A TERM PAPER ON

NOISE - INDUCED HEARING DAMAGE

BY

ARC – 01 – 9208            AKOSILE    Adetona Olaolu
ARC – 01 – 9225            IYAMORE    ‘Rotimi Godwin
ARC – 01 – 9242            OLUWAYOMI    ‘Seyi    ‘Tope

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY IN ARCHITECTURE

TO

THE DEPARTMENT OF ARCHITECTURE
SCHOOL OF ENVIRONMENTAL TECHNOLOGY
FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

COURSE LECTURER:  PROFESSOR OLU OLA OGUNSOTE

APRIL 2007
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>1</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>WHAT IS NOISE INDUCED HEARING LOSS?</td>
<td>2</td>
</tr>
<tr>
<td>Noise Exposure</td>
<td>3</td>
</tr>
<tr>
<td>Sound intensity</td>
<td>3</td>
</tr>
<tr>
<td>Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>Pathophysiology</td>
<td>4</td>
</tr>
<tr>
<td>How Do We Hear?</td>
<td>4</td>
</tr>
<tr>
<td>SOUNDS THAT CAUSES NIHL</td>
<td>5</td>
</tr>
<tr>
<td>How loud can a sound get before it affects hearing?</td>
<td>5</td>
</tr>
<tr>
<td>Who is affected by NIHL?</td>
<td>5</td>
</tr>
<tr>
<td>How can a person tell if a noisy situation is dangerous to their hearing?</td>
<td>5</td>
</tr>
<tr>
<td>WORK-RELATED HEARING LOSS</td>
<td>7</td>
</tr>
<tr>
<td>Magnitude</td>
<td>7</td>
</tr>
<tr>
<td>Costs</td>
<td>7</td>
</tr>
<tr>
<td>Regulations regarding on-the-job exposure to noise</td>
<td>8</td>
</tr>
<tr>
<td>EFFECTS OF NIHL</td>
<td>9</td>
</tr>
<tr>
<td>TINNITUS</td>
<td>9</td>
</tr>
<tr>
<td>ACOUSTIC TRAUMA</td>
<td>9</td>
</tr>
<tr>
<td>TEMPORARY THRESHOLD SHIFT (TTS)</td>
<td>10</td>
</tr>
<tr>
<td>PERMANENT THRESHOLD SHIFT (PTS)</td>
<td>10</td>
</tr>
<tr>
<td>OTHER ADVERSE EFFECT OF NOISE</td>
<td>10</td>
</tr>
<tr>
<td>What factors increase a person's susceptibility to noise induced hearing loss?</td>
<td>11</td>
</tr>
<tr>
<td>Do the duration and closeness of exposure to loud noise relate to hearing damage?</td>
<td>11</td>
</tr>
<tr>
<td>The Symptoms of NIHL</td>
<td>11</td>
</tr>
<tr>
<td>PREVENTION OF NIHL</td>
<td>12</td>
</tr>
<tr>
<td>What Research is being done on NIHL?</td>
<td>12</td>
</tr>
<tr>
<td>Otoprotective Agents Sought for Noise-Induced Hearing Loss</td>
<td>12</td>
</tr>
<tr>
<td>CONCLUSION</td>
<td>13</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>13</td>
</tr>
</tbody>
</table>
ABSTRACT

People at special risk of hearing damage are usually those in heavy productive industry, such as metal work, drilling and quarrying, stone cutting, or the use of noisy machinery, as in textiles, printing, wood cutting, transportation and agriculture. Noises above 90 dB, as measured with special instruments that are electronically weighted to mimic loudness functions of the human ear, are likely to cause damage to a proportion of the exposed population with continued exposure. Very high levels may cause damage after relatively short periods, even when the noise is intermittent. This may be illustrated by the frequent finding of hearing loss in people who have fired guns as an occasional hobby, as well as in people who are exposed to noise of lower levels but more constantly, such as those working on construction sites or in other industrial locations such as mines.

