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SCHOOL HEARING SCREENING: FIRST STEPS IN ARMENIA

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Abstract

Hearing has a great importance for normal speech development and social integration of a child. Hearing disorders in children can be acquired during early childhood and may stay unnoticed by parents and teachers. Neonatal screening system was introduced in Armenia in December 2007. In the policlinics of the Republic of Armenia, all children get ENT consultation at the age of six, however no hearing screening is conducted.

The goal of this research was to detect hearing loss among the preschool and school age children using a screening program. A total of 3560 children were included in this study. The pure tone audiometry with signal of 25 dB of air conduction at frequency rates of 500, 1000, 2000, 4000 and 8000 Hz has been used for screening.

The 5.2% of examined children (185 children) did not pass the screening, and were sent to specialized clinics for further work up. The results of further work up in those 185 showed that 109 of them (3.06% of total number) had been diagnosed with different otic diseases and disorders. In this group, 7 children were diagnosed with uni- or bilateral sensorineural hearing loss; at the same time neither the parents nor the children were aware of the disease.

The large-scale screening held for the first time among preschool and school age children in Armenia. It results showed, that this group is key in terms of early identification of hearing loss and prevention of subsequent complications to ensure and improve the health of the younger generation

Keywords: *preschool and school age children, hearing loss, school screening.*

Introduction

Hearing is of utmost importance for normal speech and social development. Even children who have mild or unilateral permanent hearing loss may experience difficulties with understanding speech, as well as problems with educational and psycho-social development.

World Health Organization estimates that 466 million people in the world suffer from disabling hearing loss (6.1% of the world's population), 34 million of which are children below age 15. It is estimated that by 2050 over 900 million people – or one out of every ten people – will have disabling hearing loss [*WHO, 2018*].

Hearing disorders in children are not always congenital, sometimes they can be acquired during early childhood. World statistics states that in economically developed countries 1-2 newborns per 1000 live births are born with significant hearing loss and 1 is born deaf. Besides, during the first 3 years of life 2-3 children lose hearing [*Mehra S et al., 2008*].

It is to be noted that even children with positive results of neonatal hearing screening can develop progressive or acquired hearing loss provoked by either genetic, traumatic or other diseases. Neonatal hearing screening programs may possibly not detect the 10 to 20% of cases of permanent childhood hearing loss that start later in life [*Grote J, 2000*]. It is estimated that 6-7% of 1000 schoolchildren have permanent hearing loss [*Bamford J et al., 2007*]. By school age, 9-10 per 1000 children will have identifiable permanent hearing loss in one or both ears [*Sharagorodsky J, 2010; White K, 2010*]. As calculated by White, the 3/1000 prevalence of permanent hearing loss in infants can be expected to increase to 9-10/1000 children in the school-age population [*White K, 2010*] and permanent and/or transient hearing loss in one or both ears affects more than 14% (one in seven) of school-aged children. Hearing loss, whether consistent or fluctuating, interferes with the accurate reception of speech, especially under noisy and re-

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verberant classroom conditions and when speech is presented at a distance from the student [*Blumsack J, Anderson K, 2004*]. The behavioural effects of hearing loss are often subtle and resemble effects similar to those of children who experience attention deficit disorders, learning disabilities, language processing problems or cognitive delays. The presumption that hearing loss can be reliably identified based on a child's behaviour in everyday situations has been shown to be faulty by several studies documenting outcomes from the use of parent questionnaires [*Olusanya B, 2001; Gomes M, Lichtig I, 2005; Lo P et al., 2006*]. Scientific research has shown, that even though the majority of hearing loss in this report was identified as unilateral and of minimal degree, evidence suggests these hearing deficits can adversely affect a child's development, overall well-being, or both [*Ross D et al., 2008*]. The detection of children with such problems helps teachers to ensure necessary and appropriate attention towards these children and, if necessary, to change their seats in the classroom, in order to make lesson materials more understandable. Seating assignment in classrooms under such a factor is more important in Armenian schools, the number of children in each classroom often being over 20. The early detection of hearing problems of these children, in its turn, causes parents to take appropriate measures to prevent possible hearing losses.

