

# Our results of the school-age hearing screening program

## *Okul çağı çocuklarda işitme tarama programı sonuçlarımız*

Mehmet Akif Alan , Ekrem Özsöz 

*Department of Otolaryngology, Konya City Hospital, Konya, Türkiye*

### ABSTRACT

**Objectives:** This study evaluated the results of the hearing screening program in school-age children in our region and their etiologies.

**Patients and Methods:** The school-age hearing screening audiometry results of 6,073 first-year primary school students (2,915 males, 3,158 females; mean age: 75.6±3.9 months; range, 66 to 84 months) performed between January 2019 and March 2020 were retrospectively scanned from the Ministry of Health National Hearing Screening Program database. The data of children who were referred due to hearing screening failure or risk factors were also scanned and included in the study.

**Results:** One hundred eighty-three (3%) of the 6,073 first-year students who underwent screening audiometry were referred to an otolaryngologist due to failing the test or risk factors. Of the 183 referred children, 74 (40.5%) had impacted cerumen, and 48 (26.5%) had otitis media with effusion. Control audiometry tests of 61 (33%) children were normal. No statistically significant difference was observed in referral rates between the sexes. The hearing loss type was conductive hearing loss in all children with hearing loss.

**Conclusion:** Although impacted cerumen is an easily preventable cause, it negatively affects academic performance, speech, and language development when left untreated. The high incidence of preventable and treatable hearing loss in preschool and school-age children and, although not observed in our study, the prevalence of acquired sensorineural hearing loss in these age groups shows the importance of hearing screening programs and the need for widespread use.

**Keywords:** Child, hearing loss, hearing screening, school-age children.

### ÖZ

**Amaç:** Bu çalışmada bölgemizde okul çağındaki çocuklara uygulanan işitme taraması programının sonuçları ve etiyojileri değerlendirildi.

**Hastalar ve Yöntemler:** Ocak 2019 ve Mart 2020 tarihleri arasında 6073 ilkokul birinci sınıf öğrencisinin (2915 erkek, 3158 kadın; ort. yaş: 75.6±3.9 ay; dağılım, 66-84 ay) okul çağı işitme taraması odyometri sonuçları Sağlık Bakanlığı Ulusal İşitme Tarama Programı veri tabanından geriye dönük olarak tarandı. İşitme taraması başarısızlığı veya risk faktörleri nedeniyle sevk edilen çocukların verileri de taranarak çalışmaya dahil edildi.

**Bulgular:** Tarama odyometrisi yapılan 6073 birinci sınıf öğrencisinin 183'ü (%3) testte başarısız olma veya risk faktörleri nedeniyle kulak burun boğaz uzmanına yönlendirildi. Yönlendirilen 183 çocuktan 74'ünde (%40.5) gömülü kulak kiri ve 48'inde (%26.5) efüzyonlu otitis media vardı. Altmış bir (%33) çocuğun kontrol odyometri testleri normaldi. Cinsiyetler arasında sevk etme oranlarında istatistiksel olarak anlamlı bir fark gözlenmedi. İşitme kaybı olan çocukların hepsinde işitme kaybı tipi iletim tipi işitme kaybıydı.

**Sonuç:** Gömülü kulak kiri kolayca önlenabilir bir neden olmasına rağmen tedavi edilmediğinde akademik performansı, konuşma ve dil gelişimini olumsuz etkiler. Önlenabilir ve tedavi edilebilir işitme kaybının okul öncesi ve okul çağındaki çocuklarda yüksek olması ve çalışmamızda gözlemlenmemekle birlikte bu yaş gruplarında edinilmiş sensörinöral işitme kaybı prevalansı işitme tarama programlarının önemini ve yaygınlaştırılması gerektiğini göstermektedir.

**Anahtar sözcükler:** Çocuk, işitme kaybı, işitme taraması, okul çağı çocuklar.

**Received:** November 29, 2022

**Accepted:** February 06, 2023

**Published online:** February 20, 2023

**Correspondence:** Mehmet Akif Alan, MD.

**E-mail:** makifalannn@gmail.com

*Presented at the 43<sup>rd</sup> National Congress of Otorhinolaryngology, November 16-20, 2022, Belek, Antalya, Türkiye*

### Citation:

Alan MA, Özsöz E. Our results of the school-age hearing screening program. KBB Uygulamaları 2023;11(1):18-22. doi: 10.5606/kbbu.2023.49358.



