teach their students about NIHL and promote healthy hearing behavior among their student musicians. Once the teacher has taught his/her music students about NIHL and its prevention, Ear Peace Foundation provides that teacher's music students with access to discounted or free high-quality musician's filtered ear plugs for hearing protection.

A common misconception among musicians is that hearing protection is uncomfortable and obstructs or distorts the sound. This often prevents musicians from even considering the use of protection during rehearsals or performances. By providing students with access to filtered silicon ear plugs which are comfortable and effective, Ear Peace Foundation shows young musicians that they can continue to play their instruments, hear their instructor, and enjoy the music while protecting their hearing. Since 24% of high school students in the U.S. spend at least one year in a performing music class and 20% of them participate in a music ensemble [23], the incorporation of the Protect-A-band program into their academic curriculum could potentially save the hearing of millions of students.

As part of its Young Ambassador Program, Ear Peace Foundation trained a middle school band student who then spread the word to his band teacher and fellow students. This young ambassador went on to train camp friends in Chicago, a summer class at Julliard Music School in New York, international teenage athletes, and additional music students when he entered high school. His outreach work demonstrates the effectiveness of peer-to-peer education.

Of course, hearing health information is just as critical for more experienced and professional musicians. If more professional musicians would speak out about their personal experience of hearing loss and promote the use of hearing protection, it would have the potential to save the hearing of future generations of music performers and enthusiasts.

### **Reach Young Adults during their Professional Training**

The youth of today will be the healthcare providers of tomorrow. Graduate programs in fields such as education, medicine, nursing, audiology, science, and public health should all include education about the consequences of NIHL and training in the simple methods for its prevention. Students provided this information in their required coursework are more likely to incorporate hearing health into their practices and pass along this critical health information to their patients/clients.

Toward this end, Ear Peace Foundation has partnered with local universities and graduate programs to educate their students about the importance of hearing preservation. As one example, the Foundation has collaborated with the University of Miami Department of Public Health Sciences since 2014 to ensure that all their MPH and MD/MPH students are educated about NIHL and its prevention prior to graduating and entering the public health workforce. Its graduate students have completed Capstone projects, done field placement hours, and taught their fellow classmates.

### **Utilize Social Media Platforms**

Young people, considered to be 'digital natives', prefer the use of digital media in their personal lives [24]. The most popular platform today, Facebook, recorded 2.3 billion active users in 2019. A 2018 study found that about 78% of Americans 18-24 years old use Snapchat with 71% of users saying they visit the platform multiple times a day. 71% of this age group also use Instagram daily [25]. These numbers continue to increase.

Ear Peace Foundation utilizes social media (Instagram, Facebook, YouTube, Snapchat, etc.) to raise youth awareness of NIHL and advocate for hearing preservation and there is more to be done. Given its potential to reach billions of young people, social media platforms need to be recognized and utilized as a primary vehicle for creating youth awareness and advocating for hearing preservation behavior.

### **Employ Film and Other Forms of Media**

The use of film media (including commercial movies, television shows and documentaries) is an effective way to raise awareness about NIHL among our youth. In 2020, Kelly was one of two Ear Peace Foundation's Young Ambassadors to be featured in a documentary film, "The Wonder of Hearing," produced by ARTE (German and French versions) [26] and DW Documentary (English version) [27]. The director was interested in featuring young hearing health advocates who could be interviewed about how they protect their own hearing and their efforts to educate their peers. The incorporation of hearing health information into video games could also be helpful in raising awareness and promoting the importance of hearing safety.



## **Educator Training and Classroom Workshops**

To date, NIHL and hearing conservation are not required subjects in the K-12 curriculum of most U.S. public or private schools. This distressing omission has serious public health consequences and places the hearing health of every student at risk.

While this topic has not typically been incorporated into academic curriculums, there are a limited number of programs which have done so successfully. One such classroom-based program was developed by Dangerous Decibels and demonstrated the effectiveness of an interactive learning model [28]. Another such program was the Sound and Noise Educational Module that has been used by New York City schools [29, 30]. Programs like these and the Ear Peace Foundation classroom program meet K-12 STEAM standards and can be easily implemented and incorporated into existing academic curriculums. They could also be introduced in other school-associated activities, such as school clubs and extracurricular organizations.