The harmful effects of noise are cumulative and not, confined to the workplace. The use of personal stereos and frequenting of discos has resulted in young people having some early damage to hearing before they even start work.

Thus, there is a need for individual and authorities to take a critical look into the preventive solutions to the hearing damages caused by noise so as to reduce the problem of hearing losses. It is also important to note that the term Noise induced hearing damage is the same as noise induced hearing loss.

INTRODUCTION

Hearing loss caused by exposure to recreational and occupational noise results in devastating disability that is virtually 100 percent preventable. Noise-induced hearing loss is the second most common form of sensorineural hearing deficit, after presbyacusis (age-related hearing loss). Shearing forces caused by any sound have an impact on the stereocilia of the hair cells of the basilar membrane of the cochlea; when excessive, these forces can cause cell death. Avoiding noise exposure stops further progression of the damage. Noise-induced hearing loss can be prevented by avoiding excessive noise and using hearing protection such as earplugs and earmuffs. Patients who have been exposed to excessive noise should be screened. When hearing loss is suspected, a thorough history, physical examination and audiometry should be performed. If these examinations disclose evidence of hearing loss, referral for full audiolologic evaluation is recommended.
WHAT IS NOISE INDUCED HEARING LOSS?

Everyday we experience sound in our outdoor and indoor environments: the television, radio, washing machine, automobiles, buses, trucks, airplanes, trains, car alarms, motorcycles, lawn mowers, chain saws, construction equipment, and ventilator systems. Noise pollution is a growing problem in the world today, one that has immediate and cumulative adverse effects on health. When an individual is exposed to harmful sounds -- sounds that are too loud, or loud sounds over a period of long time -- sensitive structures of the inner ear can be damaged, causing Noise-Induced Hearing Loss (NIHL).

Noise-induced hearing loss is a sensorineural hearing deficit that begins at the higher frequencies (3,000 to 6,000 Hz) and develops gradually as a result of chronic exposure to excessive sound levels. Although the loss is typically symmetric, noise from such sources as firearms or sirens may produce an asymmetric loss. Acoustic trauma, a related condition, results from an acute exposure to short-term impulsive noise.

Noise Exposure

Noise is perhaps the most common occupational and environmental hazard. Several Nigerians are exposed to potentially harmful sound levels in their workplaces. Outside of work, many persons pursue recreational activities that can produce harmful noise. Some people own firearms, and many use them without adequate hearing protection. Other non occupational sources of noise include chain saws and other power tools, amplified music, and recreational vehicles such as cable cars and motorcycles. Some types of toys for children can produce sounds capable of causing permanent hearing damage.

Noise can be described in terms of intensity (perceived as loudness) and frequency (perceived as pitch). Both the intensity and the duration of noise exposure determine the potential for damage to the hair cells of the inner ear. Even sounds perceived as "comfortably" loud can be harmful.

Sound intensity

Sound intensity is measured as Sound Pressure Level (SPL) in a logarithmic decibel (dB) scale. Noise exposure measurements are often expressed as dB (A): a scale weighted toward sounds at higher frequencies, to which the human ear is more sensitive. Noise can cause permanent hearing loss at chronic exposures equal to an average SPL of 85 dB (A) or higher for an eight-hour period. Based on the logarithmic scale, a 3-dB increase in SPL represents a doubling of the sound intensity. Therefore, four hours of noise exposure at 88 dB(A) is considered to provide the same noise "dose" as eight hours at 85 dB(A), and a single gunshot, which is approximately 140 to 170 dB(A), has the same sound energy as 40 hours of 90-dB(A) noise.