This research is part of a general study and is focused on the assessment of hearing loss prevailing among preschool and school age children.

Basically, the goal of preschool and school screening is the detection of hearing loss among those children who fall outside the scope of neonatal screening, and thus are out of care. Another purpose of the screening is to detect late developed hearing loss, which may baffle speech development and performance at school.

We aim to detect hearing loss among the children of early school age with the use of a small-scale screening program, and, on a particular example, to inform and raise the awareness of teachers, school psychologists and parents about the problems caused by hearing loss and to propose necessary actions if needed.

Materials and methods

A total of 3560 children were included in this study. Subset of 693 of the 6-7 years old children were randomly selected from the residents of the Goris region of Armenia, where newborn screening was not implemented, and 2867 children from the capital Yerevan, where newborn screening was implemented during the last decade. Examinations were held in the school, on its quietest premise.

The pure tone audiometry with signal of 25 *dB* of air conduction at frequency rates of 500, 1000, 2000, 4000 and 8000 *Hz* has been used for screening. Screening was "pass" if responses were reliable at criterion *dB* level at each frequency in each ear.

If a child did not respond at criterion *dB* level at two sequential frequencies in either ear, or at 8000 *Hz*, she/he was reinstructed and rescreened within the same screening session where it failed. The children who failed the rescreening were instructed to a further detailed examination in specialized clinics within two weeks.

Results

Out of 3560 children, 185 (5.2%) did not pass screening, and were sent to specialized clinics for further detailed examination.

The results of examination in those 185 were as follows: in 59 children the repeat examination revealed normal hearing; 41 patients had ear wax; 33 children were diagnosed with tubootitis; 28 children had otitis media with effusion; 3 children were diagnosed with unilateral sensorineural hearing loss of different degrees; 2 children were diagnosed with bilateral mild sensorineural hearing loss, 2 children had bilateral high frequency hearing loss up 6000 *Hz*; 17 children never showed up.

3 out of 7 patients with sensorineural hearing loss were revealed in a region where at that time there was no newborn screening implemented and children were left without observation. Only 1/5 of the total number of children in the study represented this region. In the capital city, where newborn screening was implemented and which included 4/5 of total number of children of the study, 4 patients with sensorineural hearing loss were revealed.

Discussion

Rates of morbidity, prevalence of various forms of pathology are key to the population's health status characteristics, and they define the necessity in various therapeutic-preventive measures.

Neonatal audiology screening system was introduced in Armenia in December 2007. It was implemented as a pilot program in 4 maternity homes in Yerevan and during further several years, step-by step engaged all the other maternity homes in Armenia. Within the framework of the program children with congenital deafness were found and sent for

cochlear implantation that prevented deaf-dumbness. Nowadays, the data collected allow us to assess the general picture of hearing loss prevalence among newborns. However, as mentioned above, even among the children with positive examination results, hearing loss can be detected at school age.

During the early stage of our research study conducted in 2006-2014, the prevalence and structure of ENT diseases among pre-conscript and conscript age adolescents in Armenia was studied. The data obtained showed that hearing loss is considerably important in the structure of ENT diseases. It is noteworthy that among about 22 to 25% of adolescents diagnosed with hearing loss the pathology was bilateral and in more than half of cases the disease had sensorineural nature. The problem of hearing loss gets even more important, given that part of the examined adolescents was recognized as "ineligible" for military service or "eligible" for non-combatant service. In many of the stated cases the development of the disease could have been prevented due to early diagnosis and initiated treatment. This once again draw our attention to a gap in terms of lack of data about the feature of hearing impairment amongst the preschool and school age children [*Sargsyan S et al., 2016*].

In the polyclinics of the Republic of Armenia, all children get ENT consultation at the age of six, however, no hearing screening is conducted. The considerable percent of hearing loss cannot be diagnosed by the standard ENT-examination. Besides, as noted in the literature, it is possible for hearing loss to be detected among "seemingly healthy" children [*Ross D et al., 2008*].

