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# The Effectiveness of the School-Age Hearing Screening Program in Turkey and the Effects of the COVID-19 Pandemic

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**Abstract:** The aim of the study is to evaluate the effectiveness of the hearing screening program in school-age children in Turkey, and to discuss alternative methods for children who cannot be screened due to the COVID-19 pandemic. Within the scope of the school-age hearing screening program, children who fail the screening are referred to reference centers. The effectiveness of the screening program was investigated by recording the ear examinations and definitive audiometric examination results of the children who were referred to a tertiery-level center. Evaluations were made of a total of 87 children, comprising 49 boys (56.3%) and 38 girls (43.7%) with a mean age of 6.97 years, and no risk factors for hearing loss. The physical examination results showed that 53 children were normal, 15 had cerumen impaction, 3 otitis externa, 13 otitis media with effusion and 3 acute otitis media. The audiometric examination results were recorded as 72 normal, 13 conductive hearing loss, and 2 sensorineural hearing loss. Thus, the false positive rate of screening audiometry performed at school was 82.7%. School-age hearing screening is an important test to ensure the cognitive and academic development of children. Pure tone audiometry is indispensable in the evaluation of children who fail the test. For the evaluation of children who could not be tested for 1.5 years due to the COVID-19 pandemic, alternative methods such as tele-audiometry may be utilized. 

**Keywords:** Audiometry; Child; COVID-19; Hearing; Screening.

## 1. Introduction

Hearing loss is an important preventable and treatable cause of developmental disorders in childhood (1). Hearing loss can cause retardation in speech, cognitive and social development in children, regardless of its degree (2). In order to detect hearing loss, hearing screening programs (HSP) are performed for newborns and school-age children in many countries of the world. A European Consensus Statement was published in 2012 on what needs to be done in this regard (3).

In Turkey, the "Hearing Screening Program for School-Age Children" has been implemented since 2015 by the Turkish Public Health Institution, integrated with the Ministry of National Education. According to this program, screening audiometry is performed for first-grade primary school children, and those with suspected hearing loss or who are not tested are referred to reference centers. The main purpose of this study was to investigate the effectiveness of the testing method used in the HSP

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for school-age children and to develop a standardization for the evaluation of suspicious cases. The secondary aim was to discuss alternative screening methods for the detection of children with hearing loss at this time when face-to-face education and screening programs have been disrupted due to the COVID-19 pandemic.

## 2. Material and Methods

Screening audiometry is performed with a "Resonance R17A" device for all students who attend the 1st grade of primary school in Turkey with an informed consent form signed by their parents. In this test, hearing loss of 20 dB and above at frequencies of 500 Hz, 1, 2, 4 kHz is investigated. A child who fails at any frequency is tested again within 48 hours-1 week. Children who fail the repeated screening are referred to reference centers for a complete ENT examination and audiological evaluation.

According to the screening program, there are also direct referral criteria independent of the audiometric examination. These are a family history of late-onset hearing loss, craniofacial and/or ear anomalies, head trauma-loss of consciousness, ototoxic drug use, pre-existing sensorineural hearing loss, developmental disorder, speech and language delay, learning disability, cleft palate and lip, Down's syndrome, recurrent or chronic otitis media (COM), exposure to noise, receiving special education, or grade repetition.

In this study, evaluations were made of all children who failed the school-age hearing screening who were referred to the ENT outpatient department of a tertiary-level hospital between February 1st, 2019 and March 1st, 2020. As the risk factors for hearing loss were questioned before the screening test performed at school, only children who did not have risk factors but failed the test were included in the study. Otoscopic examination, tympanometry and pure tone audiometry (PTA) were performed and the results were recorded. Earwax aspiration was performed after the use of emollient drops in children with impacted plugs. Audiological tests were performed after earwax removal. Those with type B results in the tympanometry were diagnosed with otitis media with effusion (OME) and followed up for 6 months. In the audiometric examination, pure tone averages were determined at frequencies of 250, 500, 1000, 2000, 4000 and 8000 Hz in all children. According to the level of hearing loss, patients were classified as mild (20-39 dB), moderate (40-59 dB), moderately severe (60-84 dB), or severe (85 dB and above). The necessary treatments were applied to children who had hearing loss or who had abnormal examination results. The false-positive rate was determined by calculating the percentage of children with normal hearing despite having failed the hearing screening. Those who were found to have hearing impairment in PTA were categorized according to the conductive type and sensorineural type loss. The treatments applied and the results of the follow-up were recorded. There were no exclusion criteria in this study, as all patients who were refered to the outpatient clinic were included.

