



## **Summary: Hearing Screening Finland**

**Produced as part of Work Package 4**

**Date: 2019-03-22**

**Allison Mackey & Inger Uhlén**

Karolinska Institutet, Stockholm Sweden

**Hearing screening representatives for Finland:** Riina Niemensivu, Helsinki University Hospital, Department of Ear, Nose, Throat, Head and Neck Surgery & Tytti Willberg, Turku University Hospital.

**General information acquired from:** Marke Hietanen-Peltola, The National Institute for Health and Welfare, Department of Child, Youth and Family

**Disclaimer:** This is a summary report representing the responses from a screening expert working within hearing care services of the country or region reported. This report is the product of professional research conducted for the EUSCREEN study and does not represent conclusions made by the authors. It is not meant to represent the position or opinions of the EUSCREEN study or its Partners. Efforts were made to cross-check the information supplied; however, not all information supplied is fully verified by the authors.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 733352

## Table of Contents

List of Tables.....	4
1. Glossary of Terms: Hearing Screening .....	5
2. Abbreviations .....	8
3. Background.....	9
3.1. General.....	9
3.2. Neonatal hearing screening.....	9
3.3. Preschool hearing screening .....	10
4. Guidelines & Quality Control .....	11
5. Process: Screening, Diagnosis, Intervention .....	12
5.1. Neonatal hearing screening.....	12
5.2. Neonatal diagnostic assessment.....	12
5.3. Preschool hearing screening .....	12
5.4. Intervention approach .....	12
6. Protocols .....	13
6.1. Neonatal hearing screening (well) .....	13
6.2. Neonatal hearing screening (at-risk).....	13
6.3. Preschool hearing screening .....	13
7. Professionals.....	15
7.1. Neonatal hearing screening (well) .....	15
7.2. Neonatal hearing screening (at-risk).....	15
7.3. Preschool hearing screening .....	15
8. Results: Neonatal Hearing Screening.....	16
8.1. Coverage and attendance rates.....	16
8.2. Referral rates.....	16
8.3. Diagnostic assessment attendance .....	16
8.4. Prevalence / Diagnosis.....	16
8.5. Treatment success .....	16
8.6. Screening evaluation.....	16
9. Results: Preschool Hearing Screening.....	18
9.1. Coverage and attendance rates.....	18
9.2. Referral rates.....	18
9.3. Diagnostic assessment attendance .....	18
9.4. Screening evaluation.....	18
10. Costs: Neonatal Hearing Screening .....	19



- 10.1. Screening costs ..... 19
- 10.2. Equipment costs ..... 19
- 10.3. Staff costs..... 19
- 10.4. Diagnostic costs ..... 19
- 10.5. Amplification costs ..... 19
- 10.6. Social costs ..... 19
- 11. Costs: Preschool Hearing Screening ..... 20
  - 11.1. Screening costs ..... 20
  - 11.2. Equipment costs ..... 20
  - 11.3. Staff costs..... 20
- 12. References ..... 21

## List of Tables

<b>Table 1:</b> Screening process for well babies in Finland. ....	13
<b>Table 2:</b> Process for preschool and school hearing screening in Finland (Aarnisalo & Luostarinen, 2016). ....	14
<b>Table 3:</b> Prevalence of permanent hearing loss among neonates in Finland (per 1000; Mäki-Torkko, 1999) ....	16
<b>Table 4:</b> Prevalence of permanent hearing loss among preschool/school children in Finland (per 1000; Dietz, et al., 2009; Häkli, et al., 2014). ....	16