Epidemiology

Noise-induced hearing loss is the second most common sensorineural hearing loss, after age-related hearing loss (presbyacusis). Of the more than 28 million Americans with some degree of hearing impairment, as many as 10 million have hearing loss caused in part by excessive
noise exposure in the workplace or during recreational activities. The economic costs of occupational hearing loss have been estimated to be in the billions of dollars. Noise-induced hearing loss has been well recognized since the industrial revolution. An early term for the condition was "boilermakers' disease," because so many workers who made steam boilers developed hearing loss. In today's noisy society, even children and young adults are at risk. A recent study found evidence of high-frequency hearing loss in nearly one third of a cohort of college students.

Pathophysiology

To be perceived, sounds must exert a shearing force on the stereocilia of the hair cells lining the basilar membrane of the cochlea. When excessive, this force can lead to cellular metabolic overload, cell damage and cell death. Noise-induced hearing loss therefore represents excessive "wear and tear" on the delicate inner ear structures. Concurrent exposure to ototoxic substances, such as solvents and heavy metals, may increase the damage potential of noise. Once exposure to damaging noise levels is discontinued, further significant progression of hearing loss stops. Individual susceptibility to noise-induced hearing loss varies greatly, but the reason that some persons are more resistant to it while others are more susceptible is not well understood.

How Do We Hear?

Hearing is a series of events in which sound waves in the air produce electrical signals and cause nerve impulses to be sent to the brain where they are interpreted as sound. The ear has three main parts: the outer, middle and inner ear. Sound waves enter through the outer ear and reach the middle ear where they cause the ear drum to vibrate.

The vibrations are transmitted through three tiny bones in the middle ear, called the ossicles. The ear drum and ossicles amplify the vibrations and carry them to the inner ear. The vibrations move through fluid in the snail-shaped hearing part of the inner ear (cochlea) that contains the hair cells. The fluid in the cochlea moves the top portion of the hair cells, called the hair bundle, which initiates the changes that lead to the production of the nerve impulses. These nerve impulses are carried to the brain where they are interpreted as sound. Different sounds move to the population of hair cells in different ways, thus allowing the brain to distinguish among various sounds, for example, different vowel and consonant sounds.

Structure of the EAR

![Structure of the EAR](image)
NIHL can be caused by a one-time exposure to loud sound, as well as by repeated exposure to sounds at various loudness levels over an extended period of time. The loudness of sound is measured in units called decibels. For example, usual conversation is approximately 60 decibels, the humming of a refrigerator is 40 decibels and city traffic noise can be 80 decibels. Examples of sources of loud noises that cause NIHL are motorcycles, firecrackers and small arms fire, all emitting sounds from 120 decibels to 140 decibels. Sounds of less than 75 decibels, even after long exposure, are unlikely to cause hearing loss.

How loud can a sound get before it affects hearing?

Many experts agree that continual exposure to more than 85 decibels (dB) may be dangerous to the ears. As already mentioned, the decibel is a measure of the intensity of sound. The faintest sound the human ear can detect is labeled 0 dB, whereas the noise at a rocket pad during launch approaches 180 dB. A quite whisper is approximately 30 dB, normal conversation is 60 dB, and a lawnmower is 90 dB. Decibels are measured logarithmically, which means that the sound energy of noise increases by units of 10. Therefore, a dB increase of a sound from 20 to 30 dB is an increase of 10 times, and a dB increase of a sound from 20 to 40 dB is an increase of 100 times (10 times 10).

How loud is too loud?

110 decibels: regular exposure of more than 1 minute risks permanent hearing loss.
100 decibels: no more than 15 minutes unprotected exposure recommended.
90 decibels: prolonged exposure to any noise above 90 decibels can cause gradual hearing loss.

NB To avoid hearing loss from impulse noise exposure, never expose a child to a sound above 120 decibels.

