

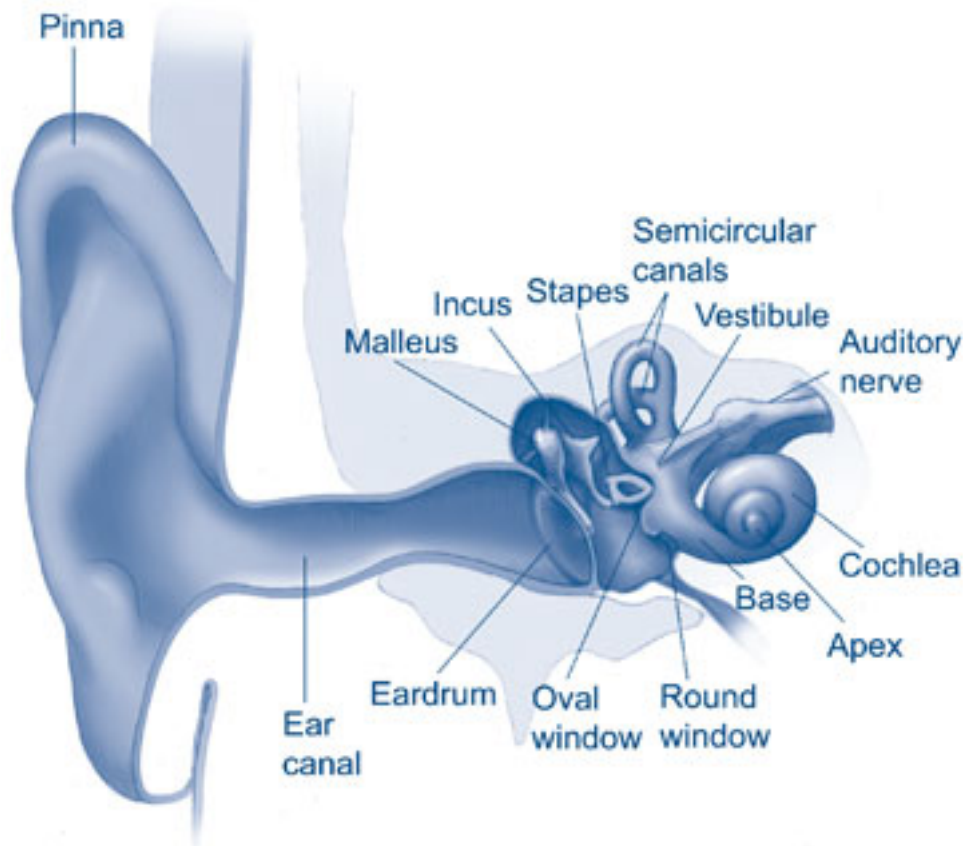
Noise-Induced Hearing Loss

This e-book will answer the following questions:

- What is noise-induced hearing loss?
- What sounds cause NIHL?
- What are the effects of NIHL?
- What are the symptoms of NIHL?
- Who is affected by NIHL?
- Can NIHL be prevented?
- How do we hear?
- What research is being done for NIHL?

Noise-Induced Hearing Loss

What is noise-induced hearing loss?



The sound pathway

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 that convert sound energy into electrical signals that travel to the brain. Once damaged, our hair cells cannot grow back.

Noise-Induced Hearing Loss

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 woodworking shop.

Sound is measured in units called decibels. On the decibel scale, an increase of 10 means that a sound is 10 times more intense, or powerful. To your ears, it sounds twice as loud. The humming of a refrigerator is 45 decibels, normal conversation is approximately 60 decibels, and the noise from heavy city traffic can reach 85 decibels. Sources of noise that can cause NIHL include motorcycles, 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). 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.

Noise-Induced Hearing Loss

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.

Scientists believe that, depending on the type of noise, the pure force of vibrations from the noise can cause hearing loss. Recent studies also show that exposure to harmful noise levels triggers the formation of molecules inside the ear that damage hair cells and result in NIHL. These destructive molecules play an important role in hearing loss in children and adults who listen to loud noise for too long.

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 15 percent of Americans between the ages of 20 and 69—or 26 million Americans—have high frequency hearing loss that may have been caused by exposure to loud sounds or noise at work or in leisure activities. 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, leaf blowers, and shop tools.

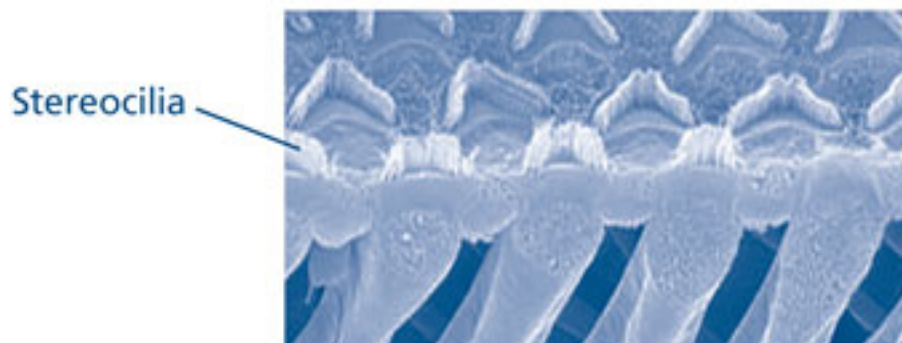
Noise-Induced Hearing Loss

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).

How do we hear?



Hair cells in the inner ear

Noise-Induced Hearing Loss

Hearing depends on a series of events that change sound waves in the air into electrical signals. Our auditory nerve then carries these signals to the brain through a complex series of steps.

- 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 vibrations and send them to the inner ear—also called the cochlea—which is shaped like a snail and is filled with fluid. An elastic membrane runs from the beginning to the end of the cochlea, splitting it 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 sound 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.”
- As the hair cells move up and down, their bristly structures bump up against an overlying membrane and tilt to one side. This tilting action causes pore-like channels, which are on the surface of the bristles, to open up. When that happens, certain chemicals rush in, creating an electrical signal.
- The auditory nerve carries this electrical 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.

What research about NIHL is being conducted?

The National Institute on Deafness and Other Communication Disorders (NIDCD) researches the causes, diagnosis, treatment, and

Noise-Induced Hearing Loss

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; they have also been studying the possibility of using gene therapy to regrow hair cells in mammals.

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, which 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. NIDCD-funded researchers are now testing the ability of nutrients, such as vitamins and minerals, to prevent NIHL in military personnel and college students.