

Noise and hearing - children and teenagers

<http://www.cyh.com/HealthTopics/HealthTopicDetails.aspx?p=114&np=304&id=1584#2>

The inner ear (cochlea) contains tiny cells that are sensitive to sound (hair cells). These cells convert the vibration of sound into messages to the brain. After long exposure to very loud noise, physical changes occur to several parts of the inner ear, including the hair cells. If the ear is rested for a few days, most of the hair cells recover, but there can be permanent damage. As people get older the hair cells get damaged too.

After damage, the person may have difficulty in picking speech out from background noise even before testing of hearing shows a problem.

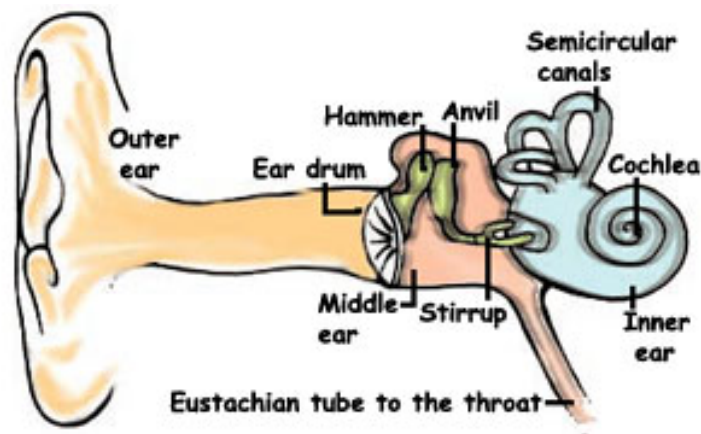
Hearing may seem slightly dulled after an evening of very loud music, **but if a person develops sudden hearing loss in ears that appear healthy he or she should be seen urgently by an ear, nose and throat specialist.** It is thought that a sudden loss of sensitivity in the inner ear (cochlea) can sometimes be reversed if treated quickly.

How the inner ear works

The inner ear, or cochlea, contains the sound-sensitive cells that turn the physical vibration of sound into messages for the brain so that we become aware of sound.

- The sounds of human speech are very complex. To recognize the difference between one speech sound and another, especially while picking them out from background noise, the ear must act as a superb sound analyzer, or set of sound filters.
- The sound-sensitive cells are of two main types:
 - Inner hair cells, which send signals to the brain when vibration in the inner ear tugs on their bristles (cilia). Normally they are finely tuned, each one responding only to, and informing the brain of, precise differences in sound.
 - Outer hair cells, which probably do not send any message to the brain. They respond to incoming sound vibration by setting up further vibration of their own - they act as amplifiers to increase the strength and precision of the sound stimulus for the inner hair cells.

Inner and outer hair cells are so called because of the rows of bristles they carry. They are nothing like the hairs of your head.



Effect of loud noise on the inner ear

- Immediately after long exposure to very loud noise, there are changes in various structures of the inner ear, including the outer hair cells, the bristles of the inner hair cells, and the connections between the nerves and the cells.
- If the ear is rested for a few days, some of the damaged structures appear to recover, but changes to scattered outer hair cells persists.
- There is gradual loss of outer hair cells and later, with increasing age, the inner hair cells.

Effect of loud noise on how the inner ear works

- When only outer hair cells are damaged, the person's response to a hearing test may not seem to be affected. Whether or not, and how quietly, a test-tone can be heard is more dependent on the inner hair cell.
- Loss of outer hair cells means that the ear becomes less skillful at hearing detail. This is made even more difficult by several voices speaking at the same time or background noise, such as in a public place, at a party, even at the family dinner table. The listener starts to depend on lip-reading and often asks for things to be said again.
- This damage seems to appear first in the 2kHz frequency region, likely to be an important range for understanding speech, and then spreads with further exposure to loud noise to involve the higher frequency part of the cochlea. It may be only when the outer hair cell damage has reached the high frequencies that it becomes detectable to standard hearing tests as raised hearing thresholds, in other words a hearing loss.

Effects of excessive noise

The short-term effects of excessive noise:

1. a sensation of dulled hearing
 2. difficulty understanding speech
 3. a feeling of fullness in the ears
 4. ringing, high-pitched noise in the ears
- These effects ease over hours, or, in severe instances, a couple of days.
 - When exposure to loud noise happens regularly, these same effects can become permanent.

How loud does noise have to be to damage the ears?

- The amount of damage that noise can do to ears seems to be related to the amount of energy in the noise.
- The amount of energy in a noise depends on:
 - the intensity of the noise, ie., how loud it is
 - its duration, ie. how long it lasts, or how long the listener is exposed to the noise.
- Obviously, a noise that lasts twice as long has twice as much energy, but the amount of energy in the sound grows very quickly as the sound gets louder (it doubles every time the sounds gets louder by 3dB).
- Thus, there is not a fixed level below which noise is entirely safe, but noise that is not so loud can be endured much longer than noise that is very loud before it will damage the ears.

- In practice, a noise is probably quite safe if it is not too difficult to hold a conversation when people are about a metre apart during the noise.
- If a very loud voice is required to talk over the noise, (or the noise is over 90dBA), it is likely that the noise is harmful if endured frequently or for long periods.
- Any experience of noise (taking into account level of noise and duration of exposure) that causes ringing in the ears or a sensation of dulled hearing, can be assumed to be damaging and should be avoided in future.

