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SCHOOL HEARING SCREENING AS A NECESSARY PREREQUISITE FOR A FULL-FLEDGED DEVELOPMENT

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Abstract

Hearing disorders in children are not always congenital; sometimes it can be acquired during early childhood. Hearing loss, whether consistent or fluctuating, interferes with the accurate reception of speech, especially under noisy and reverberant classroom conditions and when speech is presented at a distance from the student. Minimal hearing loss can stay unnoticed by parents, teachers, which will have its detrimental effect on child's school progress and social life. The detection of children with such problems helps the teachers to ensure necessary and appropriate attention to these children and, if necessary, to change their seats in the classroom, in order to make lesson materials more understandable. School hearing screenings are essential tools in identifying children with hearing loss, especially, who were not identified at birth or lost to follow-up and who developed hearing loss later. The aim of this study was to detect hearing loss among the children of early school age with the use of a screening program. This program was funded by contributions from Committee of Science in Ministry of Education and Science in Armenia. Total of 2820 children were included in this study. The study included 6-7 years old children. The pure tone audiometry with signal of 25dB of air conduction on frequencies of 500, 1000, 2000, 4000 and 8000Hz has been used for screening. From 2820 164 (5.8%) children did not pass screening and were sent to specialized clinics for further work up.

First school hearing screening performed in Armenia showed that it's critical to implement this screening on continuous basis, to include all schools and to make guidelines regarding the screening ways, settings and age groups of children included in screening.

Keywords: *hearing loss, school screening, otitis media, sensorineural hearing loss.*

Introduction

The lack of detection of hearing loss and the absence of later caring after the children with detected hearing loss brings economic effects, as well as negative impact on children's achievements at school and on their cognitive and social development. The goal of early detection of newly developing hearing loss is to maximize speech perception and, thus, improves the linguistic skills.

Hearing disorders in children are not always congenital, sometimes it can be acquired during early childhood. Progressive or acquired hearing loss can develop even in those children who had positive results of neonatal hearing screening, caused by genetic, traumatic or other diseases. Neonatal hearing screening programs would not detect 10 to 20% of cases of permanent childhood hearing loss that start later in life [*Grote J, 2000*]. According to another author, in 9-years-old children with educationally significant hearing loss, up to 50% will have passed newborn hearing screening [*Fortnum H et al., 2001*]. It is considered, that 6-7% of 1000 school children has permanent hearing loss [*Bamford J et al., 2007*]. 9-10 per 1000 children will have identifiable permanent hearing loss in one or both ears by school age [*Shargorodsky J et al., 2010; White K, 2010*]. It is calculated, that 3/1000 prevalence of permanent hearing loss in infants can be expected to increase to 9-10/1000 children in the

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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 reverberant classroom conditions and when speech is presented at a distance from the student [*Blumsack J, Anderson K, 2004*]. The behavioral 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 behavior 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 the teachers to ensure necessary and appropriate attention to 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 of which is often more than 20. The early detection of hearing problems of these children, in its turn, makes parents take appropriate measures to prevent possible hear losses.

Generally, the goal of preschool and school screening is the detection of hearing loss among those children who are not included in the frames 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 the success at school studies.

We aim to detect hearing loss among the children of early school age with the use of a small screening program, and, in particular, to inform the pedagogues, school psychologists and parents about the problems caused by hearing loss and to propose necessary actions in the case of need.

Material and methods

This program was funded by contributions from Committee of Science in Ministry of Education and Science in Armenia.

Total of 2820 children were included in this study; 515 of children were residents of the Armenian region, where newborn screening was not implemented and 2305 were from Armenian capital Yerevan, where newborn screening was implemented for more than last 7 years. The study included 6-7 years old children. Examinations were done in the school, in the quietest room of it.

The examination was done with GSI 18 screening audiometer. It provides the ability to conduct complete air conduction evaluation for all levels of hearing loss; achieve thresholds from 125 *Hz* to 8000 *Hz* and 0-100 *dB HL* (hearing level).

The pure tone audiometry with signal of 25*dB* of air conduction on frequencies of 500, 1000, 2000, 4000 and 8000*Hz* has been used for screening. Screening was passed 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*, child was reinstructed and rescreened within the same screening session in which the child fails. Children who fail the rescreening were instructed to the further work up in specialized clinics within two weeks.