### Common Sources of Noise

<table>
<thead>
<tr>
<th>Sound</th>
<th>Loudness (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gunshot (peak level)</td>
<td>140 to 170</td>
</tr>
<tr>
<td>Jet takeoff</td>
<td>140</td>
</tr>
<tr>
<td>Rock concert, chain saw</td>
<td>110 to 120</td>
</tr>
<tr>
<td>Diesel locomotive, stereo</td>
<td>110 to 120</td>
</tr>
<tr>
<td>Motorcycle, lawnmower</td>
<td>90</td>
</tr>
<tr>
<td>OSHA level for hearing</td>
<td>85* (8-hour time-conservation program weighted average)</td>
</tr>
<tr>
<td>Conversation</td>
<td>60</td>
</tr>
<tr>
<td>Quiet room</td>
<td>50</td>
</tr>
<tr>
<td>Whisper</td>
<td>30 to 40</td>
</tr>
</tbody>
</table>

OSHA = Occupational Safety and Health Administration; dB = decibels.
*--Measurement expressed as dB(A), a scale weighted toward sounds at higher frequencies.
Who is affected by NIHL?

NIHL is the most common irreversible occupational hazard in the world. The World Health Organization estimates that 120 million people worldwide have disabling hearing difficulties. An alarming population of Nigerians is exposed to hazardous sound levels on a regular basis. Individuals of all ages can develop NIHL. Harmful noise exposure occurs in the work place, but also in recreational settings and at home. There is an increasing awareness of the harmful noises in recreational activities, for example, target shooting or hunting, snowmobiles, go-carts, woodworking and other hobby equipment, power horns, cap guns and model airplanes. Harmful noises at home may come from vacuum cleaners, garbage disposals, lawn mowers, leaf blowers and shop tools. People who live in either urban or rural settings may be exposed to noisy devices on a daily basis.

How can a person tell if a noisy situation is dangerous to their hearing?

People may differ in their sensitivity to noise. Nevertheless, as a general rule, noise is probably damaging to the hearing if the noise:

- Makes it necessary to shout to be heard over the background noise
- Causes ear pain
- Makes the ears ring
- Causes a loss of hearing for several hours or more after exposure

Examples of causes of noise and their various intensities

In contrast to popular belief, there is no truth to the idea that a person is able to “toughen up” the ears by frequent exposure to loud noise. In reality, cumulative noise in the past has probably damaged the ears to such a degree that a person doesn’t hear the noise as much. Unfortunately, no treatment is available for noise induced hearing loss once the damage has occurred.
Work-related hearing loss continues to be a critical workplace safety and health issue. The National Institute for Occupational Safety and Health (NIOSH) and the occupational safety and health community named hearing loss one of the 21 priority areas for research in the next century. Noise-induced hearing loss is 100 percent preventable but once acquired, hearing loss is permanent and irreversible. Therefore, prevention measures must be taken by employers and workers to ensure the protection of workers' hearing.

**Magnitude**

Approximately 30 million workers are exposed to hazardous noise on the job and an additional nine million are at risk for hearing loss from other agents such as solvents and metals.

Noise-induced hearing loss is one of the most common occupational diseases and the second most self-reported occupational illness or injury. Industry specific studies reveal:

- 44% of carpenters and 48% of plumbers reported that they have perceived hearing loss.
- 49% of male, metal, non-metal miners will have a hearing impairment by age 50 (vs. 9% of the general population) rising to 70% by age 60.

While any worker can be at risk for noise-induced hearing loss in the workplace, workers in many industries have higher exposures to dangerous levels of noise. Industries with high numbers of exposed workers include: agriculture; mining; construction; manufacturing and utilities; transportation; and military.

**Costs**

There is no national surveillance or injury reporting system for hearing loss. As such, comprehensive data on the economic impact of hearing loss are not available. The following localized examples provide an indication of the broader economic burden.

In Washington State, workers' compensation disability settlements for hearing-related conditions cost $4.8 million in 1991 (not including medical costs). When applied to the national workforce, occupational hearing loss costs an estimated $242.4 million per year in disability alone.

This figure does not include medical costs or personal costs which can include approximately $1500 for a hearing aid and around $300 per year for batteries. Moreover, workers' compensation data is an underestimate of the true frequency of occupational illness, representing only the tip of the iceberg.

