

RESEARCH ARTICLE

The prevalence of hearing loss in the first high school students in Hamadan, western Iran

Morteza Hamidi Nahrani^{1*}, Farhad Farahani², Ebrahim Pirasteh^{3,4}, Morteza Hajhosseini⁵

¹- Department of Audiology, School of Rehabilitation, Hamadan University of Medical Sciences, Hamadan, Iran

²- Department of ENT, School of Medicine, Hamadan University of Medical Sciences, Hamadan, Iran

³- Department of Audiology, School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran

⁴- Department of Audiology, Faculty of Rehabilitation Sciences, Zahedan University of Medical Sciences, Zahedan, Iran

⁵- Cardiovascular Diseases Research Center, Birjand University of Medical Sciences, Birjand, Iran

Received: 3 Sep 2017, Revised: 28 Sep 2017, Accepted: 2 Oct 2017, Published: 15 Jan 2018

Abstract

Background and Aim: Because children learn to communicate by hearing sounds, a hearing loss (HL) will deteriorate their cognitive and speaking abilities and language learning. Early detection and intervention are important factors in the successful treatment of HL in children. HL is divided into two main groups: conductive hearing loss (CHL) and sensorineural hearing loss (SNHL); the former is more prevalent in children and many of its causes are easy to detect and treat.

Methods: In this descriptive cross-sectional study, 1,446 children, aged 11-13 years, entering first-degree high school in the school year 2016, were randomly selected from two schools in Hamadan, western Iran, and their audiograms were studied. The collected data were analyzed by descriptive statistics using SPSS 16.

Results: Out of the 1,446 high school children examined in this study, 18 children (1.2%) suffered from HL (44.5% female and 55.5% male), 33% from CHL, and 67% from SNHL. Besides, 89% suffered from bilateral HL and 11% from

unilateral HL.

Conclusion: Considering the prevalence of HL, especially SNHL, in this study in first-degree high school students of Hamadan, it seems vital to raise public awareness and early screening of ear diseases, which can lead to the detection and treatment in most cases.

Keywords: Hearing screening test; hearing loss; sensorineural hearing loss; conductive hearing loss

Citation: Hamidi Nahrani M, Farahani F, Pirasteh E, Hajhosseini M. The prevalence of hearing loss in the first high school students in Hamadan, western Iran. *Aud Vest Res.* 2018;27(1): 19-24.

Introduction

Hearing loss is the most common birth defect in industrialized countries [1]. According to the World Health Organization (WHO), there are more than 360 million hearing-impaired in the world, among whom 32 million are children under 15 years old and 80% live in developing countries with low incomes [2]. It is noteworthy that not all types of hearing loss (HL), including progressive or late HL, and HL due to otitis media, not diagnosed at birth. The prevalence of HL in childhood is different between ages and social classes [3-5]. Language deficits due to

* **Corresponding author:** Department of Audiology, School of Rehabilitation, Hamadan University of Medical Sciences, Shahid Fahmideh Blvd., Hamadan, 6517836488, Iran. Tel: 009881-38381571, E-mail: m.hamidi@umsha.ac.ir

lack of timely diagnosis of HL can lead to low levels of literacy, education, and social poverty. The hearing-impaired children are also in danger of mental disorder such as anxiety and depression [4,6-8]. Another common hearing impairment is unilateral HL. Regarding the impact of unilateral HL on children's academic achievement, it was found that 30% of children with unilateral deafness lag at least 1.2 years behind their normal peers in terms of academic achievement [9]. There have been growing concerns about the rising prevalence of HL in children and adolescents, particularly noise-induced hearing loss, which is possibly due to recreational noise exposure [10]. Conducting various programs such as early and frequent hearing screening, diagnosis, and treatment of HL cases can be effective in reducing the unpleasant consequences of HL. Such measures assure that hearing-impaired individuals receive the benefits of treatment and rehabilitation through hearing screening programs [8,11-13].

