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Impact on performance of hearing screening program through prevalence and diagnostic age evaluation in elementary school students in north-eastern city of Iran, Mashhad

Q1 Saeedeh TarvijEslami^{1,3}, Hossain Nassirian^{1,3}, Seyedehsara Bayesh^{2,3,*}Q2¹ Department of Pediatrics, Islamic Azad University, Tehran Medical Science Branch, Tehran, Iran² Students' Research Committee, Islamic Azad University, Tehran Medical Sciences Branch, Tehran, Iran

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ABSTRACT

Background: Lack of a national neonatal screening protocol in Iran, displaces routine hearing screening at elementary school entry. Early diagnosis of hearing loss (HL) leads to early intervention and improvement of developmental skills in children. The current research aimed to determine diagnostic age and causes of HL in male students at school entry to evaluate this hearing screening performance and its efficacy as a guideline for deciding early diagnosis. **Methods:** This cross sectional study included 2277 male students aged 6–7 years from elementary school boys in Mashhad, Iran from 2010 to 2011. We evaluated subjects' medical archives, interviewed with their parents and hygiene teacher and took physical examination, demographic information, birth and HL history for data gathering. Audiologic assessment consisted of otoscopy, tympanometry and audiometry. **Results:** 36 (1.58%) of students had hearing impairment. Prevalence of HL in urban schools was significantly higher than rural ones ($P = 0.02$). Making diagnosis by physician was significantly more than by parents ($P < 0.04$) with no diagnosis role of teachers. There was a significant association between using earphone and HL intensity ($P = 0.001$). The common age of diagnosis was at elementary school entry ($P < 0.001$). **Discussion:** Screening protocol at elementary school entry suggested late diagnosis and poor outcome in Iran. National screening is necessary in newborns, elementary school entry and when suspect to HL. The parents, teachers and population should have much greater awareness of HL diagnosis. In present study, chicken pox may lead to HL, therefore routine vaccination is recommended.

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* Corresponding author.

E-mail address: sarabayesh@yahoo.com (S. Bayesh).³ These authors contributed equally to this manuscript.<http://dx.doi.org/10.1016/j.pepo.2017.07.005>

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Background

Hearing loss (HL), also known as hard of hearing, or hearing impairment, is the most common sensory deficit. In children, there are many causes of HL include genetic, infectious, drug-related, physical trauma and structural causes. HL in children across the world constitutes a particularly great barrier to their optimal development and education, including learning dialect and language, cognitive skills and study [1]. Hearing screening programs were implemented in the 1970s either as universal hearing screening or as targeted groups. However, the sensitivity/specificity of hearing screening test was poor. Throughout the 1990s, Universal Neonatal Hearing Screening programs (UNHS) implemented in the United States and later extended to European countries that implemented UNHS on a national level. UNHS and Intervention Programs reported that the incidence of HL have been 1–3:1000 live births in 2006 [2]. In phenylketonuria, Universal screening were performed from several past decades before HL Screening, while its incidence is very low comparing with HL incidence, 1:10 000 vs. 1–3:1000 live births [2]. In a child with attention and behavior disorder in school, long lasting communication, social and educational deficits, hearing impairment should be considered by teachers [3]. Early diagnosis of HL and applying new rehabilitation techniques, individual hearing aid and new methods of treatment like cochlear implantation are very effective in emotional and communication development academic and social performance improvement [4]. The current research aimed to evaluate prevalence and age of diagnosing HL because the problem occurs because of late identifying the impairment. Assessing the causes of hearing impairment would emphasize the preventing factors.

Methods

This cross sectional study included 2284 male students aged six to seven years old with random sampling in different elementary schools from eight regions of education organization in a north-eastern city of Iran, Mashhad from 2010 to 2011. The schools were socially, economically and culturally different. Privileged schools included Ebne Sina, Mofateh, Sajad and Shamsabadi. The other schools were semi-privileged and under – privileged. To gain sample size, we used the following criteria: $Z = 1.96$, $P = 0.227$, $d = 0.05$, sample size was calculated 270, that was extended to 2284 children. After that, the sample selection continued by nonprobability sampling that researcher select the sample based on judgment derived by physical examination and relevant tests. Inclusion criteria were six to seven year old male children who were examined at elementary school boys entry and were affected by disabling HL. Healthy male children at elementary schools entry and older children were excluded. For data obtaining, we assessed subjects' medical archives and health license of students, interviewed with their parents and hygiene teachers. We sent a questionnaire to the parents of the affected HL children with emphasis on use and benefits of hearing aids used by their children and

its impact on their verbal communication. We assessed medical history including general physical examination, information, birth and HL history. Audiologic assessment consisted of otoscopy, audiometry and tympanometry. The affection of students with history of HL diagnosing confirmed by repeated auditory tests. Two children were excluded from tympanometry examination because of perforated drums and ear discharge, five children refused the audiometry. Therefore a subset of 2277 students remained as sample size. The relevant information was recorded. The main auditory method was pure tone auditory (PTA) which evaluates air and bone conduction ways separately, as well as Weber and Rinne tests. Weber test is useful in unilateral HL diagnosis and Rinne test is used for comparing air way with bone way [5]. Rate of HL and tympanometry were recorded as well. For performing the tests, the apparatuses had high sensitivity and perpetuity >90%. Audiometry and tympanometry apparatus characteristics were INTERACOUSTIC AD 299E and INTERACOUSTIC AZ 26 respectively. Normal hearing sensitivity is about 25 dB in children. HL staging based on the severity was considered as follows:

Mild HL, 25–40 dB: The child affected this rate of HL, losses 25–40% of the words. Moderate hearing loss, 40–50 dB: In this impairment, in situation of a classroom the children losses 50–75% of the words. They have problem in the dialect and the vocabulary is limited to two levels retardation compared with their peers. Severe hearing loss, 70–90 dB: They can hear if they are supported with hearing aids [6]. Different variables evaluated as prevalence of HL, age diagnosing, history of causative disease, parent ages at the time of children birth day, parental consanguinity, effect rate of HL on vocabulary and attention, diagnosis rate of HL by parents and teachers and comparing diagnosed HL in urban with rural schools. For data analysis, chi square and Fisher's exact tests were used through SPSS 17.0. Statistical significance was considered at P value less than 0.05.

Ethical considerations

This study was approved by the Ethical Committee of Mashhad University of Medical Sciences Research Center. The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki, the Guidelines for the Ethical Conduct of Medical Research Involving Children, revised by the Royal College of Pediatrics and Child Health: Ethics Advisory Committee. We considered Committee on Publication Ethics (COPE) guidelines as well. There was no moral inconsideration about the study method so all the cooperators and the parents were explained about the mentioned method. We received written informed consent from parents and eight regions of Education Organization in Mashhad.

Results

Of 2277 male students, 36 (1.5%) had hearing impairment, which 8 (22.2%) were affected by sensory-neural HL and 28 (77.8%) had conductive one. Conductive HL rate was significantly higher than sensorineural type, $P < 0.001$ (Table 1).

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