



Summary: Hearing Screening

Turkey

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Allison Mackey & Inger Uhlén

Karolinska Institutet, Stockholm Sweden

Hearing screening representatives for Turkey: Mine Baydan, Department of Audiology, Ankara University

General information acquired from answers by: Ciler Tezcaner, Otorhinolaryngology Department, Ankara University School of Medicine

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1. Glossary of Terms: Hearing Screening

Abnormal test result	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.”
Attendance rate	<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"> • <u>Invited for screening</u> includes all those that are offered the screening test. • <u>Tested and receive a result</u> could be a “pass” or “fail”. <p>Attendance rate provides information on the willingness of families to participate in screening.</p>
Attendance rate in first year of life	<p>See definition of Attendance rate.</p> <p>The calculation cut-off is after <u>one year of life</u>.</p>
Compliance with referral (percentage)	<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>
Coverage	<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"> • <u>Eligible for screening</u> includes those within the population that are covered under the screening or health care program. • <u>Tested and receive a result</u> could be a “pass” or “refer to diagnostic assessment”. • <u>Specific time</u> can be defined, such as 1 month after birth, 3 months after birth, etc. <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>
Coverage in first year of life	<p>See definition of Coverage.</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>
False negatives	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%.
False positives	<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>
Guidelines	Recommendations or instructions provided by an authoritative body on the practice of screening in the country or region.
Hearing screening professional	A person qualified to perform hearing screening, according to the practice in your country or region.
Inconclusive test result	A test result where a normal “pass” response could not be detected due to poor test conditions.
Invited for screening	Offered screening.
Outcome of hearing screening	An indication of the effectiveness or performance of screening, such as a measurement of coverage rate, referral rate, number of infants detected, etc.
Permanent hearing loss	<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>
Positive predictive value	<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 Target Condition (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>
Preschool or (pre)school children	All children between 3-6 years of age.
Preschool or (pre)school screening	<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>



Prevalence	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.
Programme	An organized system for screening, which could be based nationally, regionally or locally.
Protocol	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.
Quality assurance	A method for checking and ensuring that screening is functioning adequately and meeting set goals and benchmarks.
Referral criteria	<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>
Risk babies / Babies at-risk	<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>
Sensitivity	<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>
Specificity	<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>
Target condition	<p>The hearing loss condition you are aiming to detect via your screening programme. This includes:</p> <ul style="list-style-type: none"> • The <u>laterality of the condition</u>, whether the program aims to detect both unilateral and bilateral hearing loss or just bilateral hearing loss. • The <u>severity of the condition</u>, whether the program aims to detect hearing loss ≥ 30 dB HL, ≥ 35 dB HL, ≥ 40 dB HL or ≥ 45 dB HL
Well, healthy babies	<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 Turkey, hearing screening is performed and organized nationally. The following report contains information with regards to childhood hearing screening in the entire country of Turkey.

3.1. General

Turkey has a total area of 783 562 km² with a population of 79 814 871 in 2016 (TurkStat, 2018).

In Turkey, all births are registered through the Ministry of Health. The number of live births in Turkey in 2016 was 1 309 771 (TurkStat, 2018).

The World Bank income classification categorizes Turkey as an upper middle-income country (The World Bank, 2018). The gross domestic product (GDP) in 2016 was 10883 USD or €9 616 per capita (TurkStat, 2018).

From the World Health Organization (WHO) Global Health Expenditure Database, health expenditure for Turkey in 2015 was 455 USD or €402 per capita (World Health Organization (WHO), 2018).

An infant mortality rate of 10.7 per 1000 live births is reported for Turkey (United Nations Statistics Division, 2016; TurkStat, 2018).

3.2. Neonatal hearing screening

In Turkey, neonatal hearing screening is conducted universally. All babies in Turkey have access to hearing screening, and screening is obligatory for parents. Neonatal hearing screening for well and at-risk babies was first implemented in 2000 and became available nationally in 2004. Neonatal hearing screening is embedded in the Preventive Child Health Care screening system and is funded by health insurance.

Neonatal hearing screening is organized by the Turkish Public Health Institution through the Ministry of Health. Each maternity hospital is responsible for training staff, managing equipment, and sending data to the National Institute of Health.

National guidelines and a national neonatal hearing screening protocol are available. Maternity hospitals use the same protocol for performing screening and reporting data across all regions of Turkey. The only protocol difference across regions is with regards to the referral centre for at-risk infants. For regions without a primary health care centre, at-risk infants are then referred to another region.

