NIDCD Fact Sheet

Noise-Induced Hearing Loss

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES · NATIONAL INSTITUTES OF HEALTH · NATIONAL INSTITUTE ON DEAFNESS AND OTHER COMMUNICATION DISORDERS

What is noise-induced hearing loss?

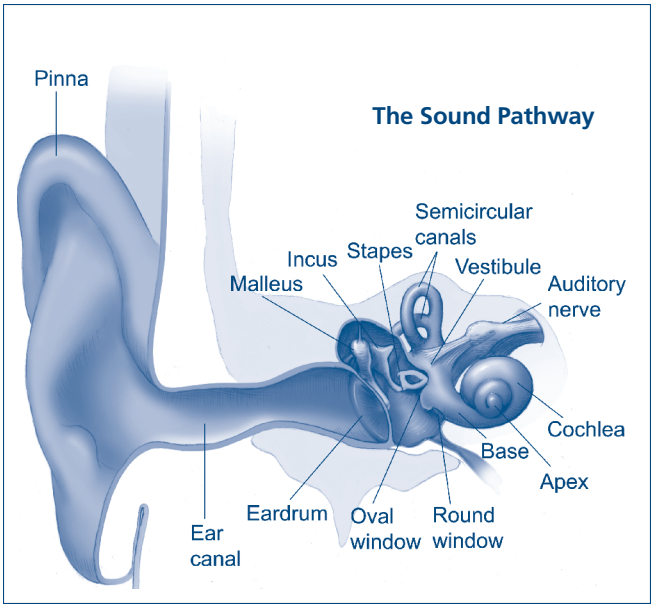
Every day, we experience sound in our environment, such as the sounds from television and radio, household appliances, and traffic. Normally, we hear these sounds at safe levels that do not affect our hearing. However, when we are exposed to harmful noise—sounds that are too loud or loud sounds that last a long time—sensitive structures in our inner ear can be damaged, causing noise-induced hearing loss (NIHL). These sensitive structures, called hair cells, are small sensory cells in the inner ear that convert sound energy into electrical signals that travel to the brain. Once damaged, our hair cells cannot grow back.

Scientists once believed that the pure force of vibrations from loud sounds caused the damage to hair cells. Instead, recent studies have shown that exposure to harmful noise triggers the formation of molecules inside the ear that can damage or kill hair cells.

What sounds cause NIHL?

NIHL can be caused by a one-time exposure to an intense "impulse" sound, such as an explosion, or by continuous exposure to loud sounds over an extended period of time, such as noise generated in a wood-working shop.

The loudness of sound is measured in units called decibels. For example, the humming of a refrigerator is 40 decibels, normal conversation is approximately 60 decibels, and city traffic noise can be 85 decibels. Sources of noise that can cause NIHL include motor-



NIH Medical Arts

cycles, firecrackers, and small firearms, all emitting sounds from 120 to 150 decibels. Long or repeated exposure to sounds at or above 85 decibels can cause hearing loss. The louder the sound, the shorter the time period before NIHL can occur. Sounds of less than 75 decibels, even after long exposure, are unlikely to cause hearing loss.

Although being aware of decibel levels is an important factor in protecting one's hearing, distance from the source of the sound and duration of exposure to the sound are equally important. A good rule of thumb is to avoid noises that are "too loud" and "too close" or that last "too long."

What are the effects of NIHL?

Exposure to harmful sounds causes damage to the hair cells as well as the auditory, or hearing, nerve (see figure).

NIDCD National Institute on Deafness and Other Communication Disorders
Improving the lives of people who have communication disorders

NIDCD Fact Sheet

Noise-Induced Hearing Loss

Impulse sound can result in immediate hearing loss that may be permanent. This kind of hearing loss may be accompanied by tinnitus—a ringing, buzzing, or roaring in the ears or head—which may subside over time. Hearing loss and tinnitus may be experienced in one or both ears, and tinnitus may continue constantly or occasionally throughout a lifetime.

Continuous exposure to loud noise also can damage the structure of hair cells, resulting in hearing loss and tinnitus, although the process occurs more gradually than for impulse noise.

Exposure to impulse and continuous noise may cause only a temporary hearing loss. If a person regains hearing, the temporary hearing loss is called a temporary threshold shift. The temporary threshold shift largely disappears 16 to 48 hours after exposure to loud noise. You can prevent NIHL from both impulse and continuous noise by regularly using hearing protectors such as earplugs or earmuffs.

What are the symptoms of NIHL?

When a person is exposed to loud noise over a long period of time, symptoms of NIHL will increase gradually. Over time, the sounds a person hears may become distorted or muffled, and it may be difficult for the person to understand speech. Someone with NIHL may not even be aware of the loss, but it can be detected with a hearing test.

Who is affected by NIHL?

People of all ages, including children, teens, young adults, and older people, can develop NIHL. Approximately ten percent of Americans between ages 20 and 69—or 22 million Americans— already may have suffered permanent damage to their hearing from excessive noise exposure. Exposure occurs in the workplace, in recreational settings, and at home. Recreational activities that can put someone at risk for NIHL include target shooting and hunting, snowmobile riding, woodworking and other hobbies, playing in a band, and attending rock concerts. Harmful noises at home may come from lawnmowers, leafblowers, and shop tools.