Data obtained in the study were analyzed statistically using SPSS version 22 Software (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY, USA). Descriptive tables containing the ratios and percentages of the data were formed.

Approval for the study was obtained from the Clinical Research Local Ethics Committee of a tertiary-level healthcare center (Decision No: GOKA/2021/6/12).

## 3. Results

Evaluations were made of a total of 87 children, comprising 49 boys (56.3 %) and 38 girls (43.7 %) with an average age of 6.97 years, and no risk factors for hearing loss. The results of the physical examination were that 53 children were normal, there were 15 cases of cerumen impaction, 3 otitis externa (OE), 13 OME and 3 acute otitis media (AOM) (Table 1). The audiometric examination results were recorded as 72 normal, 13 conductive hearing loss (CHL), and 2 sensorineural hearing loss (SNHL) (Table 2). Accordingly, the false positive rate of screening audiometry performed at school was 82.7 %.

**Table 1:** Otoscopic ear examination results.

| Examination | Total (n, %) | Male (n, %) | Female (n, %) |
|---|---|---|---|
| Normal | 53 (60.91) | 28 (32.18) | 25 (28.73) |
| Earwax | 15 (17.24) | 9 (10.34) | 6 (6.89) |
| Otitis Externa | 3 (3.44) | 2 (2.29) | 1 (1.14) |
| Otitis Media with Efusion | 13 (14.94) | 7 (8.04) | 6 (6.89) |
| Acute Otitis Media | 3 (3.44) | 3 (3.44) | 0 |

Removal of earwax was performed using aspiration after softening ear drops. Syringing was not performed on any patient. In all cases with earwax, the examination after aspiration showed normal tympanic membranes. The final audiometric examination was performed in 3 patients with AOM at 3 months after the treatment, and all 3 had normal hearing after treatment. In the 6-month follow-up of 13 patients with OME, bilateral ventilation tube application was performed in 6 patients, while spontaneous recovery was observed in 7 patients. Pure tone audiometry of these cases was also normal after surgery. Bilateral mild sensorineural hearing loss (SNHL) was detected

in 2 patients and hearing aids were provided. In the free field audiometry performed after hearing aid treatment, both cases had normal hearing with the aids. Abnormalities were detected in the examination or audiometric examination in 41.3 % of the children who failed the screening audiometry (39 % examination, 17.2 % audiometry). Treatment was required in 12.6 % of all subjects. All patients with abnormality achieved normal hearing after the necessary treatment

**Table 2:** Pure tone audiometry results.

| | | **Right Ear** | **Left Ear** |
|---|---|---|---|
| Normal Hearing | | 72 (82.7 %) | 72 (82.7 %) |
| Conductive Hearing Loss | Mild | 13 (14.9 %) | 13 (14,9 %) |
| | Moderate | 0 | 0 |
| | Severe | 0 | 0 |
| | Profound | 0 | 0 |
| Sensorineural Hearing Loss | Mild | 1 (1.1 %) | 1 (1.1 %) |
| | Moderate | 1 (1.1 %) | 1 (1.1 %) |
| | Severe | 0 | 0 |
| | Profound | 0 | 0 |

## 4. Discussion

Hearing impairment is a global public health problem that affects 350 million people around the world, according to data from the World Health Organization (WHO) (4). Approximately 10 % of these individuals are children and 60 % of hearing loss in children is due to preventable causes (4). Hearing loss is a rehabilitable and preventable disease, but when not treated, it can cause varying degrees of language and speech retardation, and cognitive and intellectual development disorders (5). All this information highlights the importance and necessity of childhood HSP.

