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Research Article

Prevalence of Hearing Loss Diagnosed for the First Time in Primary School Children in Damascus, Syria

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Highlights

- The most common cause of school children hearing loss is CHL due to OME
- Hearing loss is a serious problem among children that needs more care and attention

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ABSTRACT

Background and Aim: Hearing loss is considered a main cause of speech-language delay and academic performance retardation. This study aimed to detect the prevalence of hearing loss diagnosed for the first time in primary school children.

Methods: A cross-sectional study has involved 624, randomly chosen, primary school children. The children have undergone hearing screening using tympanometry, and pure tone audiometry screening in order to detect the children with undiagnosed hearing loss.

Results: Six hundred and twenty-four children underwent tympanometry which showed that 481 children have type A Tympanogram, 39 have type C, 16 have type A in one ear and type C in the other, 78 have type B, and 10 of them have type B in one ear and type C in the other. Then all children underwent pure tone audiometry screening and this showed that 565 children have responded to 20 dB for all frequencies, 42 have not responded to 20 dB at any frequency, 27 of them are from those children with type B Tympanogram, 10 children have not responded to 20 dB for frequencies >2000 Hz, 7 of them have not responded to 20 dB at any frequency in one ear with normal responses in the other.

Conclusion: School age hearing screening is an important procedure to detect hearing loss in children in order to manage hearing loss as early as possible and avoid its consequences.

Keywords: Hearing loss; sensorineural hearing loss; otitis media with effusion; pure tone audiometry; tympanometry; screening

Introduction

Normal hearing is considered a main factor in the psycho-social development of children, it plays an important role in all stages of life, because it is very essential for speech-language development, comprehension, reading and writing capabilities, and for good learning and academic performance. Normal hearing is attained through proper functioning of the outer, middle and inner ear, in addition to the auditory central pathway [1].

Hearing loss has a significant impact on the individual and the society, especially in children. Even a slight hearing loss in children (any loss >20 dB) can affect speech-language development, social abilities, and self-image [2]. Many cases of hearing loss in school age are misdiagnosed and may be identified late, so they can cause delay in speech-language development and affect socio-academic performance before they are diagnosed.

Later in life, any degree of hearing loss will cause learning difficulties, reading disorders, vocational problems, and affect motives and competitiveness which may impact the individual's academic performance and job choices. These factors may impair the psychological status in term of in the negatively status of the individuals, push them towards isolation, and cause problems in their communication skills [3].

The World Health Organization reports reveal the prevalence of mild hearing impairment in the region of the Middle East and North Africa region at 4.5% (Prevalence range: 2.0-10.4%) and 2.8% (Prevalence range: 1.2-6.7%) for boys and girls within the age range of 5–14 years, respectively, while the prevalence of moderate to severe hearing impairment is reported as 0.8% and 0.5% for boys and girls, respectively [4].

Many researchers [5, 6] report that neonatal hearing screening programs cannot detect 10 to 20% of cases of permanent late onset childhood hearing loss. The prevalence studies for children hearing loss in the United Kingdom reveal that for every 10 children with permanent bilateral hearing impairment of greater than 40 dB HL detected by universal newborn hearing screening, other 5 to 9 children would manifest such hearing impairment by the age of 9 years [7]. One of the school hearing screening programs indicate that 2.9% of children at schools may have a significant hearing loss that requires management such as consultation with parents, referral to education services, watchful waiting, medical and surgical treatment, and amplification, while 2.2% are identified to have hearing loss for the first time [8].

Screening is identified as a simple, fast, and low-cost process that can identify individuals who, more likely, have impaired tested function. Upon failing this test, the individual should be referred to more complex diagnostic procedures. Hearing screening aims to detect individuals with any degree of hearing loss to refer them to undergo more comprehensive hearing assessment [9, 10]. Newborn hearing screening is considered a mainstay of health systems in many countries all over the world, whereas hearing screening for school children is still less common, and is just utilized in highly developed countries, such as USA, Australia, China, and a few European countries as an opportunistic program [11]. Unfortunately, in Syria we still do not have formal screening programs carried out by the governmental authorities, which causes the lack of information needed to follow up with children with hearing loss.

Hearing screenings should be done in schools [12], as large numbers of children of many ages are easily accessible and screening can be applied quickly and easily, additionally, the cost of hearing screening compared to services performed in other sectors of the health care system is lower. School hearing screening provides the opportunity to detect children with hearing loss that have not been previously diagnosed.

Routine hearing screening of school children should be considered in low- and middle-income countries [13], because for children under 15 years of age, 60% of hearing loss cases can be preventable. Early diagnosis and interventions are essential to minimize the impact of hearing loss on child development and academic performance [14].