Results

From 2820 164 (5.8%) children did not pass screening and were sent to specialized clinics for further work up.

The results of further work up in those 164 were; in 56 children repeat examination revealed normal hearing; 39 patient had ear wax; 29 children were diagnosed with tubootitis; 21 children had otitis media with effusion; 3 children were diagnosed with unilateral sensorineural hearing loss of different degrees; 1 child were diagnosed bilateral mild sensorineural hearing loss, 2 child had bilateral high frequency hearing loss up 6000*Hz*; 13 children did not show up.

Three out of 6 patients with sensorineural hearing loss were revealed in region where there was no newborn screening performed. Only 1/5 of total number of children in study was from this region. In capital, where newborn screening was imple-

mented and which included 4/5 of total number of children of the study, 3 patients with sensorineural hearing loss were revealed.

Discussion

Currently in the Republic of Armenia a program of neonatal screening is running, which is also introduced by the initiative of the supervisor of this program. It allows making an early diagnosis of inborn hearing loss. However, in not all hospitals the program is available; also as it was already mentioned, even among those children with positive results of examination can be detected hearing loss at school age.

In polyclinic of Armenia at the age of 6 all children get ENT consultation, but no hearing screening. The greatest percent of hearing loss cannot be diagnosed by the standard ENT-examination. Besides, it is noted in the literature, that 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 been shown to increase the sensitivity in identifying minimal hearing loss [*Dodd-Murphy J, Murphy W, 2009*]. 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 identifying minimal hearing loss [*Dodd-Murphy J, Murphy W, 2006*]. 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 also have implemented 25 *dB HL*, taking into account the lack of acoustically appropriate screening environment in our schools. It is important to screen 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 contribute to difficulty screening at levels less than 20 *dB* HL.

Diseases that are usually detected as a result of school hearing screening have also been detected by us. One of them was unilateral sensorineural hearing loss (mean air conduction thresholds >20 *dB* in the impaired ear). It is noted in scientifical works, that although differences in language skills and intelligence were not found between those with unilateral hearing loss and normal-hearing children, a slightly higher incidence of behavior problems was noted for the group with unilateral hearing loss [*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 that such children are at higher risk for academic struggles, speech-language deficits and social-emotional difficulties [*Tharpe A, Bess F, 1991; Bess F et al., 1998; Bess F, 1999; 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 prevalence of 7.6% for 6-11 year old students. Latest results show that the frequency level of high frequency hearing loss has reached to 19.5% [*Shargorodsky J et al., 2010*]. Many children have an effusion presence in the middle ear. The non-symptomatic 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*].

It is important to use 8000 *Hz* frequency for screening, although some guidelines are not using it [*ASHA, 1997; American Academy of Audiology, 2011*]. Meinke D. and Dice N. (2007) evaluated a database of 641 students in the 9th and 12th grades with identified high frequency hearing loss using four different intensity and frequency combinations. They showed that when protocols include 6000 or 8000 *Hz*, percentage of identifying of known high frequency hearing loss was 44.4%, and when protocols include till 4000 *Hz*, percentage of identifying of known high frequency hearing loss was 22.2%. The authors performed further analysis of 45 out of 641 audiograms and found that 48.8% of the diagnosed hearing losses in-

volved the frequency of 4000 *Hz*, 46.1% – 6000 *Hz*, and 5.1% – 3000 *Hz*.

So, school hearing screenings are essential tools in identifying children with hearing loss, especially who were not identified at birth or lost to follow-up and who developed hearing loss later.