## 1. Glossary of Terms: Hearing Screening

<b>Abnormal test result</b>	A test result where a normal “pass” response could not be detected under good conditions. The result on screening equipment may indicate “no response,” “fail,” or “refer.”
<b>Attendance rate</b>	<p>The proportion of all those <u>invited for screening</u> that are <u>tested and receive a result</u>,</p> <ul style="list-style-type: none"> <li>• <u>Invited for screening</u> includes all those that are offered the screening test.</li> <li>• <u>Tested and receive a result</u> could be a “pass” or “fail”.</li> </ul> <p>Attendance rate provides information on the willingness of families to participate in screening.</p>
<b>Attendance rate in first year of life</b>	<p>See definition of <b>Attendance rate</b>.</p> <p>The calculation cut-off is after <u>one year of life</u>.</p>
<b>Compliance with referral (percentage)</b>	<p>The percentage of those who are <u>referred from screening</u> to a diagnostic assessment that actually <u>attend</u> the first diagnostic assessment.</p> <p>Percentage of compliance provides information on the willingness of families to attend the diagnostic assessment after referral from screening.</p>
<b>Coverage</b>	<p>The proportion of those <u>eligible for screening</u> that are <u>tested and receive a result</u> within a <u>specific time</u>.</p> <ul style="list-style-type: none"> <li>• <u>Eligible for screening</u> includes those within the population that are covered under the screening or health care program.</li> <li>• <u>Tested and receive a result</u> could be a “pass” or “refer to diagnostic assessment”.</li> <li>• <u>Specific time</u> can be defined, such as 1 month after birth, 3 months after birth, etc.</li> </ul> <p>Coverage provides information on the overall effectiveness and timeliness of a complete screening programme.</p> <p>Factors such as being offered screening, willingness to participate, missed screening, ability to complete the screen, and ability to document the screening results will influence the coverage.</p>
<b>Coverage in first year of life</b>	<p>See definition of <b>Coverage</b>.</p> <p>The <u>specific time</u> is pre-defined as within the first year of life.</p> <p>In other words, the coverage is the proportion of those eligible for screening that complete the screening sequence to a final result within the first year of life.</p>
<b>False negatives</b>	The percentage of <u>infants/children with a hearing loss</u> (defined by the target condition) that <u>receive a result of “pass”</u> during screening.



	Example: If 100 infants with hearing loss are screened, and 1 infant passes the screening, the percentage of false negatives is 1%.
<b>False positives</b>	<p>The percentage of <u>infants/children with normal hearing</u> that <u>receive a result of “fail”</u> from the final screening test.</p> <p>Example: If 100 infants with normal hearing are screened, and 3 infants fail the screening and are referred for diagnostic assessment, the percentage of false positives is 3%.</p>
<b>Guidelines</b>	Recommendations or instructions provided by an authoritative body on the practice of screening in the country or region.
<b>Hearing screening professional</b>	A person qualified to perform hearing screening, according to the practice in your country or region.
<b>Inconclusive test result</b>	A test result where a normal “pass” response could not be detected due to poor test conditions.
<b>Invited for screening</b>	Offered screening.
<b>Outcome of hearing screening</b>	An indication of the effectiveness or performance of screening, such as a measurement of coverage rate, referral rate, number of infants detected, etc.
<b>Permanent hearing loss</b>	<p>A hearing impairment that is <i>not</i> due to a temporary or transient condition such as middle ear fluid.</p> <p>Permanent hearing loss can be either sensorineural or permanent conductive.</p>
<b>Positive predictive value</b>	<p>The percentage of infants/children referred from screening who have a confirmed <u>hearing loss</u>, as described by your protocol or guideline and indicated in the <b>Target Condition</b> (see definition).</p> <p>For example, if 100 babies are referred from screening for diagnostic assessment and 90 have normal hearing while 10 have a confirmed hearing loss, the positive predictive value would be 10%.</p>
<b>Preschool or (pre)school children</b>	All children between 3-6 years of age.
<b>Preschool or (pre)school screening</b>	<p>Screening that takes place during the time children are between 3-6 years of age.</p> <p>This refers to <i>any</i> hearing screening during this age. The location of the screening is irrelevant to the definition.</p>



