Health Scope. 2019 February; 8(1):e65901. doi: 10.5812/jhealthscope.65901.

Published online 2018 September 1. **Research Article**

Prevalence and Pattern of Using Headphones and Its Relationship with Hearing Loss among Students

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Received 2018 January 04; **Revised** 2018 March 02; **Accepted** 2018 March 12.

Abstract

Background: Noise-induced hearing loss (NIHL) is one of the most important public health problems. There is scant information about NIHL, the prevalence and using patterns of headphones and music player devices in Iran.
Objectives: This study aimed to assess the prevalence and using patterns of earphones and investigate the relationship between earphone use and hearing loss in a sample of students from Qazvin University of Medical Sciences (QUMS).
Methods: In this cross-sectional study, 890 students were randomly selected using a proportional cluster sampling method in April and May 2015. The students completed a self-administered questionnaire assessing the pattern of their earphone use and hearing loss. Receiver operating characteristic (ROC) curve analysis was used to determine the cut-off point for the questionnaire.
Results: The results suggested that 60.2% (95% confidence interval (CI): 56.9 - 66.4) of the students reported a history of hearing loss and hearing impairment and 86.4% (95% CI: 84.0 - 88.5) of the participants reported using an earphone in the past. Most of the participants listened to music on their cell phones (81.7%) and 89.6% of them used headphones for listening to music. The results indicated that 51.3% of those who used earphones used earbud-style earphones, 42.2% used supra-aural earphones, and 6.5% used headphones. Students who used earphones, those who used earphones more frequently during the week, and those who used earphones for more years had higher hearing loss scores compared to other students.
Conclusions: Students have a risky pattern of using personal listening devices. The higher hearing loss score among headphone users requires further attention in order to implement interventions to increase students' awareness and attitude towards the use of headphones.

Keywords: Noise-Induced Hearing Loss, Earphone, Music Player, Headphone

1. Background

Noise-induced hearing loss (NIHL) is one of the most important social and public health problems. Although measures to address this problem have mainly focused on reducing the risk of workplace sounds in adults, numerous studies have indicated that NIHL in adolescents is increasing. For example, the findings from the third national health and nutrition examination survey (NHANES III) in the U.S. suggested that children were exposed to excessive amounts of hazardous levels of noise and 12.5% of the children aged 6 to 19 years were estimated to have noise-induced hearing threshold shifts in one or both ears (1). Another study in the U.S. also indicated that the prevalence of hearing loss increased significantly from 14.9% in 1988 - 1994 to 19.5% in 2005 - 2006 in a sample of adolescents aged 12 to 19 years (2).

Nowadays, most adolescents and young adults often listen to their MP3 player at maximum volume and therefore they consciously are exposed to hours of loud music (3). Several studies (4, 5) have indicated poorer hearing thresholds in adolescents and young adults who use headphones compared to those who do not use headphones. The growing popularity of portable music players and devices such as cell phones that connect directly to the ear is worrying because it may increase the prevalence of hearing loss among young people. In fact, numerous studies (1, 6) have documented increases in the loss of power to hear sounds with higher frequencies, slight ringing in the ears

or inability to hear others' voice in noisy environments among adolescents and young adults.

There is scant information about NIHL, the prevalence, and pattern of using headphones and music player devices in Iran. A descriptive study conducted by Ansari and colleagues examined the using patterns of earphones and music player devices among 2359 high school students in Tabriz (the northwest of Iran) in 2011. The results showed that 36.8% of the participants listened to music continuously without any rest or stop, 49.6% of the students reported listening to 'somewhat loud' or 'very loud' music and 44.3% of the respondents reported a history of hearing problems in the past (7). Another descriptive study in Iran found that 91.2% of the college students used headphones, 10.4% of the students used headphones more than one hour a day, and 52% of the students set higher than three-fourths of the output capacity when using their headphones (8). In this study, we aimed to assess the prevalence and using patterns of earphones and investigate the relationship between earphone use and hearing loss in a sample of students from Qazvin University of Medical Sciences (QUMS). The results of this study not only augment the body of information that is accumulating on the prevalence and using patterns of earphones in Iran but also shed some light on the association between earphone use and hearing loss among the youth and young adult population in Iran.