The most common causes of hearing loss during school age [12] are minimal sensorineural hearing loss (SNHL) which includes three different categories: 1) bilateral SNHL with average air conduction thresholds between 20 and 40 dB in both ears, 2) high-frequency SNHL with mean air conduction thresholds >25 dB at two or more frequencies above 2 kHz in one or both ears, and 3) unilateral SNHL with mean air conduction thresholds >20 dB in the impaired ear. Children with minimal SNHL may complain of academic struggles (37% of hearing impaired-children may repeat a grade) and suffer from speech-language problems (4.3 times more likely to experience trouble in communication), in addition to social and emotional sufferings (poor self-esteem, social isolation and shyness) [15]. The other main cause of hear-

ing loss during school age is due to otitis media with effusion. Otitis media with effusion (OME) is defined as fluid in the middle ear without signs or symptoms of acute ear infection. The main corresponding factor to OME is Eustachian tube dysfunction, and it may also happen as an inflammatory response to acute otitis media. The conductive hearing loss associated with OME is variable, fluctuating, and typically mild to moderate in degree (15-50 dB HL across the frequencies of 500-4000 Hz) [16].

This study aimed to detect the cases of first time diagnosed hearing loss in primary school children aged 6-9 years in four primary schools in Damascus, and isolate cases of hearing loss caused by otitis media with effusion and those caused by minimal SNHL.

Methods

An observational study (cross-sectional study) was conducted to detect the prevalence of first time diagnosed hearing loss among school children in four primary schools in Damascus.

The study has included 631 children aged 6-9 years (306 males and 325 females, the mean age is 7.6 years, SD=0.35). These children are students at 1st, 2nd, and 3rd grade in four randomly chosen primary schools in Damascus. All formal permissions were obtained from the Directorate of Education in Damascus after proving that this study causes no harm to the students and that it conforms with the research ethical covenants.

The inclusion criteria for this study are the following: the child should be co-operative with the researcher to undergo the screening tests, has no previous history of hearing loss, and does not use any kind of hearing aids. This information was extracted from the parents by sending them a simple survey the day before screening. This survey includes information about the child's previous medical and audiological history. Furthermore, the clinical examination of the ear should not reveal any cerumen which cannot be extracted easily, any tympanic membrane perforations, any kind of acute ear infections or any kind of congenital deformities such as atresia or severe stenosis of the external ear canal. The examiner should make sure that the child has no cleft lip or palate even if it is surgically repaired.

After applying these criteria, seven children were excluded (three children with cerumen impact which could not be extracted in the classroom environment, two children with a history of hearing loss and using hearing aids and two children who did not co-operate with the researcher and refused to undergo the tests) after the exclusion of these children, the final sample of our study was 624 children (302 males, 322 females, the mean age 7.51 years SD=0.34).

These 624 children underwent tympanometry using the Audiometry and Tympanometry Screening device (Interacoustics MT10©). Pressure range (–50 to +200 daPa) and pump speed (200 daPa/s) have been used to detect the type of tympanogram and isolate the cases with type B tympanogram which suggests the presence of OME.

Then these 624 children underwent a pure tone audiometry (PTA) screening using the screening that applies 20 dB pure tone for frequencies (500, 1000, 2000 and 4000 Hz) to detect any case of hearing loss that exceed 20 dB.

Results

The 624 children included in the study underwent tympanometry to detect the type of tympanogram and isolate children with OME. The results are demonstrating (Table 1).

Then these 624 children underwent a screening PTA applying 20 dB for frequencies (500, 1000, 2000 and

Table 1. Distribution of the study sample according to the type of tympanogram

Tympanogram type	n	%
A	481	77.10
One ear A, other C	16	2.55
C	39	6.25
One ear B, other C	10	1.60
B	78	12.50

Table 2. Distribution of the ears according to pure tone audiometry screening

	500 Hz	1000 Hz	2000 Hz	4000 Hz
(+) response 20 dB	1157	1157	1157	1137
(–) response 20 dB	91	91	91	111

4000 Hz) for both ears, so we screened 1248 ears. The result signed (+) if the child has responded to the tone and (–) if he/she has not responded. The results have been summarized in Table 2.

The children have been classified according to the PTA as in Table 3.

The results shown in the previous tables (1 and 3) indicate that 27 children (64.3%) among the 42 who have not responded to any frequency are type B Tympanogram, so the hearing loss could be attributed to OME, while hearing loss in the remaining15 children (35.7%) could be due to minimal SNHL (Table 4).

Discussion

As you know, Syria is classified as a low-income country, consequently there is a lack of screening programs, particularly hearing screening programs which include younger students. So, this study was done to prove the importance of school age hearing screening, to detect children with hearing loss and manage their disability in the proper way to avoid any retardation in their academic performance that can affect their future.

