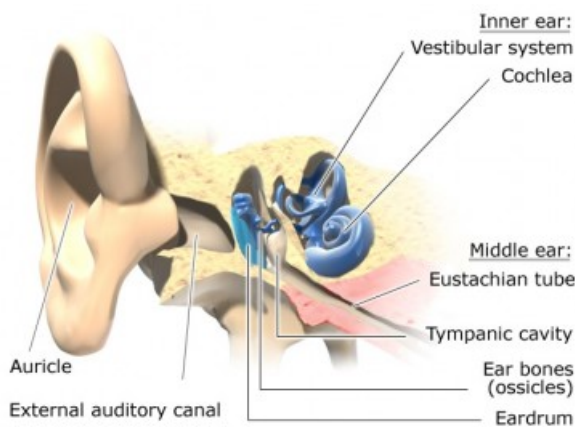


Fact sheet: Hearing tests in newborns and babies

Nearly all babies can hear well: 997 out of 1,000 babies are born with normal hearing. At the most, 3 out of every 1,000 newborns have a moderate or severe hearing impairment. Although these children hear a little worse than normal, most of them are not deaf. Hearing problems are often first detected when a child is between two and four years old. However, some hearing tests can already be carried out in newborns.

How does our hearing work?

This video (URL: <http://www.informedhealthonline.org/index.780.en.html>) shows how the ear works. The ear picks up sound waves and transforms them into electrical signals which travel along nerves to the brain. The signals are "decoded" and interpreted by the brain. The sound may then be perceived as loud, quiet, speech, music or a message such as "the phone is ringing".



The ear has three parts:

- the outer ear (visible part, called "auricle" or "pinna", and external auditory canal),
- the middle ear (the eardrum or "tympanic membrane" and the tympanic cavity containing tiny ear bones. These are called the hammer, anvil and stirrup, or "ossicles"),
- the inner ear (cochlea and the organ of balance, called the "vestibular system").

Sound waves reaching the outer ear cause the eardrum to vibrate. The vibrations are passed on from the middle ear to the inner ear. This is where the actual organ of hearing, the cochlea, is found. Fine hair cells in the cochlea play an important role in converting the sound waves into electrical signals. The organ of balance is also found in the inner ear.

What happens if a newborn has a hearing problem?

If a baby cannot hear properly, the brain cells responsible for hearing are not used much. This means that the cells might not develop properly, and the baby's ability to hear may be permanently affected. It is very difficult to make up for this later on. Children who do not hear well might possibly learn to speak later than other children. This, in turn, can affect their ability to learn in general, as well as their personal and social development.

How are hearing impairments diagnosed?

It is difficult to judge whether the hearing of newborns and babies is good. Whereas older children can actively participate in tests that check their reaction to tones and sounds, that is not possible with babies. In the "objective" test methods that are used in newborn hearing screening (URL:

<http://www.informedhealthonline.org/index.367.en.html>), the child does not need to actively participate, or even be awake. Two approaches are particularly suitable for testing the hearing of babies: "otoacoustic emission" measurement and "brainstem evoked response audiometry".

These tests do not hurt at all and can be done while your baby is sleeping. Newborn hearing screening is not carried out on a routine basis in all hospitals in Germany. You can read about our hearing and how it is measured in our other fact sheet (URL: <http://www.informedhealthonline.org/index.369.en.html>).

What are "otoacoustic emissions" and how are they measured?

Otoacoustic emissions (OAE) are measured using an approach based on echoes. A small probe is put into the outer ear. The probe makes soft "clicking" sounds which travel to the inner ear, right through to the fine hair cells in the cochlea. If the sound reaches them, the hair cells "answer" by vibrating. Like an echo, these vibrations are then carried from the inner ear back to the outer ear as

sound waves. There, a tiny microphone on the probe picks up the sound waves and measures how strong they are. If there is no signal or if it is very weak, that could be a sign that the cochlea is not receiving sounds properly. This is often due to a problem with the hair cells.