3.3. Preschool hearing screening

There is currently no preschool hearing screening programme in Turkey.



4. Guidelines & Quality Control

There are national hearing screening guidelines and a protocol for neonatal hearing screening in Turkey (Ministry of Health; Ministry of Health).

The neonatal hearing screening programme was created by the Turkish Public Health Institution. In 2013, the hearing screening programme was changed; however, information regarding the extent of this change is not indicated. It is unknown how often the programme is revised or how these revisions are funded.

Quality assurance of hearing screening programme is imposed by the government. Data are collected through the National Neonatal Hearing Screening Database, which is managed through the Ministry of Health, Health Information Systems. Maternity centres are responsible for entering the screening results into the national database. The national database is owned and operated by the Ministry who is responsible for analysis of data. It is unknown how these data are used for monitoring the effectiveness of the screening programme or how annual reporting is performed within the Ministry; however, some results (coverage rate, referral rate and detection rates) are published in Turkey's Health Yearbook. Only authorized persons have access to these data or reports.

Research performed on the neonatal hearing screening programme in Turkey (e.g., Bolat, Bebitoglu, Ozbas, Altunsu, & Kose, 2009; Kemaloglu, et al., 2016; Konukseven, et al., 2010; Konukseven, et al., 2017).



5. Screening – Diagnosis – Intervention process

5.1. Neonatal hearing screening

Well-babies and at-risk babies are screened in the hospital or private clinic. It is roughly estimated that 99% of births take place in maternity hospitals, where the average length of stay is roughly estimated to be 2 days. Parents/caregivers of well and at-risk babies are invited to participate in neonatal hearing screening directly in the hospital.

It is recommended that screening should be completed within the first 72 hours, and ideally before discharge. However, there is no set maximum time by which screening should be completed; instead, guidelines stipulate a criterion age for the diagnosis of hearing impairment.

At-risk infants are defined as those who were born with assistance of forceps or suction, are premature <35 weeks, weigh less than 1500 kg at birth, have a NICU stay (undefined duration), have atresia or microtia, bacterial meningitis, hyperbilirubinemia, or if the mother had fever-invoking illness during pregnancy.

Data on the prevalence of CMV or meningitis is unknown; though the prevalence rate of CMV is roughly estimated in 0.2 to 2.2 per 1000.

The target condition for screening for well- and at-risk babies is all types and severities of hearing loss, including both unilateral and bilateral. No set target is defined in protocol.

5.2. Neonatal diagnostic assessment

The diagnostic assessment after neonatal hearing screening referral is described in the article by Kemaloglu, et al. (2016) as including OAEs, clinical ABR and behavioural audiometry. The diagnostic assessment should be completed by 3 months of age for well and at-risk infants.

5.3. Preschool hearing screening

Not applicable.

5.4. Intervention approach

In Turkey, treatment options available include hearing aids, bone conductive devices, and cochlear implants. Infants are fitted with hearing aids from less than 6 months of age or older. Intervention should be implemented prior to 6 months of age, according to the national protocol. The fitting criteria in Turkey for a hearing aid is a unilateral or bilateral sensorineural hearing loss of 25 dB HL or 30 dB eHL or worse. Cochlear implants are provided by 9-10 months of age when the infant is mature enough to undergo imaging (MRI and CT).



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 process for neonatal hearing screening for well babies is described in Table 1. A 3-step OAE-aABR protocol is in effect, whereby the first OAE is performed in the maternity hospital. If the infant fails the first test, rescreening occurs either before discharge or 3-5 days later when the return to the birth hospital for dried bloodspot screening. A subsequent fail would warrant a third screening with aABR. This may be performed also prior to discharge during the follow-up visit (if the hospital has adequate equipment), or at a secondary implementation unit with both aABR and OAE screening equipment as well as a qualified ENT or audiologist on staff.

Table 1: Process for neonatal hearing screening for well, healthy infants in Turkey.

Test	Age	Referral Criteria	Device	Unilateral Referrals?	Location
OAE1*	24-72 hours	Various	Various	Yes	Maternity hospital
OAE2	1 week / Before discharge	Various		Yes	Maternity hospital
aABR	1 week / Before discharge	35 dB nHL		Yes	Maternity hospital / Secondary unit

*A minimum of two attempts is suggested before referral to rescreening.