In order to detect childhood hearing loss, newborn HSP has been implemented in Turkey since 2004 (6). Newborn hearing screening is performed using OAE and/or automated ABR but in these tests, hearing losses below 40 dB cannot be detected (7, 8). In addition, late-onset or acquired hearing losses are overlooked by only newborn screening. Therefore, a second screening should be applied in the pre-school period (4-7 years) in order to prevent social problems caused by hearing loss in children. The "European Consensus Statement on Hearing Screening of Preschool and School-age Children" was published in 2012 (3). Accordingly, even if the hearing loss is mild (20-40 dB), when it is not rehabilitated, it reduces social and academic achievement in adulthood. Therefore, hearing screening audiometry in preschool children should detect hearing loss of 20 dB and above. For this purpose, an HSP has been implemented for children in the 1st grade of primary school since 2015 in Turkey (9).

In a study conducted in Kyrgyzstan, hearing loss was found in 123 children (27.2 %) in the audiometric screening of 452 children aged 7-13 years (10). According to another study in India, 284 children aged 6-10 years were screened with audiometry, and hearing loss was detected in 34 (11.9 %) (11). A further study on the subject was conducted in Malatya, Turkey, in which a total of 812 5th grade students were screened and 24 students (3 %) failed this screening. Hearing loss was detected in 11 of the 24 children in the definitive audiometric examination (12). These studies show that hearing loss, which is directly related to the cognitive and behavioral development of children, can be diagnosed early with childhood screening tests, thereby preventing a major public health problem.

In previous studies in the literature, the screening test results of the children were directly reported. Unlike those studies, the current study evaluated the exact audiometric examination results of the children who were screened, not the screening test results. In this way, a very large population was investigated indirectly with a small number of subjects.

In the HSP for school-age children, how the screening tests will be performed and who will be referred to the reference center are prescribed in detail. However, there is no standardization for the evaluation of these children in the reference center. Sometimes only scans such as ear examination, acoustic immitance or otoacoustic emission are performed and hearing is evaluated accordingly. In this case, patients with hearing loss of 40 db and below cannot be detected (13). In this study, ear examination, tympanometric examination and pure tone audiometry were routinely applied to all children who were refered to the reference center. Applying pure tone audiometry clearly reveals even 20 db hearing loss. In this way, two patients started to use hearing aids in the previous year in the center. It is known that even with mild hearing loss, instrumentation is one of the most important factors that directly affect the future academic success of children (14, 15). Therefore, these children should be evaluated in a center equipped to perform pure tone audiometry.

Another handicap of the school age HSP is the requirement for one-on-one interviews. Due to the COVID-19 pandemic, face-to-face education was not conducted in Turkey for 1.5 years. Therefore, some of the children currently in the 2nd and 3rd grade of primary school has not passed the HSP. This situation

constitutes an important public health problem. Scanning with tele-audiometry, which does not require face-to-face interviews, can also be considered as an alternative method for these children. This is a scanning method that is performing by sending some standard sounds through a special internet-based computer program (16). It has been demonstrated in various studies that tele-audiometry is no different from face-to-face scanning audiometry devices (16-18).

## 5. Conclusions

School-age hearing screening is an important test to ensure the cognitive and academic development of children. As pure tone audiometry is indispensable in the evaluation of children who fail the test, patients should be referred to fully equipped hospitals. For the evaluation of children who could not be tested for 1.5 years due to the COVID-19 pandemic, alternative methods such as tele-audiometry may be utilized. This study will contribute to the literature in terms of raising awareness among both pediatrics and otolaryngologists about school-age hearing screening.

**Limitations of the Study**

A few participants and the lack of a multicenter study.

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**Conflict of Interests**

There are no financial interests or personal conflicts that may affect the study in this article.

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**Author Contributions**

The study has a single author and U.Y. contributed.

**Ethical Approval**

Ethics committee approval was obtained from the local ethics committee of the tertiary health center (Degree no: GOKA/2021/6/12).

**Informed Consent**

Informed consent forms were obtained from the patient's parents.

**Availability of Data and Materials**

Study data is appropriate and open to share for the development of other research.

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