The study sample included 624 children (48.4% males and 51.6% females) aged (6–9 years). These children have been selected according to inclusion criteria which excluded children with any case of hearing loss diagnosed before, in addition to the exclusion of non-cooperative students.

These students underwent tympanometry to detect the type of tympanogram, and cases of OME that cause type B Tympanogram were isolated. 77.1% of children have type A Tympanogram, 6.25% have type C, 2.56% have type A in one ear and type C in the other, 1.6% have type B in one ear and type C in the other, and 12.5% have type B in both ears. These results indicate that the percentage of OME in one ear or in both is about 14.1%. This ratio is statistically significant, and it can mainly be due to Eustachian tube dysfunction among children of this age group who usually suffer from adenoid hypertrophy and recurrent upper respiratory tract infections. This ratio is consistent with the international ratios of distribution of OME among school children (11.2–18.3%) [16].

All children then underwent a screening PTA using 20 dB for frequencies (500, 1000, 2000 and 4000 Hz) showing the following results: 90.5% of children have hearing within normal limits (hearing threshold >20dB),

Table 3. Children classification according to pure tone audiometry

	n	%
Response to all frequencies	565	90.50
No response to any frequency in both ears	42	6.73
No response to high frequencies in both ears	10	1.60
No response to any frequencies in one ear	7	1.17

Table 4. Distribution of the no response to any frequency in both ears

	n	%
No response with type B Tympanogram	27	64.3
No response with any other type of Tympanogram	15	35.7
Total	42	100

whereas the overall percentage of children who failed the screening and referred to more comprehensive audiological assessment is 9.5%. This ratio is less than that recorded in the same study done in Kyrgyzstan, 27.2% [17], but more than the ratio of the United Kingdom statistics for children diagnosed with hearing loss for the first time at school 2.2% [8]. 6.73% of children did not respond to 20 dB on any frequency. 4.33% of children did not respond to any frequency, and have type B Tympanogram, so their suspected hearing loss and their failure in the screening test may be due to OME, whereas 2.4% did not respond to 20 dB for any frequency and have other types of Tympanograms so their suspected hearing loss may be due to sensorineural etiology. The ratio of 2.4% is very close to the screening ratios in the United States for the same age group 3.5%–5.3% in (2008) [14], but noticeably less than the ratio recorded in another American study that depended on the screening program done in (1998) for age group (6-11 years) 12.2% [12]. This ratio also is more than these recorded in two Iranian studies done in 2013 (0,7%–1%) [18], and in 2020 (1.04%–1.14%) [19]. But in this study 1.6% of the sample have not responded to high frequencies (>2000 Hz) in both ears. This ratio is obviously less than the ratios recorded in other studies on international level 12.3% [12]. This may be due to the usage of personal music player devices, which are not that common in our country for this age group; This helps lessen the ratio of high frequency hearing loss which in most cases can be due to noise exposure [20]. 1.12% of children have not responded to 20 dB at any frequency in just one ear, which indicates suspected unilateral hearing loss. This ratio is less than that recorded in Bess study, 3% [21], and that of Ross study, in the United States (3–6%) [22]. This study faced many limitations, for instance, there were no newborn hearing screening results available, in addition to the lack of information provided by the parents in the surveys. In one of the schools, it proved difficult to provide a noise free location to perform the tests, so the examiner was obliged to repeat the tests many times to confirm the results.

Conclusion

Hearing loss is a serious problem. This study demonstrates the prevalence of hearing loss in children of school age in Syria enough to justify hearing screening in schools and consider it as an important part of the national health plan. The results encourage the health authorities to develop national screening programs to detect any case of hearing loss as early as possible and mange it properly. This helps attain good hearing results for children and good academic and social performance.

Ethical Considerations

Compliance with ethical guidelines

The protocol of this manuscript complies with the recommendations of Helsinki and Tokyo Declarations and is approved by Damascus University Ethics Committee.

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Author's contributions

RNM: Study design, acquisition of data, interpretation of results, statistical analysis, literature review, drafting the manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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References

[1] Vieira ABC, Macêdo LR. [O diagnóstico da perdaauditivanainfância/The diagnosis of hearing loss in childhood]. Pediatria. 2007;29(1):43-9. Portuguese.