In British Columbia, in the five-year period from 1994 to 1998, the workers' compensation board paid $18 million in permanent disability awards to 3,207 workers suffering from hearing loss. An additional $36 million was paid out for hearing aids.
Through their hearing conservation program, the U.S. Army saved about $504.3 million by reducing hearing loss among combat arms personnel between 1974 and 1994. The Department of Veterans saved $220.8 million and the Army and additional $149 million by reducing civilian hearing loss between 1987 and 1997.

**Regulations regarding on-the-job exposure to noise**

Habitual exposure to noise above 85dB will cause a gradual hearing loss in a significant number of individuals. Moreover, noise greater than 85dB will accelerate this damage. Accordingly, the Occupational Safety and Health Administration (OSHA) has imposed regulations nationwide regarding on-the-job exposure to noise. For unprotected ears, the allowed exposure time decreases by one half for each 5 dB increase in the average noise level. For instance, exposure is limited to 8 hours at 90 dB, 4 hr at 95 dB, and 2 hr at 100 dB. The highest permissible noise exposure for the unprotected ear is 115 dB for 15 minutes per day. Any noise above 140 dB is not permitted.

OSHA, in its Hearing Conservation Amendment of 1983, required the institution of a hearing conservation program in noisy workplaces. Such a program must include a yearly hearing test for workers exposed to an average of 85 dB or more of noise during their 8-hour workday. It turns out that approximately 25% of the American industrial workforce is exposed to this much noise.

Ideally, noisy machinery and work places should be designed to be quieter and/or the workers' time in the noise should be reduced. The cost of reducing noise exposure in these ways, however, is often prohibitive. As an alternative, individual hearing protectors are required when noise averages more than 90 dB during an 8-hour day.

When noise measurements indicate that hearing protectors are needed, the employer must offer at least one type of earplug and one type of earmuff without cost to employees. If the yearly hearing test reveals a hearing loss of 10 dB or more in the higher sound frequencies (pitch) in either ear, the worker must be informed. (The higher frequencies of sound are the most sensitive to noise damage.) Also, the worker must wear hearing protectors when noise averages more than 85 dB for an 8-hour day. Greater losses of hearing or the possibility of ear disease necessitates referral to an ear doctor (Otolaryngologist).
The effect from impulse sound can be instantaneous and can result in an immediate hearing loss that may be permanent. The structures of the inner ear may be severely damaged.

The damage that occurs slowly over years of continuous exposure to loud noise is accompanied by various changes in the structure of the hair cells. It can also result in hearing loss and tinnitus as would be discussed. Exposure to impulse and continuous noise may cause only a temporary hearing loss.

The following are four ways in which noise can affect hearing:

**TINNITUS:** *Ringing, buzzing or roaring in the ears or head -- which may subside over time.*

Tinnitus is the term given to noises which are heard “in the ears” or “in the head” which do not come from an external source.
Tinnitus may be experienced in one or both ears, and may continue or intermittently throughout a lifetime.

After exposure to noise, tinnitus, which is a ringing or another sound in the ears, occurs commonly. The tinnitus is a sign that inner ear damage or nerve destruction has occurred. Initially the tinnitus will just be temporary, lasting only several hours. As more cumulative exposure and damage occur, the tinnitus will last longer until eventually it will become permanent.

Although research into the causes of tinnitus is ongoing, the current theory is that damage to the hair cells of the inner ear (from noise or other agents) causes the generation of weak, abnormal nerve impulses, which are mistakenly perceived by the brain as real external sounds.
These weak signals are amplified to a disturbing level in the neural pathways that connect the cochlea to the different parts of the brain. This process seems to be made worse by stress or emotional events, which may explain why tinnitus is twice as common in hearing impaired people - straining to hear focuses the subconscious brain to pick up anything coming from the inner ear.