How do we reach as many young people as possible? Ear Peace Foundation found that training one teacher can translate into the education of many hundreds of students on an annual basis. The Foundation provides free training workshops to educators, with hearing health information that is simple to teach and easy to comprehend. The Educator Training Workshop is available in person in Miami-Dade County, Florida and online elsewhere. It includes information about the science of sound and its measurement, healthy hearing anatomy, decibel levels and their measurement, discussion of venues/activities where hearing may be at risk due to volume levels or length of exposure, how to engage students in demonstrations and activities related to sound. It also teaches the three simple ways to prevent noise-induced hearing loss: (1) decrease the sound volume and length of exposure, (2) increase one's distance from the source of loud sound, and (3) use hearing protection (ear plugs, earmuffs, noise-cancelling headphones, etc).

Concurrent with the impact of Covid-19 on classroom education, Ear Peace Foundation pivoted to using a 30-minute video lesson which can now be presented either in person in a physical classroom or virtually/online. Pre- and post- testing assessments are also available for educators to gauge student learning. This format makes it easier for educators to teach their students and has been utilized by students themselves to reach their peers. It is our hope that hearing preservation education eventually will be routinely taught in all U.S classrooms.

## **EAR PEACE FOUNDATION OUTREACH PROJECTS**

During its first decade, Ear Peace Foundation has developed many projects intended to make learning about NIHL informative, interactive, and interesting to young people [31]. To highlight a few:

### **Restaurant Noise Project**

In 2018, Ear Peace Foundation partnered with SoundPrint, a free smartphone app that utilizes a sound level meter to record and crowdsource sound data from dining locations around the country. For our collaboration, students and volunteers downloaded the SoundPrint app and used it to record sound levels at restaurants across Miami-Dade County to help identify which restaurants provided a venue with comfortable and safe listening levels [32]. This project

encouraged young people to become more aware of their listening environments and act to educate others (friends, fellow diners, restaurant staff and management, etc.) about the discomfort and potential danger to hearing posed by excessively loud background noise.

### **Poster Contest**

In its annual contest, Ear Peace Foundation invites students to create posters that can be used to educate other young people about the risk of NIHL and how to listen safely. The Foundation provides awards to the top entries and features winning artwork on its website and in social media posts. The poster contest is a fun and creative way to engage students from elementary through high school.

### **Jolene Project**

A 'Jolene' is a mannequin equipped with a device to measure the sound levels of personal stereo systems. Students can place their own earbuds into the ears of the mannequin to learn the decibel level of the music being played. This unique and interactive way for students to learn about NIHL has shown much success in raising awareness of the dangers of loud music [33].

## **FUTURE OUTREACH**

### **Educate Young People Interested in Future Military Service**

The U.S. Military has mandated hearing requirements for enlistment and service [6]. Given that 20 percent of U.S. teens have NIHL by the age of 19, a significant number are already considered to be ineligible to serve. Young people must be taught about their risk for NIHL and how to protect their hearing so they can remain eligible for service. High school and college Reserve Officer Training Programs (ROTC and JROTC) should provide information about NIHL and its prevention to ensure that young people interested in a military career can pursue that path.

### **Encourage Use of Smartphone and Mobile Health Apps**

Smartphone apps are another great resource to reach young people. They use a variety of apps to conveniently access information and guidance in all areas of their lives. Apps that measure decibel levels are already available free of charge, allowing anyone with a cell phone to measure ambient sound levels to determine if they are listening within safe limits. Because many apps do not provide accurate measurements using a 3 dBA exchange rate, Ear Peace Foundation encourages the use of the 'NIOSH SLM' App, a sound level meter that reliably records decibel levels use cell phone microphones and can also function as a dosimeter [34].

There are also apps that can assess hearing status. In March 2018, the World Health Organization launched their app 'hearWHO' allowing people to self-monitor their hearing and seek professional advice based on the provided feedback [35]. These types of smartphone apps could easily be used to inform young people's decisions in their everyday lives related to their hearing health, to self-monitor their hearing levels and to prevent hearing damage due to loud sound exposure.