6.2. Neonatal hearing screening (at-risk)

The screening process for at-risk infants is described in Table 2. For these infants, aABR is performed in the hospital, as well as OAE when possible. After two attempts, if the aABR shows a failed result, infants are referred directly to an audiological centre for diagnostic assessment.

Table 2: Process for neonatal hearing screening for at-risk infants in Turkey.

Test	Age	Referral criteria	Device	Unilateral Referrals?	Location
aABR* (+OAE)	24-72 hours (< 2 weeks if premature)	35 dB nHL	Various	Yes	Hospital

*A minimum of two attempts is suggested before referral to rescreening.

6.3. Preschool hearing screening

Not applicable.



7. Professionals

7.1. Neonatal hearing screening (well)

Screening is performed by trained nurses, audiometrists, or audiologists. There is a specific training (Newborn Hearing Screening Course) within the national neonatal hearing screening programme. Training is performed at the diagnostic assessment centre and consists of a full day course. A certificate is provided to screening staff that have completed the training.

7.2. Neonatal hearing screening (at-risk)

Screening for at-risk infants is also performed by nurses audiometrists, or audiologists (see 7.1 for training requirements).

7.3. Preschool hearing screening

Not applicable.



8. Results: Neonatal Hearing Screening

8.1. Coverage and attendance rates

Coverage rate data are available through the Ministry of Health Programme Statistics. In 2017, the coverage rate was 95.6% (1 234 547 infants were screened out of 1 291 055 born according to TurkStat birth figures) (Halk Sağlığı Genel Müdürlüğü, 2017) .

8.2. Referral rates

Data are unavailable regarding pass/refer rates for each screening step.

However, final referral rates are provided for all babies. In 2017, the final referral rate was 2.7%. This figure is also like data from recent years (Halk Sağlığı Genel Müdürlüğü, 2017).

8.3. Diagnostic assessment attendance

Data are unavailable regarding the compliance rate to a diagnostic assessment.

8.4. Prevalence / Diagnosis

In 2017, 2 569 infants were diagnosed with hearing impairment after neonatal hearing screening. This amounts to a prevalence rate of 2.08 per 1000 for all hearing impairment. This figure is also like data from recent years (Halk Sağlığı Genel Müdürlüğü, 2017).

For specific levels of hearing impairment, data are not available. It is roughly estimated that the prevalence of permanent bilateral hearing loss ≥ 40 dB HL is 1 to 6 per 1000. It is roughly estimated that the prevalence of permanent unilateral hearing loss ≥ 40 dB HL is 0.9 per 1000.

8.5. Treatment success

It is unknown how many children per year are fitted with hearing aids or cochlear implants in Turkey.

8.6. Screening evaluation

Data are unavailable on the sensitivity, specificity, false positives, false negatives, or positive predictive values of neonatal hearing screening.



9. Results: Preschool Hearing Screening

9.1. Coverage and attendance rates

Not applicable

9.2. Referral rates

Not applicable

9.3. Diagnostic assessment attendance

Not applicable.

9.4. Screening evaluation

Not applicable.



10. Costs: Neonatal Hearing Screening

Financing of neonatal hearing screening in Turkey is provided by the health insurance. Screening 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.

A cost analysis of neonatal hearing screening in Turkey has not been completed.

10.1. Screening costs

The screening costs are unknown.

10.2. Equipment costs

The cost of a screening device is unknown. Maintenance costs are unknown. It is unknown how often devices should be replaced, but would depend on the level of usage of the device. The cost for disposables is unknown.

10.3. Staff costs

The number of screening staff across all of Turkey is unknown. The average salary for a screening professional is unknown. The cost for training hearing screening professionals is unknown.

10.4. Diagnostic costs

The total cost of diagnostic confirmation is not indicated.

10.5. Amplification costs

In the Turkey, children of parents who refuse cochlear implantation for their children may not be treated.

The costs for a hearing aid or cochler implant treatment is unknown

10.6. Social costs

It is roughly estimated that there are 50 schools for hearing impaired students in Turkey with 10 164 students.

In mainstream schools, extra support is not provided to children with hearing impairment.

All costs for mainstream or special education schools are unknown.



11. Costs: Preschool Hearing Screening

11.1. Screening costs

Not applicable.

11.2. Equipment costs

Not applicable.

11.3. Staff costs

Not applicable.



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