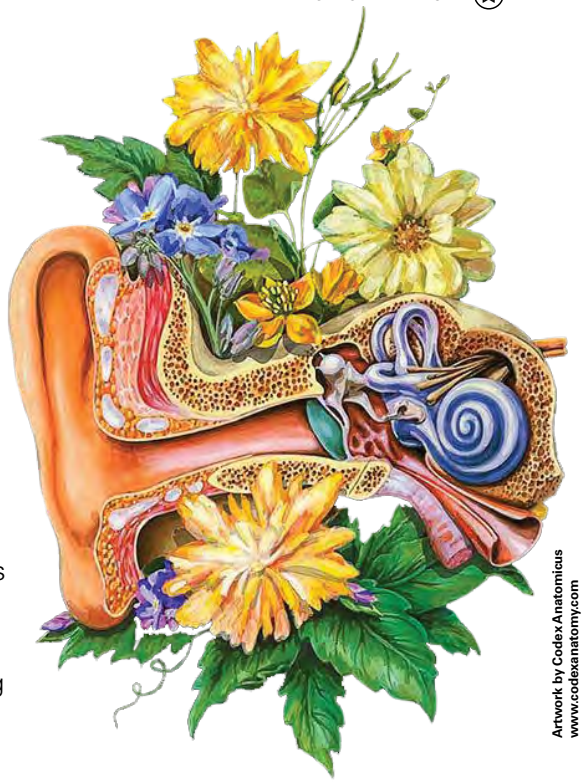
If Only We Could See the Damage of Noise Exposure



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By Jan L. Mayes, MSc

If our ears bled from exposure to loud noise, protecting hearing would undoubtedly be a public health priority. No one would tolerate unregulated sound if we had such a gruesome illustration of how everyday sounds cause injury to our ears. But that's not how hearing injuries show themselves. Instead, we have an invisible crisis of noise-induced hearing loss (NIHL) and tinnitus, which is showing up among all ages, including children. I and my colleague Daniel Fink, MD, who chairs the Quiet Coalition, identified harmful noise emissions from common offenders, including personal listening systems, home appliances and power tools, landscaping equipment, social and entertainment activities, and public transit systems.[1] We make a case that immediate changes are necessary to stem the tide of invisible hearing damage that is clearly harming wide swathes of society.

Exposure to loud noise adds up over our life span, despite quiet periods between exposures, like damage from each puff of nicotine adds up for smokers over a lifetime. The louder and more frequent the noise exposure, the faster and more severe the auditory damage. Besides injuring the inner ear, noise triggers hearing nerve degeneration and auditory brain changes. Such changes are linked to tinnitus, hyperacusis or decreased sound tolerance, and hidden hearing loss, a type of hearing loss that cannot be measured by a routine diagnostic hearing test, or problems understanding speech with noise in the background, even when hearing thresholds test within the "normal" range. NIHL typically develops within five to 10 years of harmful exposure.

In 1974, the U.S. Environmental Protection Agency (EPA) identified noise levels required "to protect public health and welfare with an adequate margin of safety."[2] This included a maximum daily average sound level of 70 decibels (dB) over a 24-hour period to prevent any measurable hearing loss over a lifetime. The EPA identified lower average noise levels needed for people to understand spoken conversations: 55 dB in outdoor public spaces and softer for inside homes, schools, and hospitals.

Noise-sensitive populations, including infants and children, people who already have tinnitus or hearing loss, and older adults, are at higher risk. Sensitive individuals can have more difficulty understanding speech in ambient noise and develop auditory problems faster or at lower noise exposures than adults with normal hearing. Until the brain matures in the late teen years, infants and children are more vulnerable to moderate and loud noise damage. Moderate noise exposures too low to cause NIHL can cause auditory brain changes linked to tinnitus, hyperacusis, and hidden hearing loss.

Humans haven't always suffered noise-induced health damage. Populations with limited exposure to modern-day noise maintained good hearing into their older years, as found among the Maabans in the Sudan.[3] Common moderate-to-loud sounds among the Maabans included spoken conversations, weather sounds like heavy rain, noise from wooden tools used to harvest crops, and livestock bleating. The loudest sounds were emitted from humans shouting, babies crying, roosters crowing, or thunder clapping. High-level sound was recorded among younger Maabans engaged in entertainment, which included singing, playing a five-string lyre, and drumming on logs with sticks; they too retained good hearing, even after age 70. This is in stark

contrast to modern society, where hearing loss in older adults is too often wrongly blamed on "age" instead of a lifetime of widespread exposure to harmful noise.[4]

When I started out as an audiologist in the 1980s, NIHL was common in adults exposed to loud noise from military service, work environment, hobbies, and/or entertainment. NIHL in children and teens was rare. I mainly saw it in hunters.

