Rijksinstituut voor Volksgezondheid
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Newborn Hearing Screening factsheet

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What does the newborn hearing screening involve?

Since 2006, every newborn in the Netherlands has been offered newborn hearing screening (NGS). The aim of newborn hearing screening is to detect hearing loss in the first months of life so that – if necessary – treatment can start before the baby is six months old. Evidence shows that this has a beneficial effect on language and speech development in children with bilateral hearing loss. The screening also detects children with unilateral hearing loss, with the aim of giving the parents/carers tips and advice on the best way to support their child.

The hearing test is carried out as soon as possible (from 96 hours to 168 hours after birth), usually in combination with blood spot screening. In the event of an abnormal result for one or both ears, the test can be repeated twice if required. If the result remains abnormal the child is referred to an Audiology Centre (AC) for further diagnostic tests and, if necessary, treatment.

1 Clinical picture

Individuals with a hearing impairment have diminished (or greatly diminished) hearing ability. This can either be of temporary (due to the presence of fluid in the middle ear, for example) or permanent nature. Hearing disorders can be classified by type (e.g. conductive hearing loss or sensorineural hearing loss) and by the severity of the hearing loss.

Hearing impairment can be acquired or hereditary. A Dutch study has shown that in approximately 40% of children born with a hearing disorder, their condition is hereditary. In about 30% of the children, the hearing impairment is acquired (e.g. due to infections during pregnancy or oxygen deficiency during labour). In one quarter of them, it is not yet possible to establish the cause1. However, hearing impairment can also develop in older children, for example as a result of an hereditary disorder, meningitis, or exposure to noise.

International publications show that about 1 to 3 newborns per 1,000 have permanent hearing loss of at least 40 dB in both ears2.

Severe hearing impairment at a young age can – if left untreated – result in impaired or severely impaired language and speech development. This in turn may lead to a limited or delayed development of intellectual potential, problems in social-emotional development, and reduced participation in social life. It is important to detect hearing impairments quickly and to treat them in the first six months of life, as this has a beneficial effect on language and speech development2.

Depending on the severity of permanent hearing loss, there are treatment options that enable language and speech development to proceed as favourably as possible. If there is sufficient residual hearing, hearing aids can be fitted to amplify sounds. In hearing impaired people, sound is also often distorted, so they do not necessarily hear the same things with their hearing aids as those with normal hearing. If there is insufficient residual hearing, a hearing device (cochlear implant) that directly stimulates the auditory nerve can be surgically implanted.

In addition to the use of hearing aids, it is also preferable to start providing family support services. The aim here is to stimulate language and speech development in hearing-impaired children, and to support parents in the education and guidance of such children.

2 Target group

The newborn hearing screening (NGS) is designed for all newborn babies. In these infants, NGS is carried out by Child and Youth Health Services (JGZ) staff as soon as possible (from 96 hours to 168 hours after birth). In a few youth health care organisations in the provinces of Gelderland and Zuid-Holland, newborn hearing screening is offered at child health clinics, because blood spot screening there is performed by midwives.

The approximately 4,000 children who are admitted to neonatal intensive care units (NICUs) every year are not screened by Child and Youth Health Services. Here, hearing screening is part of neonatal intensive care units (NICU) care[4]

3 Figures

Number of children detected[3]: the table below shows the number of children with bilateral and unilateral hearing loss who are detected each year by Child and Youth Health Services, by means of newborn hearing screening (for the period from 2009 to 2020).

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Target group	181.574	181.059	176.713	172.432	167.490	171.528	166.911	168.790	166.101	165.149	166.367	164.981
bilateral hearing loss JGZ[3]	163	115	99	119	113	124	113	128	119	146	129	125
unilateral hearing loss JGZ[3]	82	76	88	91	87	95	82	68	74	85	77	81