Comparison of noise levels

Some typical noise levels for unprotected ears

power tools	90dBA
noisy engines, e.g. motorbikes	90dBA
tractor	93dBA
road drilling	96dBA
iron and steel working	96-102dBA
clubs (discotheques)	
average on dance floor	99dBA
but can be higher	105dBA

For every increase of 3dBA, the energy content of the noise, and thus its potential for injury, is doubled. From the above figures it can therefore be estimated that in one hour spent on an average discotheque dance floor ears will suffer as much damage as in 2 hours spent drilling the road without ear protection, or in 8 hours using power tools. On a particularly loud club dance floor (105dBA), the rate of damage of ears will be four times faster again.

What noise is damaging?

Explosions

Gunfire, particularly of heavier guns, and fireworks explosions at close range ("bangers") will quickly cause permanent damage to hearing. Many young men from South East Asia with high frequency hearing loss can tell stories of playing with fireworks at Chinese New Year, or of friends having played tricks on them with "crackers".

Power tools

Chainsaws, power drills and other noisy tools, particularly when used in an enclosed space, or applied to a resonating surface (a surface that noise "bounces off" - like a hollow box).

Noisy vehicles

Tractors and open vehicles, where the rider or passenger is close to the motor or exhaust.

Amplified music

Professional rock musicians may show reduced hearing, especially percussionists and drummers. More often they suffer sensations of dulled hearing, hypersensitivity to sound and ringing in the ears, even if their hearing tests don't show much hearing loss.

For most young people, their major source of damaging levels of noise exposure is amplified music, as in mobile phones with headphones, in-car stereo, loud music pubs, nightclubs and rock concerts.

Young children

- Because of their thinner skulls, babies and young children are at greater risk from a loud sound than adults are.
- An adult can choose to risk some hearing damage. Babies and other young children may have greater damage than the adult, without opportunity to make a choice.
- If at all possible, avoid exposing young children to loud noises, such as car racing events or loud music, to protect their hearing, as the damage could last all of their life.

How often is it safe to go to nightclubs?

- This is one of those questions which does not have a clear answer. It is like 'How much can you use your car without wearing out the tires?' Of course, it is more a question of how quickly you wear them out. At least you can buy new tires when they are worn through, but you cannot buy new ears, or not yet!
- Most people meet unavoidable loud noise from time to time from things that slam, drop, collide, squeal, scream or explode, in addition to various engines and machinery. All of these things will wear away at our supply of thousands of outer hair cells (also the inner ones) little by little, until, later in life, age causes further loss.
- Any visit to a nightclub will destroy, or hasten the destruction, of some of our thousands of hair cells that can never be replaced and leave us hearing a little less well.
- We can make a choice about attending a night club.
- If we know what we are doing, we recognize the serious price we pay for noisy pleasures.
- We often don't realize the full cost until much damage has been done, and it is too late to alter things. Is it worth it?
- Most people who go to clubs once or twice a month and don't spend too long on the dance floor (often the noisiest area) show mild damage to their hair cells but still good hearing.
- Many healthy young adults, still in their early twenties, who go to clubs a couple of times every week, after a couple more hours spent in a loud music pub, show extensive outer hair cell damage.
- Some of them have very little outer hair cell activity left.
- A hearing test may show only slight hearing loss but does not reveal the extent of the damage that has been done to the important outer hair cells.
- Such people may have difficulty understanding exactly what others are saying, need things to be said two or three times and to watch lips closely when listening conditions get a little difficult.
- And as they grow older, the situation can only get worse.

What can be done to protect ears from noise?

- Never be, or allow children to be, near firing guns or close to exploding fireworks.
- If it is necessary for you to fire a gun, then good quality heavy duty ear-muffs must be used. If you fire a gun regularly, then ear-plugs should be used underneath the ear-muffs.
- Well-fitting ear-muffs should be worn during the use of any power tools, loud machinery or vehicle that makes talking difficult, especially if unprotected use has ever caused ringing in the ears or a sensation of dulled hearing.
- Protective cabins should be used on tractors.
- If a safety helmet or sun hat should be worn during the noisy activity (eg., mowing the lawn), then good quality foam-rubber ear-plugs should be used, inserted carefully in the ears according to instructions.

- Headphones can be safely used to listen to music without disturbing others, so long as the volume is not too high. It is the volume, and to a lesser extent how long you listen, not the headphones themselves, that causes the damage. If other people can hear the music from your headphones, it is too loud.
- For young adults it may be nightclubs that are the major source of damaging levels of noise. It is better to avoid nightclubs, but if you do wish to attend a nightclub or if you are under pressure to do so:
 - agree to go only occasionally, less often than once a week
 - stay at the club no longer than necessary
 - spend most of the time there away from the dance-floor in a situation where it is possible to hold a conversation
 - and do not combine a visit to a club with first visiting a pub with amplified music.

Resources

- Australian Government Department of Health - Office of Hearing Services
<http://www.health.gov.au/hear>

More to read

American Hearing Research Foundation

<http://american-hearing.org/>

- Noise induced hearing loss
<http://american-hearing.org/disorders/noise-induced-hearing-loss/>

National Institute on Deafness and Other Communication Disorders

- 'Noise induced hearing loss'
<http://www.nidcd.nih.gov/health/hearing/pages/noise.aspx>