Now exposure to loud noise begins early in life and adds up faster with each passing year. Manufactured and amplified noise sources identified almost 50 years ago are still too loud today, including vacuums, blenders, gas-powered lawn mowers, subways, road vehicles, and air traffic noise.[5] We go to loud restaurants, wedding receptions, and sports events, usually without considering the auditory risk. Movie theaters set sound systems to unhealthy volumes, even for musicals and animated movies rated for younger audiences. Music is dangerously amplified at bars, nightclubs, and concerts. Noise exposure in everyday life is great enough to cause hearing loss among the public, not just in those with occupational noise exposure.[1]

Of all the modern-day sources of sound, personal listening systems have had the worst impact on public health.[6] Keep in mind that the volume of sound from earbuds or headphones can be as loud as a rock concert. Nowadays, children as young as 3 years old can be seen wearing personal listening devices. Children between the ages of 9 and 11 who frequently use earbuds and headphones are developing characteristic NIHL, with up to 69 percent of children, teens, and young adults who used personal listening systems for music reporting auditory problems, including tinnitus and hyperacusis.[7] Even with no NIHL, children listening at an approximate 50 percent volume setting for about an hour at a time are more likely to have tinnitus than nonusers.[8] Eighteen to 25 year olds who reported listening at high volume said they had trouble understanding conversations at family dinners.[9] The World Health Organization (WHO) now estimates that about 50 percent of children, teens, and young adults are at risk of NIHL from personal listening alone, which accounts for more than 80 million 12 to 35 years olds living in the U.S.[6,7] Just imagine the reaction if their ears bled from noise injury.

Preventable noise-induced auditory problems carry high educational, social, economic, and healthcare costs. The WHO reports that hearing loss alone costs the global economy $750 billion each year.[8] Early hearing loss—even mild—is linked to learning problems, social isolation, and poor mental health. People with tinnitus and hyperacusis are more likely to have anxiety, depression, and suicidal thoughts.[9] Hearing loss and problems understanding speech-in-noise are each linked to a higher risk of developing dementia or Alzheimer's.[10,11]

Individual impact is harder to measure. As an audiologist, my noise-exposed adult patients were often in tears. They longed for the time when music sounded good, when birds could be heard chirping, when tinnitus wasn't a constant part of the backdrop. It took too much effort to understand conversations, or it was too loud for comfort, so they isolated themselves socially. There were lots of communication breakdowns. One patient shared the embarrassment of buying red thread instead of the French bread that was asked for. Another confessed that he lost a friend by pretending to understand; "That's nice," he said, when his friend shared that his wife had died. I've always lived with hyperacusis and developed tinnitus following head trauma from a car accident. I wouldn't wish them on my worst enemy, let alone a child or a teen.

Besides auditory damage, my colleague Dr. Fink points out that there are thousands of studies that show the damage of loud noise to our health, including preventable stress, disrupted sleep, cardiovascular disease, and early death. He likens the current noise-induced health crisis to the health crisis caused by chemical pollution, like pesticides and herbicides, that Rachel Carson wrote about 60 years ago in *Silent Spring*.[12]

Why is noise any different? Imagine today's noise-exposed young people needing healthcare for tomorrow's auditory, mental, cognitive, and physical health problems. These are often avoidable cases and costs.

Under the Clean Air Act of 1970 and later Quiet Communities Act, the EPA established an Office of Noise Abatement and Control. Responsibilities included education, setting noise emission standards, and assisting local and state authorities with efforts as needed. Federal funding was cut in 1982, following attempts to regulate garbage truck noise emissions.[13] Since then, sources of noise have largely gone unchecked,

and we are peppered with harmful noise exposures as a common part of daily living.

Today, most people are unaware of auditory health risks from moderately loud noise exposure. Use of earplugs or earmuffs when engaged in noisy hobbies or entertainment isn't the norm. Governments are planning "zero emission" solutions for climate change, like expanded public transit systems, while ignoring current noise emissions hurting public health, especially sensitive populations like children. I've measured harmful sound levels from traffic and landscaping equipment in my community and have found electric leaf blowers advertised as "quiet" that are still dangerously loud. Manufacturers falsely advertise 85 dB sound-limiting headphones as "safe" for children. New noise sources like commercial delivery drones are likely proposed without thought for public health.

We need designated quiet zones for homes, schools, and public spaces. Protective noise limits are critical for environmental sources like appliances, power tools, and public transit. Signs could warn the public about loud venues like concerts or stadium events where hearing protection is necessary. Some venues, such as restaurants or movies rated for children, could turn down the volume. Personal audio systems are so high risk that noise control may never make them completely safe. Prevention approaches include restricting use of personal listening devices in childhood, safer listening habits, and output limit standards.

The WHO estimates public health interventions for hearing loss, including noise prevention and control, result in economic and healthcare benefits or savings of $7 to $15 for every $1 invested.[8] Yet there is little public or political support to solve the noise-induced public health crisis. Skopos Labs at govtrack.us predicts a 1 percent chance that the U.S. Senate will pass the Quiet Communities Act of 2021–2022 to fund the EPA Office of Noise Abatement and Control again.[14] Without government-mandated action plans and noise reduction targets, there is no reason to expect safer soundscapes in our future.

Maya Angelou said, "When you know better, do better." We know rising noise levels from old and new sources have caused the current public health crisis. We know NIHL and tinnitus are becoming insidious childhood disorders with lifelong negative consequences. Noise control measures are effective and urgently needed to save our hearing health. Without bleeding ears, will we ever start protecting current and future generations from harmful noise?

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