Early childhood hearing loss is an important public health problem that negatively affects the development of individuals mentally and socially by causing language and speech disorders, poor school performance, cognitive dysfunction, and behavioral disorders.<sup>[1]</sup> In addition to acquired factors, such as meningitis, measles, mumps, hyperbilirubinemia, salicylates, aminoglycosides, loop diuretics, and acoustic trauma, late-onset hearing loss due to genetic and structural anomalies is also included in the etiology of childhood hearing loss.<sup>[1-3]</sup> The newborn hearing screening program, which is widely applied in developed countries and in our country, is insufficient to detect late-onset and acquired hearing loss. Therefore, it is recommended that hearing screening programs should be applied to children of all age groups for the early diagnosis and treatment of hearing loss.<sup>[4]</sup> In the decision statement of the 10<sup>th</sup> Congress of the European Federation of Audiology, the target age of hearing screening in preschool and school-age children was determined as 4 to 7 years old. In the same report, the aim of the screening is mostly the diagnosis of conductive hearing loss, acquired and delayed sensorineural hearing loss, and central auditory processing disorders.<sup>[4]</sup> The prevalence of hearing loss increases with age. Children with conductive hearing loss, auditory neuropathy, and acquired sensorineural hearing loss that cannot be detected in newborn hearing screening programs are the target group of preschool and school-age hearing screening programs.<sup>[4]</sup> The hearing screening program for school-age children is implemented in the first grade of primary school students in our country.<sup>[5]</sup> The test is performed by an audiometrist with a screening audiometer device in school conditions. If no response is obtained at 20 dB in any of the 500, 1000, 2000, and 4000 Hz frequencies, the test is repeated within one week; children who fail the test or those with risk factors are referred to an otolaryngologist.<sup>[5]</sup>

Since the school-age hearing screening program is a newer practice than the newborn hearing screening program in our country, we observed that there is a lack of studies on this issue. The current study is unique in that it investigated the results of school-age hearing screening of Turkish children. The study aimed to both increase awareness about the screening program and provide ideas for new studies on this subject. In addition, the results of this study will contribute to the literature in terms of the prevalence and etiology of hearing loss.

---

## PATIENTS AND METHODS

---

In this study, the school-age hearing screening audiometry results of 6,073 first-year primary school

students (2,915 males, 3,158 females; mean age: 75.6±3.9 months; range, 66 to 84 months) performed at schools in Meram district of Konya between January 2019 and March 2020 were retrospectively scanned from the Ministry of Health National Hearing Screening Program database. Children who failed the audiometry test or who had risk factors were included in the study by referring to the screening audiometry workflow chart in school-age children determined by the General Directorate of Public Health of Türkiye. Screening audiometry in school-age children was performed at frequencies of 500, 1000, 2000, and 4000 Hz in both ears, and failure to get a response at 20 dB in one or both ears at any frequency was determined as the criterion for failing the test and for referral to an otolaryngologist. In addition, in the presence of at least one of the identified risk factors, it is recommended to refer the child to an otolaryngologist. Risk factors were determined as follows within the scope of the national hearing screening program in school-age children: family history of hearing loss, head trauma, learning disability, acoustic trauma, Down syndrome, cleft lip/palate, ototoxic drug usage, syndromic child, central nervous system disease, difficulty in hearing, difficulty in determining the direction of sound, facial abnormality, repeating what has been said, watching television at a loud volume, auditory processing disorder, frequent ear infections, history of ear infections >3 months, preexisting hearing loss, speech and language delay, history of recurrent ear disease, special education, structural disorder in the ear, and head and face structural disorders.<sup>[5]</sup>

In this study, hospital records of children who could not pass the screening test or who were referred due to risk factors were also retrospectively reviewed, and children's age, sex, examination findings, diagnosis, screening audiometry results at all frequencies, and risk factors were included in the study. The newborn hearing screening test results of all referred children were also retrospectively scanned. However, screening results of only 22 children were available in the Ministry of Health's National Hearing Screening Program database. Due to the small sample size, newborn hearing screening results were not discussed in the study.

### Statistical analysis

Statistical analyses were performed with IBM SPSS version 22.0 (IBM Corp., Armonk, NY, USA). Descriptive statistical data were presented as mean ± standard deviation or median (min-max). Pearson's chi-square test was used to analyze categorical variables. A *p*-value <0.05 was considered statistically significant.