Newborn hearing screening 2019 monitor[3]	**Figures**
Burden of disease (JGZ monitoring reports and NICU annual reports, 2008-2018[#]) [3,4]	On average, 1.1 children per 1,000 newborns have a permanent hearing loss of at least 40 dB in both ears, while in 0.6 per 1,000 have a corresponding level of hearing loss in one ear (including children identified through the neonatal intensive care units)
Size of target group	164,981*
Participation rate 1st round of screening Participation rate 2nd round of screening Participation rate 3rd round of screening Participation rate for all three rounds of screening	99.5% 99.6% 99.7% 98.8%
Number and percentage of referrals from screening to an Audiology Centre	606 (0.31%)
Detection rate for unilateral hearing loss (number) Detection rate for bilateral hearing loss (number) Detection rate for unilateral and bilateral hearing loss	0.05 (81) ** 0.08 (125) 0.125 (1.25 per 1000)
Positive predictive value (PVV) for permanent unilateral and/or bilateral hearing loss in those referred to an Audiology Centre following an abnormal screening result	35%

PPV for permanent bilateral hearing loss in those referred to an Audiology Centre following the detection of bilateral hearing loss during screening	60%
False-positive results	>61%; see note below ***
False-negative screenings	see note below ****
Timeliness of 1st round of screening (<28 d) #	89.4%
Timeliness of 2nd round of screening (<35 d) #	85.8%
Timeliness of 3rd round of screening (<42 d) #	81.7%
Timeliness of completion of diagnostic testing a diagnosis is made within 92 days of birth	82.6%

** This is the total number of children that are eligible for the first hearing screening: the total number of live births minus the children who died before the first screening, the children who were screened in neonatal intensive care units (NICUs), or those who moved to another country.*

*** The detection rate is the number of children detected/total number of children who are eligible for the first round of hearing screening, times 100.*

**** During the newborn hearing screening implementation period, the results of the diagnostic tests were examined in this group of 'false-positives'. In most cases, this turned out to involve a temporary loss of hearing. From the viewpoint of screening, the equipment used to test these children's hearing performed adequately. However, the children do not belong to the screening's target group.*

***** Neither the percentage of false-negative referrals nor screening sensitivity can be accurately measured. This is because the matter of whether late onset hearing impairments were already present at the time of the newborn hearing screening cannot be reliably determined.*

[#] In connection with the temporary cessation of newborn hearing screening at the start of the COVID-19 pandemic (24 March to 4 May 2020), the percentage of children that was screened on time in 2020 is lower than in previous years.

For more figures regarding the results of newborn hearing screening by Child and Youth Health Services, please refer to the newborn hearing screening monitor: www.pns.nl/gehoortest-baby/professionals/evaluatie.

4

Implementation

Process

Selection
- Once the parents have registered the birth, the child’s details are forwarded from the Municipal Personal Records Database (BRP) to the youth health care organisations.
- The child’s data in the youth health care organisations’ information systems is then input to the central administration system for newborn hearing screening (CANG; also known as the newborn hearing screening information system (NIS)).

Invitation
- In the third trimester of pregnancy, the obstetric care provider (midwife, gynaecologist, or general practitioner who practises obstetrics) gives the parents a leaflet containing general information about the hearing screening and blood spot screening (‘Blood spot and hearing *screening in newborns’)*.
- When they go to register the birth, the parents will be given another copy of this leaflet.
- In the case of digital birth registrations, the municipality is required to send the parents a link to the leaflet and its translations (www.rivm.nl/geboorte).
- Child and Youth Health Services makes an appointment for the hearing screening and blood spot screening to be performed at the parental home. The screeners will occasionally visit the parents without first making an appointment.
- In the provinces of Zuid-Holland and Gelderland, some youth health care organisations offer hearing screening at child health clinics, because blood spot screening there is performed by midwives and not by Child and Youth Health Services. The parents will receive an invitation to this end.

The screening test
- The newborn hearing screening should generally be performed as soon as possible after a period of 96 hours has passed, and certainly no later than 168 hours after birth. The hearing screening is performed in hospital after four to five weeks, if the child has not been discharged by that time. In the case of premature births, this period can be adjusted in line with the actual duration of the pregnancy.
- If the hearing test gives an abnormal result for one or both ears, it can be repeated two more times, usually at one-week intervals.
- During the first two rounds, screening is performed in accordance with the OAE (oto-acoustic emissions) method. In the third round,

the AABR (Automated Auditory Brainstem Response) method is used. Both of these screening methods give immediate results.