But poor test results do not always mean that the baby is hard of hearing. Instead, the signal might not be picked up properly if the child does not keep still, has fluid in his or her ear or if there are background noises that interfere. And the OAE test does not measure how severe the hearing loss is. Although the test is relatively accurate, as with most tests, it may sometimes fail to detect a hearing impairment.

Sometimes newborns with normal hearing get a wrong diagnosis after having an OAE test. Although they can hear well, they are mistakenly diagnosed as being hard of hearing. In other words, they get a “false positive” result. Wrong diagnoses like this can usually be quickly corrected if further tests are done.

The OAE test is simple and normally only takes a few minutes. It is done in a quiet environment and, if possible, when the baby is completely relaxed or sleeping. If, for instance, the baby makes sucking noises during the test, the results could be affected.

How does brainstem-evoked response audiometry (BERA) work?

This test measures whether sound waves are passed on to the brain properly. Brainstem-evoked response audiometry (BERA) is a special kind of electroencephalogram (EEG) – a test that measures electrical activity in the brain. It is also called the “auditory brainstem response” test (ABR).

Before the test is done, small metal plates (electrodes) are stuck to the skin at the top of the baby’s head and behind his or her ears. The baby is then given special headphones, through which clicking noises are sent to the inner ear. The electrodes measure whether the brain receives the sound waves from the inner ear, in the form of electrical signals. If the signals are not transmitted properly, then the baby might have a hearing problem.

Like the other test, this test also needs to be done in a quiet environment. The more active and more awake the baby is, the more electrical signals his or her brain produces. This makes it difficult to distinguish between signals from the hearing nerves and other signals. So the test works best if your baby is asleep during it.

Both the OAE test and brainstem evoked response audiometry can indicate whether hearing has been affected by damage to the inner ear or to the hearing nerve.

What are the advantages of these tests?

There are purely practical arguments for doing hearing tests immediately after birth. Hospitals offer the best possibilities for testing a large number of babies. However, treatment for hearing impairments would not be started at such a young age.

One advantage of early hearing tests is that they can provide information about whether a hearing problem can almost certainly be ruled out or not. This can help to understand the baby’s behaviour and avoid interpreting it wrongly, for example if he or she does not react when spoken to. Hearing impairments can also develop later on in childhood, though – for instance, due to infections in toddlers. So even if hearing tests show that there is nothing wrong with your child’s hearing, it is still important to keep looking out for any signs that he or she might have a hearing problem.

An early diagnosis also means it is possible to start treatment earlier. There is some evidence that children whose hearing impairment is detected during screening tests when they are newborns have better early language development compared to children whose hearing impairment is diagnosed later. Not enough is known about how an early diagnosis affects the long-term psychological wellbeing and quality of life of these children.

More research is also needed to find out which treatments are best for children who have a hearing impairment. The treatment options include hearing aids, speech therapy, and special education. So-called cochlear implants are used in particular circumstances too. This involves surgically implanting an electronic device in the ear.

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Glossary

screening

Screening is a systematic approach to trying to find illnesses among people who do not have symptoms or other obvious signs of disease. An example is screening for breast cancer with mammography.

evidence

Evidence is what we call scientific proof from well-conducted, good-quality scientific trials that have been carefully designed to answer specific questions. Depending on the types of questions, different scientific research methods (types of study) are most appropriate to find reliable answers to these questions. Randomized controlled trials (RCTs), for example, are the best way to get reliable evidence on the effectiveness of medical treatments (interventions). This type of study, however, is not the best form of evidence for all possible questions, and does not provide the best answers to all kinds of questions, either. Epidemiological studies, for example, are very suitable for establishing well-founded proof for the spreading of a disease in the population.

diagnosis

The term diagnosis (from the Greek word *diagnosi*: “distinguishing”) is used to mean the identification and naming of an illness or a disease. A diagnosis is usually made by evaluating the medical history, symptoms and test results. The tests include both comprehensive physical examination and blood tests or examinations using medical instruments such as ultrasound or x-ray.

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.

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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**

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