

## Fact sheet: Understanding the results of hearing tests



The hearing organ, the cochlea, is highly developed. It picks up vibrations in the air that are caused by sound. But what is “normal” hearing, how is it measured and when is someone considered to be hard of hearing?

Our ears receive sound waves and change them into signals which the nerves send on to the brain. The brain then analyses the signals, recognises them as sounds and interprets them: as soft music, for instance, or as loud honking or human voices.

This video (URL: <http://www.informedhealthonline.org/index.780.en.html>) shows how the ear works. Sound waves are created when an object moves, for example when a guitar string vibrates. Whether we hear a sound depends both on the power of the sound (“sound level” or “sound pressure level”) as well as on the frequency (or “pitch”) of the vibration. The volume or loudness of a sound is determined by the sound pressure level. The higher this is, the louder the sound is. You can read about how the ear works here (URL: <http://www.informedhealthonline.org/index.370.en.html>).

### What do “decibel” and “hertz” mean?

Sound pressure level is measured in decibels (dB). The term decibel comes from the word “deci” (one tenth) and the name “Bell”. Alexander Graham Bell developed the decibel unit to describe sounds using simple numbers such as 30 or 100.

The frequency is measured in hertz (Hz), named after the German physicist Heinrich Rudolf Hertz. The frequency is how many vibrations there are per second. For instance, 20 hertz means 20 vibrations per second. This very slow vibration can barely be heard. The higher the frequency, the higher the pitch.

### What do we hear?

In order for us to be able to hear a sound at all, it has to be above a certain level. This level is called the auditory threshold or hearing threshold. Our hearing threshold is around 0 decibels. Once the hearing threshold is exceeded, higher sound pressure levels will be heard as louder noises. If the sound pressure level is above 110 decibels, hearing becomes uncomfortable (threshold of discomfort), and it becomes painful above 130 decibels (threshold of pain).

The following list shows examples of the volume of familiar noises. A 10 decibel increase in volume is perceived by

most people as “twice as loud”.

*Normal hearing threshold:* 0 dB

Country quiet: 20 dB

Quiet conversation: 40 dB

Normal conversation: 60 dB

Traffic: 80 dB

*Risk of chronic hearing damage from noise*

Noises above 90 dB can lead to chronic hearing damage if people are exposed to them every day or all the time.

Industrial noise: 100 dB

MP3 player (European upper limit): 100 dB

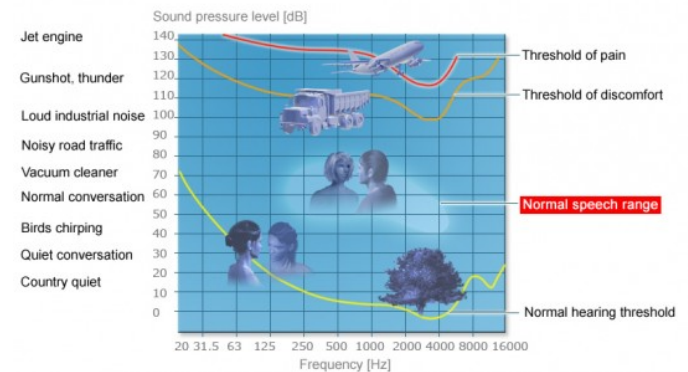
*Threshold of discomfort:* 110 dB

Nearby thunder: 120 dB

Club music: 120 dB

*Threshold of pain:* 130 dB

Jet engine: 140 dB



*Figure: Volumes and hearing threshold*

### What does “hard of hearing” or “hearing impairment” mean?

When someone is hard of hearing, their hearing still works, but not as well as usual. Hearing impairments may be permanent or temporary, caused by illness or there from birth. They often develop as people get older. You

can read about hearing tests for newborns here (URL: <http://www.informedhealthonline.org/index.368.en.html>) .

A hearing loss of up to 20 decibels below the hearing threshold is still considered to be normal hearing. More severe hearing loss is generally classified into different levels:

- Mild: hearing loss of 20 to 40 decibels
- Moderate: hearing loss of 41 to 60 decibels
- Severe: hearing loss of 61 to 80 decibels
- Profound hearing loss or deafness: hearing loss of more than 81 decibels

Hearing loss is only considered to be a hearing impairment if it is moderate to severe (40 decibels or more).