<b>Prevalence</b>	The number or percentage of individuals with a specific disease or condition. Prevalence can either be expressed as a percentage, proportion, or as the value per 1000 individuals within the same demographic.
<b>Programme</b>	An organized system for screening, which could be based nationally, regionally or locally.
<b>Protocol</b>	Documented procedure or sequence for screening, which could include which tests are performed, when tests are performed, procedures for passing and referring, and so forth.
<b>Quality assurance</b>	A method for checking and ensuring that screening is functioning adequately and meeting set goals and benchmarks.
<b>Referral criteria</b>	<p>A pre-determined cut-off boundary for when an infant/child should be re-tested or seen for a diagnostic assessment.</p> <p>For example, referral criteria may be “no response” at 35 dB nHL.</p>
<b>Risk babies / Babies at-risk</b>	<p>All infants that are considered to be at-risk or have risk factors for hearing loss according to the screening programme.</p> <p>Two common risk factors are admission to the neonatal-intensive care unit (NICU) or born prematurely. However, other risk factors for hearing loss may also be indicated in the screening programme.</p>
<b>Sensitivity</b>	<p>The percentage of infants/children with hearing loss that are identified via the screening program.</p> <p>For example, if 100 babies with hearing loss are tested, and 98 of these babies are referred for diagnostic assessment while 2 pass the screening, the sensitivity is 98%.</p>
<b>Specificity</b>	<p>The percentage of infants/children with normal hearing that pass the screening.</p> <p>For example, if 100 babies with normal hearing are tested, and 10 of these babies are referred for diagnostic assessment and 90 pass the screening, the specificity is 90%.</p>
<b>Target condition</b>	<p>The hearing loss condition you are aiming to detect via your screening programme. This includes:</p> <ul style="list-style-type: none"> <li>• The <u>laterality of the condition</u>, whether the program aims to detect both unilateral and bilateral hearing loss or just bilateral hearing loss.</li> <li>• The <u>severity of the condition</u>, whether the program aims to detect hearing loss <math>\geq 30</math> dB HL, <math>\geq 35</math> dB HL, <math>\geq 40</math> dB HL or <math>\geq 45</math> dB HL</li> </ul>
<b>Well, healthy babies</b>	<p>Infants who are <i>not</i> admitted into the NICU or born prematurely.</p> <p>Well, healthy babies may or may not have additional risk factors for hearing loss, according to the procedures indicated in the specific screening programme.</p>



## **2. Abbreviations**

ABR – auditory brainstem response

aABR – automatic auditory brainstem response

ANSD – auditory neuropathy spectrum disorder

ASSR – auditory steady-state response

CI – cochlear implant

CMV – cytomegalovirus

dB HL – decibel hearing level

dB nHL – decibel normalized hearing level

dB SNR – decibel signal-to-noise ratio

DPOAE – distortion product otoacoustic emissions

HA – hearing aid

NICU – neonatal intensive care unit

OAE – otoacoustic emissions

TEOAE – transient-evoked otoacoustic emissions



### 3. Background

In Finland, there is a national guideline for newborns and for preschool hearing screening. However, for newborn hearing screening, each hospital organizes its own protocol. For pre-school screening, Child Health Centres work regionally but are supervised nationally.

The following report contains information with regards to hearing screening in the entire country of Finland.

#### 3.1. General

The country of Finland has a total area of 390 905 km<sup>2</sup> (National Land Survey of Finland, 2018) and a population of 5 506 312 as of May 2017 (Statistics Finland, 2018). In Finland, each birth is registered with the Medical Birth Registry. The number of live births in Finland was 52 814 in 2016 (Statistics Finland, 2018).

The World Bank income classification categorizes Finland as a high-income country (The World Bank, 2018). The gross domestic product (GDP) is €39 327 per capita as of 2016 (Statistics Finland, 2018).

From the World Health Organization (WHO) Global Health Expenditure Database, health expenditure in Finland in 2015 was 4132 USD or € 3629 per capita (World Health Organization, 2018).

Finland has an infant mortality rate of 1.8 and 1.9 per 1000 in 2015 and 2016, respectively (United Nations Statistics Division, 2016; Statistics Finland, 2018).

#### 3.2. Neonatal hearing screening

In Finland, neonatal hearing screening is conducted universally, with all babies in the country having access to hearing screening. Screening is not obligatory for parents. The universal program for well and at-risk babies was estimated to have been first implemented in 2005, though each hospital started at a different time. By around 2008-2010 by estimate, implementation was complete across all hospitals. Neonatal hearing screening is embedded in the Preventive Child Health Care screening system. The programme is funded through the state, which provides money to the municipalities to organize screening (along with other health care services).

While there is a national hearing screening guideline indicating that childhood screening must be organized by law, hospitals use different protocols for neonatal screening, and therefore tests to perform and when to refer may differ regionally. There is no specific national guideline for screening at-risk babies. At-risk babies may be screened or referred for diagnostic assessment in some hospitals, or at the discretion of the neonatologist or paediatrician, regardless of a pass on screening.