**ACOUSTIC TRAUMA**

Hearing loss produced by a sudden and very loud noise (blast injury) is called acute acoustic trauma.

Acoustic trauma occurs when any excessive sound energy strikes the inner ear.

It can be defined as damage to the ear resulting from a single exposure or relatively few exposures to a very intense level of sound (peak levels greater than 140-150 dB). And it is usually impulsive in nature.

If the sound is loud enough, it can cause the eardrum to rupture or the person to have a complete loss of hearing. Sometimes, particularly if the sudden loss is total and combined with dizziness, immediate surgical exploration of the ear may be necessary. In this circumstance, the ear surgeon may need to locate and patch a hole (perilymphatic fistula) between the inner ear fluid space and the middle ear space.
From the effect of a single exposure or relatively few exposures to a very intense level of sound, Acoustic Trauma may cause one or more of the following damages:

- Damage to ear drum
- Damage to the Ossicles, and
- Mechanical damage to the hair cells, supporting cells and tissues of the organ of corti.

**TEMPORARY THRESHOLD SHIFT (TTS)**

This can be defined as a temporary change in hearing level that recovers between exposures, resulting from sound levels over about 70 to 75 dB(A). This may last depending on the nature of the exposure and the individual, for minutes, hours, or days, after the sound has stopped.

If it is brief, the noise may cause a reversible, temporary auditory fatigue, technically known as a temporary threshold shift. For example, after a loud rock concert, it is common to experience hearing dullness and ringing for several hours. In this situation, if symptoms persist beyond several days, oral steroids (cortisone-type medications) may help the inner ear recover.

If the hearing however recovers as earlier stated, this temporary hearing loss is what is known as temporary threshold shift. The temporary threshold shift largely disappears within 16 hours after exposure to loud noise. This form of NIHL can be prevented by the regular use of hearing protectors such as ear plugs or ear muffs.

**NB** As long as the intervals between exposures are long enough for complete recovery, it is unlikely that permanent damage will occur. However, TTS is a warning sign that the hearing mechanism is being overloaded.

**PERMANENT THRESHOLD SHIFT (PTS)**

This is permanent damage to the ear as a result of continued or repeated exposure to excessive noise over a period of time.

A PTS occurs gradually. Normally it is the hair cells in the inner ear which detects the 4-6 kHz frequencies that deteriorates first. As most of the speech frequencies are below this range, the loss may initially go unnoticed. But with further exposure, the hearing increases and extends to the lower frequencies as well and the person begins to have difficulty hearing speech.

If the noise is loud enough and the duration of exposure long enough, however, it may cause a permanent threshold shift. This condition is called noise induced hearing loss, and has no cure and is irreversible.

**OTHER ADVERSE EFFECT OF NOISE**

The World Health Organization's Guidelines for Community Noise enumerate a wide range of health effects caused by noise. In addition to NIHL these include the social consequences of
hearing impairment like the inability to understand speech in daily communication, disturbance of rest and sleep, mental health and performance effects, and disruptive effects on residential behavior and annoyance. People and workers continually exposed to noise are at higher risk for developing hypertension and ischaemic heart disease. In schools near airports, where children are chronically exposed to noise, children under-perform in tasks like proof-reading, persistence in puzzle solving, and some types of reading tests.

Loud noise will also cause some people to have anxiety and irritability, an increase in heart rate and blood pressure, or an increase in stomach acid. In addition, very loud noise can reduce efficiency in performing difficult tasks by diverting attention from the job.

What factors increase a person’s susceptibility to noise induced hearing loss?

The following factors have been associated with an increased susceptibility to noise induced hearing loss:

- Blue eyes
- Light skin
- Family history of hearing loss
- Diabetes mellitus
- Meniere disease
- Iron deficiency
- Vitamin A deficiency
- Older age
- Atherosclerosis (hardening of the arteries)
- Smoking tobacco

Do the duration and closeness of exposure to loud noise relate to hearing damage?