## When can noise damage our hearing?

Our ears are constantly exposed to noise, some of which can be damaging. Noise above 140 decibels, like a loud explosion, can lead to acute hearing loss. This is called acoustic trauma. Depending on how long the ears are exposed to a sound and how intense it is, it may damage the eardrum, the middle ear and/or the inner ear. Damage like this is usually temporary, but it might be permanent. Less loud sounds (about 90 dB and above) can also lead to chronic hearing loss if someone is exposed to them for longer periods of time. Examples include loud club music, industrial noise or a pneumatic drill. Even lower sound levels can be damaging if people are exposed to them long enough.

You can protect your hearing in various ways. Foam ear plugs offer protection against occasional noise. Special protective ear muffs are an alternative option in noisy workplaces. These are like headphones that completely cover and surround both ears and can easily be put on or taken off at any time. If you are regularly exposed to loud noises at work, having hearing protection tailor-made to fit your ears might be a good idea.

## Why does our hearing get worse as we get older?

It is very common for people to become hard of hearing as they get older. About 25 to 40 out of 100 people over the age of 65 are affected (25 to 40%). Half of all people who

are over 75 are hard of hearing (50%), compared to 80 out of 100 people who are over the age of 80 (80%). This usually affects their ability to understand what people are saying more than the range of tones they can hear, and they can hear low frequencies better than high frequencies. As a result, people who have age-related hearing loss find it more and more difficult to follow conversations in loud places, for example at family gatherings or in restaurants.

Exactly why our hearing gets worse as we get older is not known. The cause is thought to be changes in the inner ear and in the brain.

Nowadays, various sound-amplifying hearing aids are available to improve people's hearing and their ability to understand conversations. The main aim is to filter out background noise. Hearing aids are adapted to the individual needs of their wearer. They can be worn behind the ear or in the ear, where they are hardly visible.

*Author: Institute for Quality and Efficiency in Health Care (IQWiG)*

## Sources

IQWiG health information is based on research in the international literature. We identify the most scientifically reliable knowledge currently available, particularly so-called “systematic reviews”. These summarise and analyse the results of scientific research on the benefits and harms of treatments and other health care interventions. This helps medical professionals and people who are affected by the medical condition to weigh up the pros and cons. You can read more about systematic reviews and why these can provide the most trustworthy evidence about the state of knowledge here (URL: <http://www.gesundheitsinformation.de/evidence-based-medicine.61.en.html>) . The authors of the major systematic reviews on which our information is based are always approached to help us ensure the medical and scientific accuracy of our products.

Bance M. Hearing and aging. *CMAJ* 2007; 176: 925-927. [Full text (URL: <http://www.cmaj.ca/cgi/content/full/176/7/925>) ]

German Institute for Quality and Efficiency in Health Care (IQWiG). *Neonatal screening for early detection of hearing impairment. Final report S05-01 Version 1.0*. Cologne: IQWiG. February 2007. [Executive summary (URL: [http://www.iqwig.de/download/S05-01\\_Executive\\_Summary\\_Neonatal\\_screening\\_for\\_early\\_detection\\_of\\_hearing\\_impairment\\_neu.h](http://www.iqwig.de/download/S05-01_Executive_Summary_Neonatal_screening_for_early_detection_of_hearing_impairment_neu.h))] [Full text (URL: [http://www.iqwig.de/download/S05-01\\_Final\\_report\\_Neonatal\\_screening\\_for\\_early\\_detection\\_of\\_hearing\\_impairment.html](http://www.iqwig.de/download/S05-01_Final_report_Neonatal_screening_for_early_detection_of_hearing_impairment.html))]

Thews G, Mutschler E, Vaupel P. *Anatomie Physiologie Pathophysiologie des Menschen*. Stuttgart: Wissenschaftliche Verlagsgesellschaft mbH. 1999: 715-723.

## **The German Institute for Quality and Efficiency in Health Care (IQWiG)**

The German Institute for Quality and Efficiency in Health Care (IQWiG) was established by legislation to provide evaluations of the effectiveness, quality and efficiency of healthcare services. This includes the assessment of medicines as well as the publication of health information for consumers and patients.

## **Evidence basis of our health information**

Our information is based primarily on systematic reviews of the effects of health care. Systematic reviews are necessary to gain an objective picture of health care. In order to do this, a clear question is formulated. Researchers then find all the relevant studies that could answer this question. They then evaluate those studies.

You can find a list of the evidence and other scientific literature on which this information is based at [\*\*www.informedhealthonline.org\*\*](http://www.informedhealthonline.org)

## **Disclaimer**

This information was prepared and published by the German Institute for Quality and Efficiency in Health Care (IQWiG). It is based on the evidence and other scientific literature available at the time of publication. The information is intended for the use of patients in Germany. It is not intended to for use to diagnose illnesses and the information is not intended to substitute for medical advice.