Pure tone screening presentation levels are reported to vary from 20 *dB* to 30 *dB* [*ANSI, 1999*]. Meinke D. and Dice N. (2007) provided evidence of the greater sensitivity of a 20 *dB HL* screening level when compared to a 25 *dB HL* screening level in the identification of high frequency notches. Using a screening level of 20 *dB HL* has proved to increase the sensitivity in identifying minimal hearing loss (MHL) [*Dodd-Murphy J, Murphy W, 2014*]. The authors concluded that pure tone screening at 25 *dB HL* had the best combined sensitivity/specificity rates for educationally significant hearing loss (ESHL) but unacceptable sensitivity when screening for MHL. However, Childhood Hearing Screening Guidelines of American Academy of Audiology (2011) are forced into accepting screening levels of 20 to 25 *dB HL* because of the conditions under which most screening is performed. We have also implemented a 25 *dB HL*, taking into account the lack of acoustically appropriate screening environment in our schools. It is important that screening is held in an acoustically appropriate screening environment to minimize false negative results. Ambient noise sources from ventilation, adjacent hall or classroom noise, children moving about the room and screening personnel giving instructions – all hinder the screening process at levels less than 20 *dB HL*.

Diseases that are usually detected as a result of school hearing screening have also been researched by us. One of them was unilateral sensorineural hearing loss (mean air conduction thresholds >20 *dB* in the impaired ear). It is noted in scientific studies, that although differences in language skills and intelligence were not found between those with UHL and normal-hearing children, a slightly higher incidence of behavior problems was identified for the group with UHL [*Culbertson J, Gilbert L, 1986; Klee T, Davis-Dansky E, 1986*]. The other is bilateral minimal sensorineural hearing loss (average air conduction thresholds between 20 and 40 *dB* in both ears). Some studies report children with this MSHL are at higher risk for academic struggles, speech-language deficits and social-emotional difficulties [*Tharpe A, Bess F, 1991; Bess F et al., 1998; McKay S et al., 2008*]. There was another case of high-frequency sensorineural hearing loss (mean air conduction thresholds >25 *dB* at two or more frequencies above 2 *kHz* in one or both ears). Niskar A. and co-authors (1998) reported a low frequency hearing loss (LFHL) prevalence of 7.6% for 6-11-year-old students. Latest results show that the frequency level of high frequency hearing loss has reached 19.5% [*Shargorodsky J et al., 2010*]. Many children have an effusion presence in the middle ear. The non-symptomic clinic of this disease often complicates the diagnosis. In 40-60% of cases neither children nor their parents report significant complaints related to the disease [*Burkey J et al., 1994; Rosenfeld R et al., 1997; Olusanya B, 2001; Gomes M, Lichtig I, 2005; Lo P et al., 2006*].

As mentioned above, in our study, 7 cases of sensorineural hearing loss have been found out. It is to be underscored that neither the parents nor the children were aware of the disease. Such cases have also been observed and mentioned by other authors. Bristow K. and co-authors (2008) mentioned that, although most children with hearing impairment are identified before they begin school, some cases are missed.

AAP/Bright Futures guidelines suggest implementing regular screening within the age group of 4-10 years old children [*Bright Futures/American Academy of Pediatrics, 2017*]. This means that our target age group has been properly selected given that, the opportunities for conducting screening in various age groups are limited. The same guidelines propose including screening at 6000 and 8000 *Hz* frequencies when examining 11-14, 15-17 and 18-21 aged groups. In our study the inclusion of 8000 *Hz* frequency allowed to reveal 2 children with bilateral high frequency hearing loss, which would not have been revealed if the examination had been conducted with the use of up to 6000 *Hz* frequency.

Thus, school hearing screenings are essential tools in identifying children with hearing loss, especially, in the case of those not identified at birth or failed to be followed-up and who developed hearing loss later.

Wrapping up the results of a large-scale screening held for the first time amongst preschool and school age children in the Republic of Armenia, it can be claimed, that there is an obvious gap in this age group. To fill this gap, it is necessary that the screening program be similarly implemented for this age group to ensure sustainability. This group is key in terms of early identification of hearing loss and prevention of subsequent complications to ensure and improve the health of the younger generation.

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Abbreviations: dB – Decibel, dB HL – dB hearing level, ENT- ear, nose and throat, Hz – Hertz, MHL - minimal hearing loss, UHL - unilateral hearing loss.

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