Upon educating and rehabilitating the hearing-impaired children, nothing could be more effective than identification and early intervention in auditory rehabilitation programs to achieve successful results. Studies of this kind can be used in policy-making organizations involved in hearing rehabilitation. The special education organization can estimate the number of the required classes with special equipment for children with hearing impairment and predict the required funding. Welfare Organization decides about the range of rehabilitation services in terms of equipment and the human force required at the provincial level. Moreover, although the words mild, moderate, severe, and profound hearing loss are appropriate modifiers for audiologists and teachers, they cannot reflect the level of hearing disabilities, because even mild HL may be associated with significant problems in academic achievement. In addition, factors such as otitis media, behavior change, and the use of compensatory mechanisms (such as lip reading and natural gestures) can delay the early detection of mild and moderate sensorineural hearing loss (SNHL) [8]. The present study was conducted to determine the prevalence of HL

among the students in first-degree high schools in Hamadan, Iran.

Methods

In this descriptive cross-sectional study, 1,446 students from first-degree high schools in the city of Hamadan in the school year 2016 were screened for HL.

The selection of samples was performed through multi-stage clustering sampling method. Out of 74 high schools in Hamadan, 16 schools were selected as follows: the schools of the city of Hamadan were divided into four regions based on two educational districts and 2 municipalities, and some schools were randomly selected from each region based on the relative frequency of the schools of that region. From each school, 50 students were selected randomly.

The total number of students enrolled in first high schools in Hamadan was about 15,569 students, including 8,093 boys and 7,476 girls. The inclusion criteria for the specialized evaluation are as follows.

- The absence of any structural and anatomic problems of the auricle and the external ear canal;
- The absence of impacted cerumen during the otoscopic examination; and
- Willingness to participate in the study

On the other hand, exclusion criteria include:

- Having specific disease on the day of study
- Reluctance to continue cooperation during the study

The required data were collected and recorded by examination and applying hearing tests on the children; i.e. otoscopic examination and audiometry. The tools and equipment used in this study are as follows:

1. An otoscope (Richter, Germany) with appropriate speculums
2. A screening audiometer (Amplivox Ltd, UK)
3. Diagnostic audiometer (Interacoustic AC40, Denmark)

The physical environment in schools such as noise levels was within the permissible level (according to ANSI S12.602002). Audiometry was performed at octave frequencies (250-8000 Hz). The lowest intensity level that is responded

Table 1. Distribution of first high school according to sex

Gender	Number	Percentage (%)
Boy	720	49.8
Girl	726	50.2
Total	1446	100

at a particular frequency was considered as the threshold. Students with hearing threshold greater than 20 dB were considered unacceptable and were referred for further tests [14]. Children were classified according to hearing impairment as having mild (26-40 dB), moderate (41-55 dB), moderately severe (56-70 dB), severe (71-90 dB), and profound hearing loss (91 dB and above) [10].

Ethical considerations: all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki and Tokyo declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual parents participants included in the study.

SPSS 16 was used to analyze the data. Descriptive statistics of mean, standard deviation, and tables were used. The χ^2 was used to evaluate bivariate associations between test results. All the stages of testing and its non-invasiveness were examined in the Department of Education

and the license of administering the tests was obtained from this section.

Results

The children included in this study were 11-13 years of age (mean \pm SD=12 \pm 0.81). Of the 1,446 children, 50.2% and 49.8% were girls and boys, respectively (Table 1). A total of 18 cases (1.25%) with HL were observed, with 16 and 2 cases having bilateral unilateral HL, respectively. Audiometry in 8 (1.10%) cases of girls and 10 (1.39%) cases of boys failed and 718 (98.9%) of girls and 710 (98.61%) of boys had normal hearing (Table 2). This difference was not statistically significant.

Determining the type of HL in each ear, the average thresholds of air and bone conduction and the results of audiometry were examined. In this study, the examination is based on three types of HL: CHL, SNHL, and mixed HL. The mixed cases were not found in boys and girls in our study. According to the observations, 718 girls (98.90%) and 710 boys (98.61%) had normal hearing, and 2 cases of girls and 4 cases of boys had CHL. Also, 8 cases of boys and 4 girls had SNHL (Tables 2 and 3). Thus, 0.42% of students had CHL and 0.83% were SNHL, suggesting no significant difference between types of hearing loss ($p=0.150$). The rate of bilateral HL (1.11%) is eightfold higher than unilateral HL (0.14%). In addition, based on the degree of HL, the students were divided into three groups. Comparing the three groups simultaneously in terms of means of the χ^2 test, we found that