It is estimated that neonatologists or paediatricians may refer onward babies who have facial anomalies, perinatal infections, cCMV, intrauterine infections, syndromes associated with being at risk for hearing loss, a family histories of hearing loss, or on ototoxic medications.

Babies who meet these conditions may be referred because of the increased risk of hearing loss, or the presence of a medical condition that contraindicates conventional hearing screening (e.g., aural atresia).

The prevalence of CMV infections among neonates is 0.2% and the incidence of meningitis is not known.



### **3.3. Preschool hearing screening**

In Finland, preschool/school hearing screening exists nationally, and each Child Health Care Centre follows a protocol stipulated in the national guideline. Therefore, in contrast to neonatal hearing screening, there are no differences in preschool/school hearing screening protocols across regions. Preschool hearing screening has existed for a long time in Finland. It is estimated that preschool hearing screening in Finland started around the 1950s to 1960s. It is funded by municipalities.



#### **4. Guidelines & Quality Control**

Neonatal hearing screening in Finland follows the national hearing screening guidelines, though national protocols do not exist for either well or at-risk babies. In contrast, preschool/school hearing screening in Finland follows a national guideline (Aarnisalo & Luostarinen, 2016).

The content of the screening guideline was developed and planned by a group of experts (ENT and pediatricians) together with the public servants in the Ministry of Health. The screening programme is then carried out by municipalities.

Since its initiation, the guidelines have not been revised. The process and funding for revision of the guidelines is unknown.

In Finland, the Ministry of Social Affairs and Health supervises and guides neonatal and preschool/school hearing screening; however, the actual hearing screening programme is run locally, carried out by health care professionals in the maternity hospitals, Child Health Care Centres and schools. It is not indicated how quality assurance is carried out for neonatal hearing screening. The quality of Child Health Care Centres, which are responsible for performing preschool/school hearing screening, are monitored by the government.

Information was not provided on whether annual reports are available on either the neonatal hearing screening program, nationally or locally, or the preschool hearing screening program.

Studies have been performed on the effectiveness of hearing screening in Finland (Finnish Office for Health Technology Assessment (FinOHTA), 2005), and a study is also currently being planned.



## 5. Process: Screening, Diagnosis, Intervention

### 5.1. Neonatal hearing screening

In Finland, there are 5 university hospitals, 16 central hospitals, and about 50 small regional hospitals. Well-babies and at-risk babies are screened in the maternity wards or NICU in the hospital, where the average length of stay after delivery is around 2-3 days. It is estimated that almost 100% of children are born in hospitals and only 0 to 1% of births take place at home. About 10% of neonates are taken in to the NICU for monitoring (lighter surveillance), although the percentage of children fully admitted to the NICU in Finland is much lower.

Well-baby screening should be completed before 1 month of age. For infants at-risk, screening should be completed between 1-3 months of age, depending on the risks and wellbeing of the infant. However, there is no national guideline on the recommended age to complete screening. Instead, there is general consensus that diagnostic testing should be completed before 3 months of age, and screening should therefore be completed well before that age.

The target condition for screening for well babies is a bilateral hearing loss of 30 dB HL or greater. The target condition for screening at-risk babies is a bilateral or unilateral hearing loss of 30 dB HL or greater.

### 5.2. Neonatal diagnostic assessment

The diagnostic assessment of well-babies should be performed before 3 months of age or 6 months at the very latest; however, there are no national guidelines on age of diagnosis. The diagnostic assessment tests performed are TEOAEs, ABR and ASSR.

### 5.3. Preschool hearing screening

Preschool-age hearing screening takes place at the Child Health Care Centers during the annual well-child visits when the child is 4-5 years old and again at the age of 5-6 years old. There are many Child Health Care Centers in bigger cities and one in small cities and municipalities.

Parents are required to make the appointment through their local public health care centers, otherwise they are contacted for scheduling. Some public health care centers may send out invitations via mail.

The target condition for preschool-age screening is a hearing loss in one or both ears of 25 dB HL or greater.