There is a direct correlation between the duration of exposure to a loud noise and the damage to hearing. This means that the longer the exposure, the more the damage. Furthermore, the closer one is to the source of the intense noise, the more damaging it is. For example, a gunshot produces a noise that could damage the ears of anyone in close hearing range. Large bore guns and artillery are the worst because they are the loudest. But even a cap gun or a firecracker can damage the hearing if the explosion is close to the ears. Accordingly, anyone who uses firearms must wear hearing protection.

Studies have shown an alarming increase in hearing loss in children and young adults. Evidence suggests that loud music along with increased use of portable CD players with earphones may be responsible for this increase. Here, the problem is the long duration and close exposure to the loud music.

The Symptoms of NIHL

The symptoms of NIHL that occur over a period of continuous exposure increase gradually. Sounds may become distorted or muffled, and it may be difficult for the person to understand speech. The individual may not be aware of the loss, but it can be detected with a hearing test.
Noise-induced hearing loss is not reversible, but it is preventable. All individuals should understand the hazards of noise and how to practice good health in everyday life.

Removing hazardous noise from the workplace through engineering controls (e.g. installing a muffler or building an acoustic barrier) is the most effective way to prevent noise-induced hearing loss. Hearing protectors such as ear plugs and ear muffs should be used when it is not feasible to otherwise reduce noise to a safe level. NIOSH recommends hearing loss prevention programs for all workplaces with hazardous levels of noise. These programs should include noise assessments, engineering controls, audiometric monitoring of workers’ hearing, appropriate use of hearing protectors, worker education, recordkeeping, and program evaluation. This can be summarized as follows:

- Know which noises can cause damage (those above 75 decibels).
- Wear ear plugs or other hearing protective devices when involved in a loud activity; special ear muffs are available at hardware stores and sporting good stores.
- Be alert to hazardous noise in the environment.
- Protect children who are too young to protect themselves.
- Make family, friends and colleagues aware of the hazards of noise.
- 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 identify and measure hearing loss and to rehabilitate persons with hearing impairments.

Several measures can and should be taken in a hierarchical order: Assessment of exposure, using tools and equipment which generate a lower level of noise, segregation and insulation, appropriate work practices and personal protection such as ear muffs and ear plugs. As well as steps to protect workers from noise, many companies now carry out regular audiometry. The most reasonable way to protect the ears is to generate less noise in the first place, by better design of machinery and equipment. Secondly steps should be taken to insulate the machinery to reduce the noise that it emits and to segregate people from it (i.e. to keep them away).

People should work in areas where they are not exposed to high levels of noise. The same goes for leisure activities (e.g. discos and raves). Remember the ‘two metre rule’ - if you find it difficult to communicate with a workmate at this distance because of noise, then probably the intensity is high enough to damage your hearing.

At a personal level it is possible to protect the ears with ear muffs and/or ear plugs. If you must work in an excessively noisy environment, you should wear protectors. You should also wear them when you are using power tools, noisy yard equipment, or firearms. Personal habits are also important especially in avoiding high exposures to noise resulting from the use of so called “personal stereos”.

- ARC 507
- ENVIRONMENTAL CONTROL III
- NOISE INDUCED HEARING DAMAGE
What Research is being done on NIHL?

Scientists focusing their research on the mechanisms causing NIHL hope to better understand the internal workings of the ear have discovered that damage to the structure of the hair bundle of the hair cell is related to temporary and permanent loss of hearing. When the hair bundle is exposed to prolonged periods of damaging sound, the basic structure of the hair bundle is destroyed and the important connections among hair cells are disrupted which directly lead to hearing loss.

Other studies are investigating potential drug therapies. Scientists studying altered blood flow in the cochlea are seeking the effect on the hair cells. They have shown reduced cochlear blood flow following exposure to noise. Further research has shown that a drug which promotes blood flow used for treatment of peripheral vascular disease (any abnormal condition in blood vessels outside the heart), maintains circulation in the cochlea during exposure to noise. These findings may lead to the development of treatment strategies to reduce NIHL.