**Table 1**  
Hearing screening results

Frequency	Right ear								Left ear							
	500 Hz		1000 Hz		2000 Hz		4000 Hz		500 Hz		1000 Hz		2000 Hz		4000 Hz	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Refer	169	92.3	111	60.7	129	70.5	164	89.6	162	88.5	106	57.9	118	64.5	148	80.9
Pass	14	7.7	72	39.3	54	29.5	19	10.4	21	11.5	77	42.1	65	35.5	35	19.1

## RESULTS

Among 6,073 first-year students, 183 (3%) were referred due to failing the test or risk factors. Of those who failed the test, 99 (54%) were female and 84 (46%) were male. The mean age of those who failed the test was  $76.2 \pm 3.6$  months, and the median value was 76.0 (69.0-84.0) months. The mean age of female and male students was  $76.2 \pm 3.7$  and  $76.2 \pm 3.6$  months, respectively. There was no statistically significant difference in terms of age between sexes ( $p > 0.05$ ). Frequency-specific passing and referral rates for both ears are given in Table 1. No statistically significant difference was observed in the pass/refer ratios between sexes at any frequency (chi-square,  $p > 0.05$ ). The frequency of risk factors according to the results of the questionnaire applied to the families before the test is given in Table 2. There was no statistically significant difference between the two sexes in terms of the frequency of risk factors (chi-square,  $p > 0.05$ ). In our hospital records, according to data of 183 patients, unilateral or bilateral impacted cerumen was observed in 74 (40.5%) children who were referred due to failing

the screening audiometry test or risk factors, and otitis media with effusion was observed in 48 (26.5%), and these 48 children were followed up. Ear-nose-throat examinations and control audiometry tests of 61 (33%) children were normal.

## DISCUSSION

In this study, we evaluated the results of the hearing screening program performed in school-age children with demographic data and etiological factors. We aimed to emphasize the causes and effects of hearing loss and the importance of hearing screening programs, together with the screening results in our region. This study is the first of its kind to evaluate the results of the national hearing screening program, which has been implemented in our country since 2015 for school-age children.

In developed countries, newborn hearing screening program is carried out effectively, but postnatal factors causing hearing loss necessitate preschool and school-age screening programs in children. In addition to false negative results in newborn hearing screening, it is important to expand these screening programs for the diagnosis, follow-up, and treatment of late-onset and progressive hearing loss.<sup>[4-6]</sup> Studies on the hearing screening program for school-age children, which is a relatively new practice compared to the newborn hearing screening program in our country, will contribute to the development and dissemination of the program and increase awareness.

In the hearing screening study conducted by Yılmaz et al.<sup>[6]</sup> on 812 fifth-grade students, the rate of hearing loss was 1.35%. Of 11 patients with definite hearing loss, three had very mild, four had mild, two had moderate, and two had severe-to-profound hearing loss. Sensorineural hearing loss was detected in five, conductive hearing loss was identified in five, and mixed type hearing loss was observed in one patient. The relationship of various variables with hearing loss was evaluated by regression analysis and "difficulty in

**Table 2**  
Risk factors

	n	%
Family history of hearing loss	14	7.7
History of frequent ear infections	6	3.3
>3 month history of ear infection	6	3.3
Pre-existing hearing loss	5	2.7
Speech and language delay	5	2.7
Learning disability	2	1.1
History of having special education	2	1.1
History of acoustic trauma	2	1.1
History of head trauma	1	0.5
None	140	76.5
Total	183	100

hearing spoken words” was found as the only variable associated with hearing loss.

In our study, the rate of failing the test or referral due to risk factors was 3% in all children who underwent the screening test. Control tests were normal in 61 of 183 referred children. Unlike the study of Osei et al.,<sup>[1]</sup> we did not observe a statistically significant difference in terms of hearing loss between males and females in our study. In our study, similar to the common view in the literature, the most common reason for failing the test was impacted cerumen (40.5%).<sup>[1-7]</sup> The highest referral rates in both ears were at the frequency of 500 Hz. This result is consistent with the frequent occurrence of conductive hearing loss. This finding may be a result of the success of newborn hearing screening in our country. However, it is interesting that none of the 6,073 children had sensorineural hearing loss. It would not be correct to explain this only with the success of the newborn hearing screening program. This study aimed to focus on the audiometry results for each frequency of 183 children who failed the screening test rather than etiological reasons.

In a study conducted by Osei et al.<sup>[1]</sup> in Ghana in 210 school-age children, the most common cause of hearing loss was impacted cerumen (39.5%), and the percentage of hearing loss was higher in males. Brkić<sup>[7]</sup> reported that the most common cause of hearing loss was impacted cerumen (52.6%) in their study. In some studies, it has been emphasized that hearing loss caused by impacted cerumen may have severe negative effects on academic performance.<sup>[1-7]</sup> Considering that the most common and mostly observed causes of hearing loss in our study are plug and otitis media with effusion and that these are preventable and treatable causes, both otolaryngologists and families have important responsibilities. If families can be informed about conductive hearing loss and its causes and if they can reach an otolaryngologist in a timely manner and be followed up, the screening program will not only be a diagnostic tool but also function as preventive health care. In this way, the screening program will be cost-effective. Similar to our opinion, Opoku et al.<sup>[8]</sup> emphasized that providing education to families, especially mothers, about the symptoms of hearing loss in children is a part of preventive health care in their study.