### 5.4. Intervention approach

In Finland, treatment options available include grommets, hearing aids, bone conductive devices, and cochlear implants. Infants are fitted with hearing aids from less than 6 months of age. Infants are fitted with cochlear implants from 6-12 months of age. The hearing aid fitting criteria is a hearing loss of >20 dB HL in the better ear at frequencies from 500 to 4000 Hz.

## 6. Protocols

Hearing screening protocols are described for neonatal hearing screening (well and at-risk) as well as for preschool hearing screening when applicable.

- The Test performed is the screening technique used
- The Age of the child is indicated in hours, days, months or years
- Referral criteria may be the lack of an OAE response at specified frequencies, a response-waveform repeatability constant, the absence of an aABR response at a specified intensity, or an absent behavioural response at a specified intensity. Referral criteria may be defined within a protocol or limited based on the device used.
- The Device is the screening device used.
- Unilateral Referrals indicates whether children are referred if only one ear fails screening.
- The Location is where the screening takes place

### 6.1. Neonatal hearing screening (well)

The neonatal hearing screening process is not defined in a national protocol; instead, each hospital is responsible for developing its own protocol; however, the process for neonatal hearing screening is similar across the country.

In Finland, all newborn babies are screened before leaving the hospital, and if they do not pass screening, they are invited for rescreening within one month. If the rescreening attempt does not pass, the baby is referred to ENT hearing center at about 2-3 months of age.

A screening protocol for well babies is indicated in Table 1. Some maternity clinics have aABR equipment, in which case they may perform aABR as their second or third step, while others only use OAE. Furthermore, some hospitals will refer an infant onwards with a unilateral fail, while other hospitals require both ears to fail screening before referral.

The University Hospitals in Finland are in the process of considering screening both ears, and referring infants for diagnostic with a passing result in one ear only. There is ongoing discussion in Finland over the optimal protocol for well-baby screening.

**Table 1:** Screening process for well babies in Finland.

Test	Age	Referral criteria	Device	Unilateral Referrals?	Location
OAE1	24-72 hours	Not specified	Not specified	Varies	Hospital
OAE2	Before discharge	Not specified	Not specified	Varies	Hospital
OAE3 or aABR (some)	Before discharge / < 1 month	35 dB nHL	Not specified	Varies	Hospital

### 6.2. Neonatal hearing screening (at-risk)

The screening process of infants at-risk is similar to the protocol for well babies in Table 1, except that babies at risk may be referred to ENT clinics for an aABR, regardless of OAE result at the initial screen is a pass or refer. That being said, there is no specific protocol for how to handle at-risk babies or which babies are considered at-risk.

### 6.3. Preschool hearing screening



Hearing screening is performed at two well-child check-ups, at age 4 if possible and again at age 5-6. Screening audiometers are used to perform behavioural air-conduction screening at 20 dB HL at the frequencies 250, 500, 1000, 2000 and 4000 Hz. The first (training) tone is presented at 50 dB HL at 1000 Hz. The child is instructed to indicate a response to each tone presented, often using a toy (e.g., place a stick in a box, a ring on a peg, etc.). After training at 50 dB HL, the 20-dB HL screening level is presented across frequencies starting with 1000 Hz, then 2000 Hz, 4000 Hz, 1000 Hz (again), 500 Hz, and finally 250 Hz (Aarnisalo & Luostarinen, 2016).

Hearing status is indicated at each frequency with a + or – symbol, and results are recorded in the patient record.

If the child refers from preschool screening, then a diagnostic pure-tone audiogram is performed on the failed frequencies to assess the hearing impairment. A follow-up retest is scheduled in 1-2 months if there is an obvious cause for impairment, such as recent otitis media. Otherwise, the child is referred to an ENT clinic for assessment.

**Table 2:** Process for preschool and school hearing screening in Finland (Aarnisalo & Luostarinen, 2016).

<b>Test</b>	<b>Age</b>	<b>Referral criteria</b>	<b>Unilateral Referrals?</b>	<b>Location</b>
Pure-tone screening	4 years and 5-6 years	Threshold >20 dB HL (250-4000 Hz)	Yes	Child Health Centre



## **7. Professionals**

### **7.1. Neonatal hearing screening (well)**

Screening for well babies is performed by nurses or midwives in the hospitals.