2. Methods

In this cross-sectional study, 890 students were randomly selected from five schools at QUMS (Medicine, Dentistry, Nursing and Midwifery, Public Health, and Paramedical Sciences schools) using a proportional cluster sampling method in April and May 2015. The sample size was calculated based on the estimation of the prevalence of headphone use (more than one hour in each day) by considering P = 0.10 (8), d = 0.025, and $\alpha = 0.05$. The minimum estimated sample size was 553. The required sample size increased to 830 after taking into account cluster sampling and design effect (1.5).

The students completed a two-part self-administered questionnaire. The participants were informed about the voluntary nature of their participation in the study and their right to refuse or skip any questions. The first part of the questionnaire assessed the prevalence and using patterns of earphones. We used questionnaires developed by Ansari et al. (7) and Wandadi et al. (8) to assess the prevalence and pattern of the use of earphones. The content validity of the first part of the questionnaire was approved by eight experts and its reliability was assessed and approved in a sample of 24 students (intra-class correlation coefficient = 0.829, 95% CI: 0.803 - 0.848).

The second part of the questionnaire evaluated hearing loss in students and was developed using the relevant literature and opinions of experts on this topic. Similarly, the content validity of the second part of the questionnaire was approved by eight experts and its reliability was evaluated and approved in a sample of 24 students (intra-class correlation coefficient = 0.859, 95% CI: 0.824 - 0.891). To assess the validity of the second part of the questionnaire, the results of hearing loss questionnaire were compared with the results of audiometry (as a gold standard) in a subsample of 256 students (9). Pure-tone air conduction audiometry was performed to determine the hearing thresholds at the frequencies of 125, 250, 500, 1000, 2000, 4000, and 8000 Hz for both ears of all subjects using an audiometer with earmuffs. The subjects were considered to have NIHL in either ear if an average threshold shift at high frequency (2000, 4000, and 8000 Hz) had been recorded for more than 25 dB in each ear.

Descriptive statistics were used to summarize our data. The prevalence of using earphone with a 95% confidence interval (CI) was calculated. The cluster sampling method in this study could affect the standard errors. Thus, the survey analysis was used in all analyses. The Chi-square test, *t*-test, one-way analysis of variance (ANOVA), and Pearson correlation coefficient were used for statistical analysis. Receiver operating characteristic (ROC) curve analysis was used to compare the scores of the questionnaire with audiometry results. All the analyses were performed using SPSS-21 (Chicago, IL, USA) and Stata10 (Stata Corp, College Station, TX, USA) software.

2.1. Ethics Approval

The Ethics Committee of QUMS approved the study and its questionnaire.

3. Results

Of the 890 selected students, 866 participated in the study and filled out the questionnaire (response rate: 97.3%). The average age of the students in the sample was 22.15 (standard deviation = 3.10), ranging from 17 to 37 years. Approximately, 35.5% of the students were males and 64.5% were females. Notably, 60.2% (95% CI: 56.9 - 66.4) of the students reported a history of hearing loss and hearing impairments. Of the total sample, 27, 135, 76, 204, and 89 students reported a history of ear disease, hearing loss, ear infection, ringing in the ears, and dizziness, respectively. The results also showed that 86.4% (95% CI: 84.0 - 88.5) of

the participants had used earphones. Most of the participants had listened to music on their cell phones (81.7%), laptops (10.8%), computers (4.1%), and MP3 players (3.4%). With regard to the reasons for using earphones, 89.6% of the participants used earphones for listening to music, 4.6% used for listening to lectures, 4.2% used for English learning, and 1.6% used for game playing. The results indicated that 51.3% of those who used earphones used earbud-style earphones, 42.2% used supra-aural earphones, and 6.5% of them used headphones. 28% of the students (222) reported listening to 'somewhat loud' (gain setting at 50% - 75%) or 'very loud' (gain setting of more than 75%) music.