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REFERENCES

1. *American Academy of Audiology*. Childhood Hearing Screening Guidelines. 2011. 78p.
2. *American National Standards Institute (ANSI).* American national standard specifications for maximum ambient noise levels for audiometric test rooms. ANSI S3.1-1999. New York: Acoustical Society of America. 1999.
3. *American Speech-Language-Hearing Association (ASHA).* Guidelines for Audiological Screening. 1997. 63p.
4. *Bamford J, Fortnum H, Bristow K, Smith J, Vamvakas G., et al.* Current practice, accuracy, effectiveness and cost-effectiveness of the school-entry hearing screen. Health Technology Assessment. 2007; 11(32): 1-168.
5. *Bess FH, Dodd-Murphy J, Parker RA.* Children with minimal sensorineural hearing loss: prevalence, educational performance, and functional status. Ear Hear. 1998; 19(5): 339-354.
6. *Bess FH.* School-aged children with minimal sensorineural hearing loss. Hear J. 1999; 52: 5.
7. *Blumsack JT, Anderson KL.* Back to school! 13 facts revisited. Hearing Review. 2004; 11(10): 14-16, 62-63.
8. *Burkey JM, Hamilton MJ, Schatz KA, Sylvester SP.* Study finds most parents overlook otitis media-related hearing loss. Hear J. 1994; 47(6): 39-42.
9. *Culbertson JL, Gilbert LE.* Children with unilateral sensorineural hearing loss: cognitive, academic and social development. Ear Hear. 1986; 7(1): 38-42.
10. *Dodd-Murphy J, Murphy W.* Predictive value of school hearing screenings. Manuscript in preparation. 2009.
11. *Dodd-Murphy J, Murphy W.* School hearing screening referral and DPOAEs. Presented at the annual meeting of the American Auditory Society, Scottsdale, AZ. March 2006.
12. *Fortnum H, Summerfield A, Marshall D, Davis A, Bamford J., et al.* Prevalence of permanent childhood hearing impairment in the United Kingdom and implications for universal neonatal hearing screening: questionnaire based ascertainment study. Br Med J. 2001; 323(7312): 536-542.
13. *Gomes M, Lichtig I.* Evaluation of the use of a questionnaire by noon-specialists to detect hearing loss in preschool Brazilian children. Int J Rehabil Res. 2005; 28(2): 171-174.
14. *Grote J.* Neonatal screening for hearing impairment. Lancet. 2000; 355(9203): 513-514.
15. *Klee T, Davis-Dansky E.* A comparison of unilaterally hearing-impaired children and normal-hearing children on a battery of standardized language tests. Ear Hear. 1986; 7(1): 27-37.
16. *Lo PS, Tong MC, Wong EM, van Hasselt CA.* Parental suspicion of hearing loss in children with otitis media with effusion. Eur J Pediatr. 2006; 165(12): 851-857.
17. *McKay S, Gravel JS, Tharpe AM.* Amplification considerations for children with minimal or mild bilateral hearing loss or unilateral hearing loss. Trends Amplif. 2008; 12: 43-54.
18. *Meinke DK, Dice N.* Comparison of audiometric screening criteria for the identification of noise-induced hearing loss in adolescents. Am J Audiol. 2007; 16(2): S190-202.

19. *Niskar AS, Kiezak SM, Holmes A, Esteban E, Rubin C, Brody DJ.* Prevalence of hearing loss among children 6 to 19 years of age. JAMA. 1998; 279(14): 1071-1075.

20. *Olusanya B.* Early detection of hearing impairment in a developing country: what options? Audiology. 2001; 40(3): 141-147.

21. *Roeser R, Northern J.* Screening for hearing loss and middle ear disorders. In Auditory Disorders in School Children, edited by R. Roeser and M. Downs. New York: Thieme-Stratton. 1981.

22. *Rosenfeld RM, Goldsmith AJ, Tetlus L, Balzano A.* Quality of life for children with otitis media. Arch Otolaryngol Head Neck Surg. 1997; 123(10): 1049-1054.

23. *Ross DS, Gaffney M, Green D, Holstrum WJ.* Prevalence and effects. Seminars in Hearing. 2008; 29(2): 141-148.

24. *Shargorodsky J, Curhan SG, Curhan GC, Eavey R.* Change in prevalence of hearing loss in US adolescents. JAMA. 2010; 304(7): 772-778.

25. *Tharpe AM, Bess FH.* Identification and management of children with minimal hearing loss. Int J Pediatr Otorhinolaryngol. 1991; 21(1): 41-50.

26. *White K.* Twenty years of early hearing detection and intervention (EHDI): Where we've been and what we've learned. ASHA Audiology Virtual Conference. 2010.