Nurses and midwives are trained on how to operate the devices, but this training is done on the job during routine clinical work by nurses and midwives with experience.

### **7.2. Neonatal hearing screening (at-risk)**

Screening for at-risk infants in NICUs is also performed by nurses or midwives in the hospital and audiologists or ENT doctors at the audiology centre (see above).

### **7.3. Preschool hearing screening**

Screening for preschool-age children is performed by nurses at the Child Health Care Centres. Nurses are trained on how to perform hearing screening.

## 8. Results: Neonatal Hearing Screening

### 8.1. Coverage and attendance rates

In Finland, coverage and attendance rate is believed to be close to 100%, given that one of the requirements for discharging a baby from a maternity ward is the completion of hearing screening. However, there are no data collected on coverage or attendance rates.

### 8.2. Referral rates

Referral rates for the neonatal screening are unknown

### 8.3. Diagnostic assessment attendance

Compliance to referral for diagnostic assessment is unknown; however, it is estimated to be very good. A follow-up appointment is scheduled at the time of referral. If a family has missed multiple referral appointments, a note is sent the child's well-baby clinic and further action may be pursued by the child's appointed doctor or nurse.

### 8.4. Prevalence / Diagnosis

The known prevalence values of permanent hearing loss among neonates in Finland is presented in Table 3, though these data were published before the implementation of neonatal hearing screening. The prevalence of unilateral neonatal hearing loss in Finland would be difficult to establish, as only children who fail the screening on both ears are referred for further testing in some hospitals.

**Table 3:** Prevalence of permanent hearing loss among neonates in Finland (per 1000; Mäki-Torkko, 1999)

	Bilateral		Unilateral	
	≥ 40 dB HL	≥ 80 dB HL	≥ 40 dB HL	≥ 80 dB HL
Prevalence per 1000 (Mäki-Torkko, 1999)	1.0			

The prevalence of permanent hearing loss among preschool- or school-aged children in Finland is presented in Table 4. Data are not available for unilateral hearing loss, as values are defined for the better ear.

**Table 4:** Prevalence of permanent hearing loss among preschool/school children in Finland (per 1000; Dietz, et al., 2009; Häkli, et al., 2014).

	Bilateral			Unilateral	
	≥ 20 dB HL	≥ 40 dB HL	≥ 80 dB HL	≥ 40 dB HL	≥ 80 dB HL
Dietz, et al., 2009	2.1 (age 7)*	1.2 (age 7)*			
Häkli, et al., 2014	2.3 (age 10)	1.1 (age 10)			

\*Includes only sensorineural hearing loss

### 8.5. Treatment success

Information is not provided on how many children are fitted with hearing aids or cochlear implants each year.

### 8.6. Screening evaluation



Data are unavailable with regards to the false positive or negatives associated with neonatal hearing screening for well babies or at-risk babies. However, it is assumed that any missed hearing loss after screening is due to a progressive hearing loss.

A positive predictive value of a refer result is estimated at 5-10%; however, these data are unavailable.

The sensitivity and specificity of neonatal hearing screening are unknown.



## **9. Results: Preschool Hearing Screening**

### **9.1. Coverage and attendance rates**

All children are invited to preschool hearing screening, though there are no data available on the coverage of preschool hearing screening. It is generally believed to be very good.

### **9.2. Referral rates**

There are no data available on the referral rates.

### **9.3. Diagnostic assessment attendance**

There are no data available on the compliance to referral for diagnostic assessment; however, the belief is similar to the compliance rate after neonatal hearing screening.

### **9.4. Screening evaluation**

Data are unavailable with regards to the false positive or negatives associated with preschool hearing screening.

A positive predictive value of a refer result is unknown. The sensitivity and specificity are unknown.



## 10. Costs: Neonatal Hearing Screening

Neonatal hearing screening in Finland is free of charge for parents. There is no financial reward when parents attend hearing screening, and there is no penalty for those who do not attend hearing screening.

There has not been a cost effectiveness analysis completed in Finland.

### 10.1. Screening costs

The total screening annual costs for all neonatal hearing screening in Finland is unknown.

### 10.2. Equipment costs

Equipment is maintained by engineers in the hospitals, and costs are therefore unknown.