Table 2. Distribution of first high school according to the overall results of hearing screening

	Sex			
	Boy		Girl	
	Number	Prevalence (%)	Number	Prevalence (%)
Normal hearing	710	98.61	718	98.75
Hearing loss	10	1.39	8	1.25
Total	720	100	726	100

Table 3. Frequency distribution and analyses of hearing loss based on sex, type and degree of hearing loss in first high school students

Characteristic	Number (%)	Prevalence	p
Total	18 (1.25%)	1.25%	
Gender			
Boys	10 (56%)	1.4%	0.875
Girls	8 (44%)	1.1%	
Type of hearing loss			
Conductive	6 (33%)	0.42%	0.157
Sensorineural	12 (67%)	0.82%	
Laterality			
Unilateral	2 (11%)	0.14%	0.001
Bilateral	16 (89%)	1.11%	
Degree of hearing loss			
Mild	5 (28%)	0.35%	0.016
Moderate/severe	12 (67%)	0.83%	
Profound	1 (5%)	0.07%	

there is evidence of differences between them ($p=0.011$) (Table 3).

Discussion

Among 1,446 first high school students, 18 (1.25%) hearing loss cases were observed. Several studies in Iran and other parts of the world have been done in this field. Since most of these studies are related to preschool children, studying the hearing of children in this age range has been done for the first time, at least in Iran. The Special Education Organization can estimate the number of the required classes with special equipment for hard of hearing children and predict the required funding [15-22].

Studies on HL show that a lower degree of HL reported in Hamadan than the other provinces [15-17]. In a comprehensive study conducted by Firuzbakht et al. on the newborns hearing screening during eight years, the prevalence of

HL in infants was reported as an average of 3 per 1,000 [18], while in a study by Farahani et al. the prevalence of HL in the newborns in Hamadan was 0.7 per 1,000 [19]. In this regard, it seems that the prevalence of HL among the school-age children in Hamadan is lower than other provinces studied. Another significant point extracted in the present study is the difference between the studies in terms of the age of children. The HL is more often observed in winter than the other seasons because of upper respiratory tract infections and ear infections are much higher. Unfortunately, many of these studies have not reported the time of administration and it was not possible to compare these factors.

In this study, 8 (44.4%) of the children with HL were girls, and 10 [55.6%] were boys; yet, despite the larger number of boys, there was no significant correlation between HL and sex. This result is consistent with Ahvaz study [20]. However, in a study conducted in Ilam, western Iran, HL was significantly more common in boys [21]. In our study, 6 (0.42%) cases of the whole study population had CHL, and 12 (0.82%) had SNHL. SNHL rates in the entire population are 0.6% in Zanjan, 1.86% in Ardabil, 4% in Berlin, Germany, and 1.7% in Nigeria [20,22-24]. In other words, 5.3% of US 12-19 years old adolescents [3] and 7.7% Canadian youth [25] demonstrate HL. The prevalence of HL in our study is consistent with that reported for Zanjan, probably because of their neighborhood. The higher prevalence of bilateral HL (89%) in this study is in conflict with that found in other studies. In our study, mild HL (67%) had a higher prevalence than moderate and profound HL, which corresponds to the findings of other studies [21,26,27]. Therefore, SNHL has a lower rate in this study than those found in others, which may be due to the age difference in the study population, season of study and geographic location.

Of the 12 patients with SNHL, only one child with mild SNHL had no awareness of its hearing condition, and the rest were detected and referred to the hearing screening at the infancy and on arrival at school. In contrast, of six

patients with CHL, five children were not aware of the problem of their ears, and only one case was under treatment by a physician who was referred to a specialist after contact with the family.

In terms of educational status, the child suffering from the profound HL was at a poor educational level who was introduced to an exceptional education specialist. Also, a child with moderate to severe HL had poor grades in spelling and math lessons, who received the recommendations for hearing an improvement, such as how to sit in the classroom and use hearing assistance devices.

In this study, we faced limitations such as inadequate cooperation of parents for diagnostic evaluations.