- In the case of certain situations/conditions (such as after an exchange transfusion), AABR is the method of choice for screening as hearing impairment in these cases cannot always be detected with the OAE method.

Referral

- In the event of an abnormal assessment result, the child is referred to an Audiology Centre for further diagnostic testing and, if necessary, treatment.

Who is involved in the population screening programme?

- The Municipal Executive is responsible for Child and Youth Health Services.
- The youth health care organisations are responsible for the implementation of the Youth Healthcare Services Basic Package, which includes newborn hearing screening, on behalf of the Municipal Executive.
- At national level, screening is directed and coordinated by The Dutch National Institute for Public Health and the Environment's (RIVM-CvB) Centre for Population Screening, on behalf of the Dutch Ministry of Health, Welfare and Sport.
- The first and second screenings are carried out by screeners from youth health care organisations. In a few cases, however, these organisations outsource this work to maternity care organisations.
- The co-ordination of newborn hearing screening at youth health care organisation level is carried out by one of the 30 or so regional co-ordinators. These co-ordinators are usually employed by the youth health care organisations. A number of youth health care organisations have procured these services from The Dutch Foundation for Deaf and Hearing Impaired Children (NSDSK). The regional co-ordinators carry out the third screening round, monitor the screening process, provide on-the-job training for OAE screeners, offer refresher courses and, if necessary, coaching to the screeners, and assist with the interim monitoring of performance quality at screener level.
- The annual monitoring of screening quality is carried out by an independent external organisation. To date, this work has been performed by the Netherlands Organisation for Applied Scientific Research (TNO).
- The Programme Committee for Newborn Hearing Screening, which was established by RIVM's Centre for Population Screening (RIVM-CvB), advises the RIVM-CvB on the national supervision and co-ordination of the programme. The Programme Committee is composed of experts from relevant professional groups and organisations (including parents' organisations).

See the Policy framework for Prenatal and Neonatal Screening for further details about the organisation at national level.

Link to care

In general, every child that is referred from screening will attend an Audiology Centre for diagnostic testing and, if necessary, treatment. The first visit to the Audiology Centre must take place within 24 days of referral. Diagnostic testing must then be completed within the first three months of life. This timeline may be corrected in the case of premature births.

In general, hearing aids are prescribed for children with bilateral hearing loss who have a hearing loss of at least 40 dB in their best ear. In addition, family support services can also be called upon. The intervention must be started before the child reaches the age of six months.
If necessary, the GP can refer the child to one of the University Medical Centres for further assessment of the cause of the hearing impairment.

The regional co-ordinator monitors the link to care as closely as possible, and reports to his/her youth health care organisation if the parents decide not to participate. This is important because at the time of referral the risk of permanent hearing loss in one or both ears is 35%, on average. If the screening detects hearing loss in both ears, the risk of permanent hearing loss in both ears can even be as high as 60%.

Advantages and disadvantages

Advantages

The early identification and treatment of hearing disorders in young children can effectively stimulate the development of speech and language (including spoken language). This, in turn, will improve the developmental potential of hearing impaired and deaf children.

Disadvantages

- Children with mild hearing loss are not detected. This may include children with progressive hearing loss.
- Soon after its birth, parents have to face the fact that their child has a hearing impairment. Seventy-eight percent of parents whose children obtained insufficient results in all three screening rounds feel that it is important (or very important) for their child’s hearing to be tested at this age. Furthermore, no less than 88% of parents whose children have permanent hearing loss in both ears felt this way[5].

5 History

In the Netherlands, Child and Youth Health Services has been screening hearing in young children since the 1960s. This was initially done at the age of nine months, making use of children’s natural responsiveness to sound (the Ewing test). In the early 1990s, an automated version of this screening test was developed and introduced by The Dutch Foundation for Deaf and Hearing Impaired Children (NSDSK).