32% of the students reported experiencing dizziness after using an earphone. The descriptive results also indicated that 203 (25.3%) students increased the volume always or very often when listening with headphones, whereas 323 (40.4%) students never decreased the volume. Only 218 (27.1%) students reported having a break when listening with earphones for a long time.

Audiometry test was performed in 256 students and the results showed that 25 (9.8%) students had hearing loss. We used ROC curve analysis to evaluate the 17-item hearing loss part of the questionnaire Box 1. Based on this analysis, the status variable was audiometry test result and the test variable was hearing loss score obtained from the questionnaire (range: 17 - 34). The results showed that the area under the curve (AUC) was 0.706 (95% CI: 0.587 - 0.825; P = 0.001).

Table 1 reported the mean and standard deviation of the scores obtained from the hearing loss questionnaire by demographic characteristics and earphone using pattern. As can be seen, males had a higher score compared to their female counterparts. Students who used earphones, those who used earphones more frequently during the week, and those who used earphones for more years had a higher hearing loss score compared to other students.

Box 1. The 17-Item Hearing Loss Questionnaire[a,b]

Questions
1- Do you have a problem hearing over the telephone?
2- Do you have trouble following the conversation when two or more people are talking at the same time?
3- Do people complain that you turn the TV volume up too high?
4- Do you have to strain to understand conversation?
5- Do you have trouble hearing in a noisy background?
6- Do you find yourself asking people to repeat themselves?
7- Do people you talk to seem to mumble (or not speak clearly)?
8- Do you misunderstand what others are saying and respond inappropriately?
9- Do you feel slowed down by a hearing problem?
10-Does a hearing problem cause you difficulty when listening to TV or radio?
11-Do you fail to hear someone talking from behind you?
12- Do you have trouble hearing your alarm clock?
13- Do you not hear the doorbell or telephone?
14- Can you no longer hear soft sounds such as birds singing?
15- Do you find that people speak too fast (on TV, friends, doctors)?
16- Do you understand men's voices better than women's?
17- Do you need to turn toward the person speaking or cup your ear to understand what is being said?

[a] "No" answers were coded as 1 and "Yes" answers were coded as 2.
[b] The range of scores was between 17 and 34, with a higher score indicating a severe hearing loss.

4. Discussion

The results of our study indicated the high prevalence of earphone use (86.4%) among the students in Qazvin, Iran. This is consistent with the results of recent studies conducted by Wandadi et al. (8) in Iranian students and Rekha and colleagues (10) in coastal South India (10). Another study on high school students in Iran showed that almost one-third of the students listened to music more than two hours per day (7).

In this study, we estimated the prevalence and using patterns of earphones and investigated the relationship between the earphone use and hearing loss in a sample of students from QUMS. The results showed that approximately 60% of the students had a history of hearing loss or damage including ear diseases, ear infections, tinnitus, and vertigo. A study by Ansari and colleagues (7) showed that 44.3% of the high school students in Tabriz, Iran, had a history of hearing loss or damage.

Several studies in Iran and other countries (7, 8, 11-13) have also indicated the incorrect use of earphones (e.g., listening to loud music, using earphones for long periods, and not having breaks while using earphones to listen to music) among adolescents and youth. The incorrect use of earphones among these groups can be due to the lack of awareness about the risks of listening to loud music (14, 15). Since there is an upward trend in the use of earphones and personal listening devices (16) among adolescents and youth, improving awareness is therefore important to address the incorrect use of earphones among the young population in Iran. In addition, as the prevalence of temporary or permanent tinnitus, as well as hearing loss, is relatively high among adolescents and youth (2, 14, 17), it is critical to implement environmental interventions and training programs to raise the awareness about this issues among these populations (18). Nonetheless, it seems that raising awareness alone is not sufficient for changing the attitude and performance in this age group (19).