[2] Shargorodsky J, Curhan SG, Curhan GC, Eavey R. Change in prevalence of hearing loss in US adolescents. JAMA. 2010;304(7):772-8. [DOI:10.1001/jama.2010.1124]

[3] Tharpe AM. Unilateral and mild bilateral hearing loss in children: past and current perspectives. Trends Amplif. 2008;12(1):7-15. [DOI:10.1177/1084713807304668]

[4] Stevens G, Flaxman S, Brunsill E, Mascarenhas M, Mathers CD, Finucane M. Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. Eur J Public Health. 2013;23(1):146-52. [DOI:10.1093/eurpub/ckr176]

[5] Grote JJ. Neonatal screening for hearing impairment. Lancet. 2000; 355(9203):513-4. [DOI:10.1016/S0140-6736(99)00393-1]

[6] Fortnum HM, Summerfield AQ, Marshall DH, Davis AC, Bamford JM. Prevalence of permanent childhood hearing

impairment in the United Kingdom and implications for universal neonatal hearing screening: questionnaire based ascertainment study. BMJ. 2001;323(7312):536-40. [DOI:10.1136/bmj.323.7312.536]

[7] Fonseca S,Forsyth H, Neary W. School hearing screening programme in the UK: Practice and performance. Arch Dis Child. 2005;90(2):154-6. [DOI:10.1136/adc.2003.046979]

[8] Colella-Santos MF, Bragato GR, Faria Martins PM, Ballarin Dias A. [Triagemauditivaemescolares de 5 a 10 anos]. Rev CEFAC. 2009;11(4):644-53. Portugese. [DOI:10.1590/S1516-18462009000800013]

[9] Tazinazzio TG, Diniz TA, Marba ST, Colella-Santos MF. [Otoacoustic emissions and acoustic imittance measurements using 226 Hz and 1000 Hz probe tones in neonates]. Rev CEFAC. 2011;13(3):479-88. Portuguese. [DOI:10.1590/S1516-18462010005000138]

[10] Skarżyński H, Piotrowska A. Prevention of communication disorders--screening pre-school and school-age children for problems with hearing, vision and speech: European Consensus Statement. Med Sci Monit. 2012;18(4):SR17-21. [DOI:10.12659/MSM.882603]

[11] American Academy of Audiology. Childhood hearing screening guidelines. Reston, VA: American Academy of Audiology; 2011.

[12] Olusanya BO, Neumann KJ, Saunders JE. The global burden of disabling hearing impairment: a call to action. Bull World Health Organ. 2014;92(5):367-73. [DOI:10.2471/BLT.13.128728]

[13] World Heath Organization. Deafness and hearing loss. 2020. Available from: http://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss

[14] McKey S, Gravel JS, Tharpe AM. Amplification considerations for children with minimal or mild bilateral hearing loss and unilateral hearing loss. Trends Amplif. 2008;12(1):43-54. [DOI:10.1177/1084713807313570]

[15] Zumach A, Gerrits E, Chenault M, Anteunis L. Long term effects of early life otitis media on language development. J Speech Lang Hear Res. 2010;53(1):34-43. [DOI:10.1044/1092-4388(2009/08-0250)]

[16] Sanli A, Tasdemir O, Eken M, Celebi O, HilmiYilmaz S. Prevalence of otitis media with effusion among primary school age children and etiopathogenic examination. Indian J Otolaryngol Head Neck Surg. 2014;66(Suppl 1):95-8. [DOI:10.1007/s12070-011-0336-1]

[17] Skarżyński PH, Świerniak W, GosE, Pierzyńska I, Walkowiak A, Cywka KB, et al. Results of hearing screening of school-age children in Bishkek, Kyrgyzstan. Prim Health Care Res Dev. 2020;21:e18. [DOI:10.1017/S1463423620000183]

[18] Absalan A, Pirasteh I, DashtiKHavidaski GA, Asemi Rad A, Nasr Esfahani AA, Nilforoush MH. A Prevalence Study of Hearing Loss among Primary School Children in the South East of Iran. Int J Otolaryngol. 2013;2013:138935. [DOI:10.1155/2013/138935]

[19] Jalali MM, NezamdoustF, Ramezani H, Pastadast M. prevalence of hearing loss among school-age children in the north of Iran. Iran J Otorhinolaryngol. 2020;32(109):85-92.

[20] Serra MR, Biassoni EC, Hinalaf M, Abraham M, Pavlik M, Villalobo JP, et al. Hearing and loud music exposure in 14-15 years old adolescents. Noise Health. 2014;16(72):320-30. [DOI:10.4103/1463-1741.140512]

[21] Bess FH, Dadd-Murphy J, Parker RA. Children with minimal sensorineural hearing loss: prevalence, educational performance, and functional status. Ear Hear. 1998;19(5):339-54. [DOI:10.1097/00003446-199810000-00001]

[22] Ross DS, Vissed SN, Holstrum WJ, Qin T, Kenneson A. Highly variable population-based prevalence rates of unilateral hearing loss after the application of common case definitions. Ear Hear. 2010;31(1):126-33. [DOI:10.1097/AUD.0b013e3181bb69db]