The most common risk factor in our study was the presence of a family history of hearing loss. The rate of ear infections among risk factors was found to be lower than in the literature.<sup>[9,10]</sup> This may be due to the fact that families are not adequately informed about the questionnaire containing risk factors and that the questionnaires are filled carelessly. Since children with

a family history of hearing loss are also detected during newborn screening, a different and more frequent screening program can be applied to these children than the routine screening program. In the study of Yılmaz et al.,<sup>[6]</sup> more comprehensive screening was recommended for children with risk factors in school-age children since 90.9% of children who fail the hearing screening have at least one risk factor.

The limitations of our study are the retrospective design and inability to access newborn hearing screening test results of all children who failed the screening test.

In conclusion, hearing loss is still an important public health problem worldwide. Hearing screening programs for school-age children are becoming widespread. A hearing screening program for school-age children has been implemented since 2015 in our country. According to the results of this study, preventable causes of hearing loss constitute a prominent percentage in this age group, and the early diagnosis, treatment, and follow-up of these children, as well as the education provided to families about hearing loss, will make significant contributions to preventive medicine and public health.

**Ethics Committee Approval:** The study protocol was approved by the Necmettin Erbakan University Meram Faculty of Medicine Ethics Committee (date: 02.07.2021, no: 2021/3345). The study was conducted in accordance with the principles of the Declaration of Helsinki.

**Patient Consent for Publication:** A written informed consent was obtained from the parents and/or legal guardians of the patients.

**Data Sharing Statement:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

**Author Contributions:** Material preparation, data collection and analysis was performed by: M.A.A., E.Ö.; Statistical analysis was performed by: M.A.A.; The first draft of the manuscript was written by: M.A.A., E.Ö., and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

**Conflict of Interest:** The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

**Funding:** The authors received no financial support for the research and/or authorship of this article.

---

## REFERENCES

1. Osei AO, Larnyo PA, Azaglo A, Sedzro TM, Torgbenu EL. Screening for hearing loss among school going children. *Int J Pediatr Otorhinolaryngol* 2018;111:7-12. doi: 10.1016/j.ijporl.2018.05.018.

2. Hicks ML, Bacon SP. Effects of aspirin on psychophysical measures of frequency selectivity, two-tone suppression, and growth of masking. *J Acoust Soc Am* 1999;106:1436-51. doi: 10.1121/1.427146.
3. Northern JL. Hearing and hearing loss in children. In: Northern JL, Downs MP. *Hearing in children*. 5th ed. Philadelphia: Lippincott Williams and Wilkins; 2002.; p. 391-2.
4. Skarżyński H, Piotrowska A. Screening for pre-school and school-age hearing problems: European Consensus Statement. *Int J Pediatr Otorhinolaryngol* 2012;76:120-1. doi: 10.1016/j.ijporl.2011.10.016.
5. Hearing Screening Program for School Age Children. Turkish Public Health dated 23/12/2015 and numbered 234.02.E.67096. Available at: <https://hsgm.saglik.gov.tr/tr/cocukergen-tp-liste/>. [Accessed: 18.11.2022].
6. Yılmaz Ö, Yakıncı C, Karataş E. Malatya il merkezi okul çağı çocuklarda işitme taramaları. *Çocuk Sağlığı ve Hastalıkları Dergisi* 2018;61:59-66.
7. Brkić F. Significance of ear wax impaction in school children. *Acta Med Sal* 2010;39:23-5.
8. Opoku MP, Mprah WK, Owusu I, Badu E, Torgbenu EL. Challenges in accessing education for children with disabilities in Ashanti and Brong Ahafo regions of Ghana. *J Disability Stud* 2016;1:9-16.
9. Yong M, Liang J, Ballreich J, Lea J, Westerberg BD, Emmett SD. Cost-effectiveness of school hearing screening programs: A scoping review. *Otolaryngol Head Neck Surg* 2020;162:826-38. doi: 10.1177/0194599820913507.
10. American Speech-language-hearing Association, Effect of Hearing Loss on Development. Available at: <https://www.asha.org/public/hearing/effects-of-hearing-loss-on-development/>. [Accessed: 18.11.2022]