Conclusion

The prevalence of HL among the school-age children in Hamadan is lower than that in other provinces. Hearing screening seems to have lost some of its importance for high school children. This could be due to successful neonatal hearing screening programs and also at the time of primary school enrollment. However, the results of CHL and the middle ear lesions suggest the need for screening them at the age of school. The use of a combination of audiometric, otoscopic, and tympanometric tests is recommended for the identification of middle ear lesions.

Acknowledgments

The study was funded by Hamadan University of Medical Sciences (No. 9406103056). We also greatly thank the Department of Education in Hamadan for coordinating in conducting the project in schools of Hamadan.

Conflict of interest

The authors declared no conflicts of interest.

REFERENCES

- Hilgert N, Smith RJ, Van Camp G. Forty-six genes causing nonsyndromic hearing impairment: which ones should be analyzed in DNA diagnostics? *Mutat Res.* 2009;681(2-3):189-96. doi: [10.1016/j.mrrev.2008.08.002](https://doi.org/10.1016/j.mrrev.2008.08.002)
- Global estimates on prevalence of hearing loss. [Intnet]. Geneva: World Health Organization; 2012. Available from: <http://www.who.int/pbd/deafness/estimates> [accessed 25 November 2013].
- Mehra S, Eavey RD, Keamy DG Jr. The epidemiology of hearing impairment in the United States: newborns, children, and adolescents. *Otolaryngol Head Neck Surg.* 2009;140(4):461-72. doi: [10.1016/j.otohns.2008.12.022](https://doi.org/10.1016/j.otohns.2008.12.022)
- Borg E, Edquist G, Reinholdson AC, Risberg A, McAllister B. Speech and language development in a population of Swedish hearing-impaired pre-school children, a cross-sectional study. *Int J Pediatr Otorhinolaryngol.* 2007;71(7):1061-77. doi: [10.1016/j.ijporl.2007.03.016](https://doi.org/10.1016/j.ijporl.2007.03.016)
- Al-Rowaily MA, AlFayez AI, AlJomiy MS, AlBadr AM, Abolfotouh MA. Hearing impairments among Saudi preschool children. *Int J Pediatr Otorhinolaryngol.* 2012;76(11):1674-7. doi: [10.1016/j.ijporl.2012.08.004](https://doi.org/10.1016/j.ijporl.2012.08.004)
- Khairi Md Daud M, Noor RM, Rahman NA, Sidek DS, Mohamad A. The effect of mild hearing loss on academic performance in primary school children. *Int J Pediatr Otorhinolaryngol.* 2010;74(1):67-70. doi: [10.1016/j.ijporl.2009.10.013](https://doi.org/10.1016/j.ijporl.2009.10.013)
- Lewis DE, Valente DL, Spalding JL. Effect of minimal/mild hearing loss on children's speech understanding in a simulated classroom. *Ear Hear.* 2015;36(1):136-44. doi: [10.1097/AUD.0000000000000092](https://doi.org/10.1097/AUD.0000000000000092)
- Vohr BR, Topol D, Watson V, St Pierre L, Tucker R. The importance of language in the home for school-age children with permanent hearing loss. *Acta Paediatr.* 2014;103(1):62-9. doi: [10.1111/apa.12441](https://doi.org/10.1111/apa.12441)
- Lieu JE, Tye-Murray N, Fu Q. Longitudinal study of children with unilateral hearing loss. *Laryngoscope.* 2012;122(9):2088-95. doi: [10.1002/lary.23454](https://doi.org/10.1002/lary.23454)
- Lieu JEC. Variations in the prevalence of hearing loss in children: truth or artifact? *JAMA Otolaryngol Head Neck Surg.* 2017;143(9):935-6. doi: [10.1001/jamaoto.2017.1172](https://doi.org/10.1001/jamaoto.2017.1172)
- Williams TR, Alam S, Gaffney M; Centers for Disease Control and Prevention (CDC). Progress in identifying infants with hearing loss—United States, 2006-2012. *MMWR Morb Mortal Wkly Rep.* 2015;64(13):351-6.
- Verhaert N, Willems M, Van Kerschaver E, Desloovere C. Impact of early hearing screening and treatment on language development and education level: Evaluation of 6 years of universal newborn hearing screening (ALGO®) in Flanders, Belgium *International journal of pediatric otorhinolaryngology.* 2008;72(5):599-608. doi: [10.1016/j.ijporl.2008.01.012](https://doi.org/10.1016/j.ijporl.2008.01.012)
- Lü J, Huang Z, Yang T, Li Y, Mei L, Xiang M, et al. Screening for delayed-onset hearing loss in preschool children who previously passed the newborn hearing screening. *Int J Pediatr Otorhinolaryngol.* 2011;75(8):1045-9. doi: [10.1016/j.ijporl.2011.05.022](https://doi.org/10.1016/j.ijporl.2011.05.022)
- American Speech-Language-Hearing Association. Guidelines for manual pure-tone threshold audiometry [Guidelines]. 2005. Available from www.asha.org/policy.
- Baradaranfar MH, Mollasadeghi A, Jafari Z. [Prevalence of hearing disorders in 3-6 year old children of kindergartens in Yazd city]. *J Shahid Sadoughi Univ Med Sci.* 2009;16(5):20-5. Persian.
- Lotfi Y, Ja'fari Z. [The prevalence of hearing disorders among the 3-6 years old children of kindergartens in welfare organization of Tehran province]. *Journal of*