Table 1. Scores Obtained from the Hearing Loss Questionnaire Based on Demographic Characteristics and Using Patterns of Earphones

Variable	No. (%)	Mean ± SD	P Value
Sex			
Male	302 (35.7)	19.99 ± 3.51	0.009[a]
Female	543 (64.3)	19.37 ± 2.91	
Place of residence			
Parental home	283 (34.1)	19.31 ± 2.88	0.116[a]
Dormitory or others	547 (65.9)	19.66 ± 3.08	
Earphone use status			
Yes	745 (81.2)	19.8 ± 3.08	< 0.001[b]
No	100 (18.8)	19.0 ± 1.71	
Number of years of earphone use, y			
Less than 1	114 (14.1)	18.6 ± 3.11	0.002[c]
1 - 2	205 (24.4)	19.2 ± 2.80	
More than 2	543 (61.5)	19.6 ± 2.85	
Frequency of earphone use in a week, day			
Never or 1	194 (24.5)	19.2 ± 2.87	0.001[c]
2 - 3	319 (40.3)	19.6 ± 2.66	
More than 3	278 (35.2)	20.2 ± 3.54	

[a] Based on *t*-test.
[b] Based on Chi-square test.
[c] Based on one-way analysis of variance (ANOVA) test.

The descriptive statistics of the survey responses show that 27% of the students listened to loud or very loud music. The corresponding rate among high school students in Tabriz, Iran, was reported to be 50% (7). The prevalence of listening to loud or very loud music varies across countries. For example, the prevalence of listening to loud or very loud music was estimated to be 37.4% and 35% in studies in Brazil and USA, respectively (20, 21). The observed differences could be explained by the participants' age and other socio-demographic factors including cultural differences.

The results suggested that the most commonly used earphones by the students were small and portable devices such as earbuds (51.3%) and supra-aural earphones (42.2%), which directly entered the ear canal while the percentage of using earphones was only 6.5%. These results were consistent with those of other studies from other countries (4, 21). The reason that young people use in-ear headphones more frequently may be that these headphones are provided along with personal music players or they are cheaper compared to other earphones.

Some studies have failed to find a significant relationship between the prevalence of tinnitus in those who used in-ear headphones and those who used headset headphones (22). Nevertheless, the hearing loss risk due to using in-ear headphones is considered higher than that of different types of headsets (23). Furthermore, if these devices are shared, the risk of ear infection and bacterial transfer is much higher with in-ear headphones. According to previous studies, those who use earbuds prefer to listen to loud music compared to those who use headsets (16, 18).

Finally, the results of the ROC curve (0.706), which compares hearing loss measured by the designed questionnaire (i.e., Box 1) with an audiometric test as the standard test, suggested an acceptable predictive power of the designed questionnaire to identify hearing loss. Thus, considering the very low cost associated with the use of the questionnaire to determine hearing loss problem, the designed questionnaire can be used in similar studies, especially in developing countries where the resources are too limited to use other standard methods. In some countries, for example in Canada, hearing loss was mainly measured using self-reported data. Using the designed questionnaire to assess hearing loss may be better than using self-reported hearing loss. This is because some studies have already demonstrated that self-reported hearing loss may underestimate hearing loss problem, especially in mild and moderate hearing loss and among the youth (24, 25). In addition, some studies reported a significant difference between the results of audiometric tests and self-reported hearing loss (26, 27).

In conclusion, this study suggested that students have a risky pattern of using personal listening devices. The higher hearing loss score among headphone users requires further attention in order to implement interventions and develop strategies for improving students' awareness and attitude towards the use of personal listening devices.

Acknowledgments

The authors would like to greatly acknowledge the financial support for this study from Qazvin University of Medical Sciences. They also wish to thank all the participants for their valuable cooperation and participation in this study.

Footnote

Authors' Contribution: Study concept and design, Asghar Mohammadpoorasl, Mehran Ghalenoei, and Payam Heydari; acquisition of data, Payam Heydari and Mehran

Ghalenoei; analysis and interpretation of data, Asghar Mohammadpoorasl and Soudabeh Marin; drafting of the manuscript, Soudabeh Marin and Mohammad Hajizadeh.

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