### 10.3. Staff costs

In Finland, the yearly salary for a nurse is 40 000 euros per year. However, not all nurses or midwives perform screening and nurses and midwives at the maternity hospitals perform tasks other than hearing screening.

The cost for the education to become a nurse or midwife is not known.

### 10.4. Diagnostic costs

The cost to the parents for a diagnostic hearing assessment, in cases the baby is referred to the hospital ENT clinic is about €30 euros. While the family pays only a small amount, the municipality pays a much larger amount, about €200 to €300.

### 10.5. Amplification costs

In Finland, all children with hearing loss are treated; however, children may not be fitted with cochlear implants if deaf parents refuse this type of intervention.

The costs for hearing aids are not provided. The most recent tender for the least advanced cochlear implant is €12000, though exact data for this information are unavailable.

### 10.6. Social costs

In the capital region there is one school that provides classes for deaf and hard of hearing students; however, most hearing-impaired children are integrated into mainstream classrooms. Special support in schools may include a personal assistant, personalized study plans, assistive listening devices. These accommodations are financed through the state and municipalities, though data on costs are not available.



## **11. Costs: Preschool Hearing Screening**

### **11.1. Screening costs**

Screening costs for preschool hearing screening are unknown as screening is embedded in the annual well-child visits.

### **11.2. Equipment costs**

Costs for screening audiometers are not provided.

### **11.3. Staff costs**

In Finland, the yearly salary for a nurse is €40 000 per year. However, not all nurses perform screening and nurses at the Child Health Care Centres perform tasks other than hearing screening. Nurses that work at Child Health Care Centres are often long-time employees.

## 12. References

- Aarnisalo, A., & Luostarinen, L. (2016). Kuulon tutkiminen. In P. Mäki, K. Wikström, T. Hakulinen, & T. Laatikainen, *Terveystarkastukset lastenneuvolassa & kouluterveydenhuollossa. Opas 14* (Vol. 4, pp. 75-81). Helsinki: National Institute for Health and Welfare (THL).
- Dietz, A., Löppönen, T., Valtonen, H., Hyvärinen, A., & Löppönen, H. (2009). Prevalence and etiology of congenital or early acquired hearing impairment in Eastern Finland. *International Journal of Pediatric Otorhinolaryngology*, 1353-1357.
- Finnish Office for Health Technology Assessment (FinOHTA). (2005). *Kuulon seulonta vastasyntyneillä [Newborn hearing screening]*. Helsinki: Finnish Office for Health Technology Assessment (FinOHTA).
- Häkli, S., Luotonen, M., Bloigu, R., Majamaa, K., & Sorri, M. (2014). Childhood hearing impairment in northern Finland, etiology and additional disabilities. *International Journal of Pediatric Otorhinolaryngology*, 1852-1856.
- Health Service Executive (HSE). (2017). *Health Services Executive School Hearing Screening Policy*. Health Services Executive.
- Mäki-Torkko, E. M. (1999). Late ascertainment of childhood hearing impairments - a fact, not fiction. *Finnish Journal of Logopedics and Phoniatrics*, 19(1), 10-14.
- Mäki-Torkko, E. M., Lindholm, P. K., Väyrynen, M. R., Leisti, J. T., & Sorri, M. J. (1998). Epidemiology of Moderate to Profound Childhood Hearing Impairments in Northern Finland. Any Changes in Ten Years? *Scandinavian Audiology*, 27(2), 95-103.
- National Land Survey of Finland. (2018). *NLS*. Retrieved from <https://www.maanmittauslaitos.fi/en>
- Statistics Finland. (2018). *PX-Web API*. Retrieved from Statistics Finland: <https://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/?rxid=96e06fdc-cd01-4cc3-ae2f-89f7af1eb0ef>
- The World Bank. (2018). *World Bank GNI per capita Operational Guidelines & Analytical Classifications*. The World Bank.
- United Nations Statistics Division. (2016). *Demographic Yearbook – 2016*. Department of Economic and Social Affairs. New York: United Nations.
- World Health Organization. (2018). *Global Health Expenditure Database*. (W. H. Organization, Producer) Retrieved 08 01, 2018, from NHA Indicators: <http://apps.who.int/nha/database/DataExplorerRegime.aspx>