Can NIHL be prevented?

NIHL is 100 percent preventable. All individuals should understand the hazards of noise and how to practice good hearing health in everyday life. To protect your hearing:

- Know which noises can cause damage (those at or above 85 decibels).
- Wear earplugs or other hearing protective devices when involved in a loud activity (special earplugs and earmuffs are available at hardware and sporting goods stores).
- Be alert to hazardous noise in the environment.
- Protect the ears of children who are too young to protect their own.
- Make family, friends, and colleagues aware of the hazards of noise.
- If you suspect hearing loss, have a medical examination by an otolaryngologist (a physician who specializes in diseases of the ears, nose, throat, head, and neck) and a hearing test by an audiologist (a health professional trained to measure and help individuals deal with hearing loss).

What research about NIHL is being conducted?

The National Institute on Deafness and Other Communication Disorders (NIDCD) researches the causes, diagnosis, treatment, and prevention of hearing loss. Most hearing loss is caused by damaged hair cells, which do not grow back in humans and other mammals. NIDCD-supported researchers have

helped to identify some of the many genes important for ear development and hearing. One gene has been found to regrow hair cells in guinea pigs. More important, the treated animals were able to regain some of their lost hearing. This experiment is the first successful demonstration of gene therapy that improves hearing in formerly deaf animals. Scientists hope to one day use this type of gene therapy to restore hearing in humans.

NIDCD researchers also are investigating a potential way to prevent NIHL after noise exposure. Noise exposure triggers the formation of destructive molecules, called free radicals, that cause hair cell death. Researchers initially had thought that antioxidants, chemicals that protect against cell damage from free radicals, might prevent NIHL only if the antioxidants were given before noise exposure. In a recent study, however, the antioxidants in salicylate (aspirin) and Trolox (vitamin E) were given to guinea pigs as long as three days after noise exposure and still significantly reduced hearing loss. These results suggest that there is a window of opportunity in which it is possible to rescue hearing from noise trauma. Scientists hope to begin clinical trials with humans with the goal of reducing NIHL.

more →

How We Hear

Hearing depends on a series of events that change sound waves in the air into electrical signals that the auditory nerve carries to the brain.

- Sound waves enter the outer ear and travel through a narrow passageway called the ear canal, which leads to the eardrum.
- The eardrum vibrates from the incoming sound waves and sends these vibrations to three tiny bones in the middle ear. These bones are called the malleus, incus, and stapes.
- The bones in the middle ear amplify, or increase, the sound and send the vibrations to the snail-shaped cochlea, or inner ear. The cochlea is a fluid-filled organ with an elastic membrane that runs down its length and divides the cochlea into an upper and lower part. This membrane is called the "basilar" membrane because it serves as the base, or ground floor, on which key hearing structures sit.
- The vibrations cause the fluid inside the cochlea to ripple, and a traveling wave forms along the basilar membrane. Hair cells—sensory cells sitting on top of the membrane—"ride the wave." This motion causes bristly structures on top of the hair cells to bump up against an overlying membrane and deflect to one side.
- As the bristles, or stereocilia, move, pore-like channels on their surface open up. This allows certain chemicals to rush in that generate an electrical signal.
- The auditory nerve carries the signal to the brain, which translates it into a "sound" that we recognize and understand.
- Hair cells near the base of the cochlea detect higher-pitched sounds, such as a cell phone ringing. Those nearer the apex, or centermost point, detect lower-pitched sounds, such as a large dog barking.

Hair Cells in the Inner Ear

NIDCD supports and conducts research and research training on the normal and disordered processes of hearing, balance, smell, taste, voice, speech, and language and provides health information, based upon scientific discovery, to the public.

Where can I get more information?

NIDCD maintains a directory of organizations that can answer questions and provide printed or electronic information on NIHL. Please see the list of organizations at *www.nidcd.nih.gov/directory*.

Use the following keywords to help you search for organizations that are relevant to NIHL:

- Noise-induced hearing loss
- Hard-of-hearing

For more information, additional addresses and phone numbers, or a printed list of organizations, contact:

NIDCD Information Clearinghouse
1 Communication Avenue
Bethesda, MD 20892-3456
Toll-free Voice: (800) 241-1044
Toll-free TTY: (800) 241-1055
Fax: (301) 770-8977
E-mail: nidcdinfo@nidcd.nih.gov

NIDCD Fact Sheet: Noise-Induced Hearing Loss
NIH Publication No. 97-4233
Updated April 2007

For more information, contact:
NIDCD Information Clearinghouse
1 Communication Avenue
Bethesda, MD 20892-3456
Toll-free Voice: (800) 241-1044
Toll-free TTY: (800) 241-1055
Fax: (301) 770-8977
E-mail: nidcdinfo@nidcd.nih.gov
Internet: www.nidcd.nih.gov

The NIDCD Information Clearinghouse is a service of the National Institute on Deafness and Other Communication Disorders, National Institutes of Health, U.S. Department of Health and Human Services.