- Rehabilitation. 2001;2(1-2):7-13. Persian.
17. Absalan A, Pirasteh I, Dashti Khavidaki 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](https://doi.org/10.1155/2013/138935)
 18. Firoozbakht M, Mahmoudian S, Alaeddini F, Esmailzadeh M, Rafiei M, Firouzbakht A, et al. Community-based newborn hearing screening programme for early detection of permanent hearing loss in Iran: an eight-year cross-sectional study from 2005 to 2012. *J Med Screen.* 2014;21(1):10-7. doi: [10.1177/0969141314522992](https://doi.org/10.1177/0969141314522992)
 19. Farahani F, Hamidi Nahrani M, Seifrabiei MA, Emadi M. The effect of mode of delivery and hospital type on newborn hearing screening results using otoacoustic emissions: based on screening age. *Indian J Otolaryngol Head Neck Surg.* 2017;69(1):1-5. doi: [10.1007/s12070-016-0967-3](https://doi.org/10.1007/s12070-016-0967-3)
 20. Sarafraz M, Hekmat-Shoar M, Zaheri S. Determination of hearing loss prevalence in preschool children of Ahwaz. *Iran J Otorhinolaryngol.* 2011;23(3):75-8. doi: [10.22038/IJORL.2011.282](https://doi.org/10.22038/IJORL.2011.282)
 21. Sarafraz M, Ahmadi K. A practical screening model for hearing loss in Iranian school-aged children. *World J Pediatr.* 2009;5(1):46-50. doi: [10.1007/s12519-009-0008-3](https://doi.org/10.1007/s12519-009-0008-3)
 22. Hajloo N, Ansari S. [Prevalence and causes of hearing handicap in Ardabil province, Western Iran]. *Audiol.* 2011;20(1):116-27. Persian.
 23. Kruppa B, Dieroff HG, Ising H. [Sensorineural hearing loss in children starting school. Results of a representative hearing screening study]. *HNO.* 1995;43(1):31-4. German.
 24. Eziyi JAE, Amusa YB, Akinpelu OV. Prevalence of otolaryngological diseases in Nigerians. *East Cent Afr J Surg.* 2010;15(2):85-9.
 25. Feder KP, Michaud D, McNamee J, Fitzpatrick E, Ramage-Morin P, Beauregard Y. Prevalence of hearing loss among a representative sample of Canadian children and adolescents, 3 to 19 years of age. *Ear Hear.* 2017;38(1):7-20. doi: [10.1097/AUD.0000000000000345](https://doi.org/10.1097/AUD.0000000000000345)
 26. Al Khabori M, Khandekar R. Unilateral hearing impairment in Oman: a community-based cross-sectional study. *Ear Nose Throat J.* 2007;86(5):274, 277-80.
 27. Niskar AS, Kieszak SM, Holmes A, Esteban E, Rubin C, Brody DJ. Prevalence of hearing loss among children 6 to 19 years of age: the Third National Health and Nutrition Examination Survey. *JAMA.* 1998;279(14):1071-5. doi: [10.1001/jama.279.14.1071](https://doi.org/10.1001/jama.279.14.1071)