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

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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


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
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
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 $\chi^2$ 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±SD=12±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 $\chi^2$ test, we found that

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boy</td>
<td>720</td>
<td>49.8</td>
</tr>
<tr>
<td>Girl</td>
<td>726</td>
<td>50.2</td>
</tr>
<tr>
<td>Total</td>
<td>1446</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1. Distribution of first high school according to sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>Number</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boy</td>
<td>710</td>
<td>98.61</td>
</tr>
<tr>
<td>Girl</td>
<td>718</td>
<td>98.75</td>
</tr>
<tr>
<td>Total</td>
<td>1428</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2. Distribution of first high school according to the overall results of hearing screening
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 infanthood and on arrival at school. In contrast, of six

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

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

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**

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**Conflict of interest**

The authors declared no conflicts of interest.

**REFERENCES**


2. Global estimates on prevalence of hearing loss. [Intnet].


16. 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

http://avr.tums.ac.ir

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