In the late 20th century it was found that if children started treatment for hearing impairment before they reach the age of six months this has a beneficial effect on their language and speech development. This was made possible by the introduction of screening equipment that could be used to screen hearing in newborns. Newborn hearing screening made it possible to reduce referral rates to Audiology Centres from 5% – 6% (for hearing screening at the age of nine months) to less than 0.3%. Following a pilot study, newborn hearing screening was introduced from 2002-2006 in Child and Youth Health Services under the direction of The Dutch Foundation for Deaf and Hearing Impaired Children (NSDSK) and the Netherlands Organisation for Applied Scientific Research (TNO). The final evaluation was carried out jointly by TNO and NSDSK[5]. This hearing screening had already been introduced in neonatal intensive care units (NICUs) a few years earlier.

When they were introduced, the national screening protocol, the use of the same screening equipment, and the central administration system for newborn hearing screening (CANG) immediately presented an ideal opportunity for quality control.

6 Developments

Temporary cessation of newborn hearing screening at the start of the COVID-19 pandemic

At the start of the COVID-19 pandemic, newborn hearing screenings were temporarily halted from 24 March 2020 to 4 May May 2020. Children who were unable to be screened during that period should preferably have been screened by 4 August. The effect of cancelling hearing screening procedures was studied by TNO on behalf of the RIVM-CvB through subgroup analyses. The results are outlined in the monitoring report for 2020. As a result of the considerable efforts of Child and Youth Healthcare Services, participation per round of screening remained high. Approximately 250 additional children did not receive a hearing screening compared to previous years. The extent to which children with hearing loss were missed as result of this is unknown. However, based on the detection figure for hearing loss in the Child and Youth Healthcare Services population (average of 1.23 per 1,000), it is expected that no more than one child with hearing loss was missed due to the slight reduction in participation.

New screening protocols in Guidelines

As of January 2021, the Child and Youth Healthcare Services Newborn Hearing Screening Guidelines (Draaiboek Neonatale Gehoorscreening JGZ) contains two new appendices: the screening protocol for children with atresia and the screening protocol for children with Down’s Syndrome, other syndromes, severe congenital disorder, schisis or congenital loss of hearing in the family. These children are eligible for a shortened screening track.

7 Financial

The funding of newborn hearing screening, which is part of the funding of the Child and Youth Healthcare Services Basic Package, is provided by the municipalities.

8 International

Newborn hearing screening has been introduced in most Western countries, as well as in various Middle Eastern and Far Eastern countries.

In contrast to most other countries, hearing screening in the Netherlands is performed at home, not in hospital. The reason for this is that most Dutch children are either born at home or are taken home within 1-2 days of their birth.

The Netherlands was one of the first countries in the world to have newborn hearing screening with nationwide coverage. Compared to screening programmes elsewhere, the Netherlands has a high participation rate and one of the lowest referral rates to Audiology Centres.

9 Websites

www.pns.nl/gehoortest-baby (public)
www.pns.nl/gehoortest-baby/professionals (professionals)
www.nsdsk.nl (The Dutch Foundation for Deaf and Hearing Impaired Children)
www.isala.nl/gehoorscreening (hearing screening in neonatal intensive care units (NICUs))
www.gov.uk/topic/population-screening-programmes/newborn-hearing

10 Contact

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2. Nelson HD, Bougatsos C and Nygren P. Universal Newborn Hearing Screening: Systematic Review to Update the 2001 US Preventive Services Task Force Recommendation. Pediatrics 2008; 122: e266-e267.
3. Monitoring reports of Child and Youth Health Services' newborn hearing screening: www.pns.nl/gehoortest-baby/professionals/evaluatie.
4. Annual reports of newborn hearing screening in neonatal intensive care units (NICUs): www.isala.nl/nicu-neonatale-

gehoorscreening/jaarverslagen-publicaties-boekbijdragen-en-voordrachten/.

5. Kaufmann–de Boer, M., Uilenburg, N., Schuitema, T., Vinks, E., van den Bring, G., van der Ploeg, K., Hille, E., Verkerk, O, Landelijke implementatie Neonatale Gehoorscreening (National Implementation of Newborn Hearing Screening). Amsterdam: 2006.