Otoprotective Agents Sought for Noise-Induced Hearing Loss

Given the large number of patients with noise-induced hearing loss (NIHL) that audiologists see every day, there is an intense search for agents that could protect or rescue cochlear hair cells from excessive noise exposure. Although no drugs are currently approved by the U.S. Food and Drug Administration (FDA) to prevent or treat NIHL, several hold promise. A variety of approaches are on the horizon for NIHL. This section focuses on otoprotective agents which are likely to gain FDA approval before cochlear hair cell regeneration ultimately becomes a reality.

Hair Cell Life and Death

An unhealthy lifestyle increases the risk of noise-induced hearing loss. For example, a high fat diet can reduce blood flow. Smoking increases free radicals—molecules with only one electron in the outer shell—which can oxidize and damage other cells. Both have been implicated in increasing the risk of NIHL and have been shown to do so in animal studies. Thus, antioxidants, which detoxify free radicals, or other agents that increase blood flow may also serve to protect or rescue from NIHL.
A Look Into the Diet

Interestingly, many of the most promising otoprotective agents are antioxidants that occur naturally in the diet, although not usually in amounts sufficient to provide effective otoprotection against high-level noise. For example, diets rich in vitamins A, C, and E and in selenium have been shown to reduce NIHL in animals.

Several other micronutrients have shown efficacy in preventing NIHL. For example, magnesium, which is found in fish, almonds, spinach, shrimp, bran, chocolate, seeds, whole grains, avocados, bananas, dark green leafy vegetables, and potatoes, is showing some promise. It may act by increasing blood flow or acting on the calcium channels.

A Note of Caution

Audiologists and their patients shouldn't rush to the Web or health food store to prevent hearing loss. Before audiologists suggest menus for the prevention of NIHL or recommend any dietary pills or supplements beyond recommending a healthy lifestyle and diet, they should wait until a drug is approved by the FDA specifically for prevention or rescue of NIHL. Even then, any medication or dietary supplement should only be recommended by the patient's physician who can consider the patient's other medications and/or medical conditions. Many nutritional and herbal supplements available to the general public over the counter can interact with medications, may have side effects, may not be effective, or may be contraindicated in certain patients.

Prevention will always be the best treatment for NIHL, but for those who experience unavoidable or unexpected noise exposure, the future holds promise of an FDA-approved drug that may one day be available to reduce the incidence of NIHL.
In conclusion, you may be exposed (at work or through hobbies) to noise that hurts your hearing. If you have to shout when you talk to a coworker who is standing next to you, the noise level at your workplace may be hurting your ears.

Both the loudness of sound (called the intensity) and the amount of time you hear the noise are important. Sound is measured in decibels. Eight hours of hearing noise at 85 decibels could hurt your hearing. At higher sound levels, you could lose hearing in even less time.

Therefore, workplaces where sound levels are at an average of 85 decibels or above average for more than eight hours must have programs to save the hearing of workers. These workplaces must give free hearing protection devices to workers.

Furthermore, those engaged in recreational activities that produce noise should also ensure that they wear the recommended protective gadgets provided to save them from being directly exposed to damaging sounds.

REFERENCES

Professor Olu Ola Ogunsote. Acoustics and Noise Control Lecture notes

Gary W Seiben, Martin A. Gold, Glenn W Seiben, Michael G. Ermann.


Andrew Marsh. UNA 1999 Architectural Science Lecturer School of Architecture and Fine Arts University of Western Australia, Online Information and Course Notes

Neeraj N Mathur, MBBS, MS,DNB, MNAMS, Professor, Department of Ear, Nose and Throat, Lady Hardinge Medical College, SK Hospital, India et al www.emedicine.com

American Academy of Family Physicians, Online News and Publications