The Apple Hearing Study being conducted in partnership with Rick Neitzel and his colleagues at University of Michigan shines a light on the high risk of noise exposure and its potential health consequences [36]. Cell phone manufacturers (both Apple and Android) now include factory settings that routinely warn users when they are listening (or are exposed) to dangerously loud levels of sound and can sometimes be set to limit the volume to a safe listening level. Automatic warning and volume limiting systems function as additional ways to protect young people from dangerously loud sound that can cause permanent hearing damage.

### **Connect with College Health Services**

Incorporating hearing preservation education into already-existing health services on college campuses would provide millions of students with access to this critical health information.

Colleges and universities typically have campus-based programs specifically dedicated to helping students maintain a healthy lifestyle throughout their college experience with a long-term goal of establishing a foundation for life-long healthy behavior. Such health promotion services that use professional staff and student advocates to discuss health topics, provide support, and encourage meaningful engagement within the University. The addition of hearing health education into standard college-health services (whether University sponsored or student-led) would be an effective way to reach young adults while they are still in an educational setting. The urgency of providing this information is underscored when considering that college is often the last educational setting for young adults prior to them dispersing into the adult working world.

### **Emphasize Early Intervention**

In addition to incorporating hearing preservation education into academic curriculums to reach all school-age children, future outreach needs to be focused on instilling healthy hearing behavior beginning in infancy. New parents need to be provided with information about the risk of NIHL and educated about the importance of safeguarding their child's hearing in infancy and early childhood. Hearing conservation practices (such as restricting exposure to loud sound for children younger than three and the appropriate use of protective earmuffs) should be added to the list of expected parenting responsibilities in the same way we already mandate the use of car seats, sunscreen, and bicycle helmets, to ensure the safety of our children. Accessing expectant and new parents via childbirth and newborn education programs, pediatric wellness visits, and 'online Mommy-blogs' will help to ensure that the next generation of young people grows up understanding the importance of protecting their hearing.

As more young people begin to advocate for hearing safety, we can reverse the usual approach of having adults teach children and, instead, have our youth educate the adults in their communities (neighborhood centers, schools, places of worship, music booster clubs, etc.) about NIHL and its prevention. Through their own behavior and hearing health messaging, young people can underscore the importance of hearing conservation by offering a 'do-as-I-do' approach and by setting an example for hearing safety to people of all ages.



### **Underscore the Importance of Public Health Advocacy**

Moving forward, hearing health advocacy needs to, not only, encourage individual responsibility for utilizing safe-hearing behaviors but must also expand to address the public health aspect of NIHL and its prevention. Public health arenas that warrant attention include (1) the development and use of environmental and community noise control measures and (2) the inclusion of healthcare coverage for hearing and hearing protection.

### **Work with Hearing Health Allies**

You have heard the expression, ‘it takes a village.’ Given the global importance of hearing preservation, it is imperative for organizations to work together to reach as many young people as possible and to focus on the hearing health risks specific to children. The World Health Organization’s 2015 “Make Listening Safe” campaign done in collaboration with the International Telecommunication Union (ITU) educates people about safe listening practices and produced recommendations for global standards for listening devices and entertainment venues based on adult risk data [37]. Recommendations need to be developed to address the unique hearing health needs of children. Ear Peace Foundation and their young Foundation Ambassadors continue to work with national organizations such as the CDC/NIOSH/NCEH and Quiet Communities Inc to further promote the importance of educating our youth to protect their hearing. The Foundation also understands the critical importance of encouraging young people to use hearing protection and partners with companies that produce products like ear plugs (EarPeace) and earmuffs (BabyBanz and Your Ears Rock) when doing outreach work.

## **CONCLUSION**

NIHL has been characterized as an ‘old-person’s issue’ for far too long. As this type of permanent and disabling hearing loss impacts more and more of our young people, we need to engage the younger generation to take a more active role in effectively promoting awareness about the danger of loud sound and the importance of hearing preservation. Most of the current methods involve adults teaching children. We need to re-think the usual approach and instead, find ways to recruit and train our youth to educate their peers. When young people talk, other young people will listen and take steps to protect their own hearing and the hearing of others.

### **Acknowledgements**

We would like to thank the following people for their ongoing support and helpful feedback during the preparation of this paper: Adele Sandberg, Founder and President of Ear Peace Save Your Hearing Foundation, Jan L. Mayes, MSc, and our colleagues at The Quiet Coalition: David Sykes, MA, Jamie Banks, PhD and Daniel Fink, MD.

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