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Speech audiometry indicators for diagnosis of hidden hearing loss in MP3 player users

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Abstract

Study was conducted on the basis of the National Center of Audiology and S. Khechinashvili University Clinic. A population of 18 to 30 years of age was included in the study – 40 subjects and 15 individuals in the age group (50 to 55 years) were selected based on their willingness to participate in the study based on non-random complaint complaints at the clinic. The main group included 22 (40%) MP3 users, while the control group included 18 (33%) non – users and 15 (27%) persons in the middle age group. Of these, 37 (67%) were female and 18 (33%) were male. Auditory thresholds were measured monaurally by the pure tone audiometer within the band of 0.125-16 kHz frequencies. At the principal speech frequency link, 1-8 kHz, the thresholds in player music users did not differ from those in non-users. At higher frequencies from 9-16 kHz, however, the player music fans possessed greater thresholds more than 25 dB. In a noisy environment, speech audiometry in noise was performed to test the ability to correctly distinguish words. By examining the results of speech audiometry, it was found that out of 100 words and then they repeat them. Mp3 player users had worse result than adult group, higher understanding results had non-users.

The process of hearing disturbances along with a group-systematic character seemed thus to own an individual-sensitive quality also. Systematic audiometrical inspection of personal music player followers is recommended for an in-time disclosure of a hearing disorder and an immediate start then of corresponding treatment and preventive means. The hearing testing has to include high tone frequencies, 9-16 kHz. Speech audiometry in the noise can be considered like gold standard for diagnostic of Hidden Hearing Loss.

KEYWORDS: personal music player users; acoustic trauma; frequencies; Hidden hearing loss; prevention of hearing loss

Introduction

Hearing loss is one of the most common pathologies in the world. The era of industrialization and technical progress have led to an increase in the frequency of exposure to external noise and high-intensity sounds in the human ear [1]. In the past, noise-induced hearing loss was considered an occupational disease, but now virtually every person is at risk. This is due to the noise caused by the increased number of cars on the street, nightclubs and loud live music in cafes and bars [3]. In the previous century, a high percentage of hearing-impaired people came from the elderly and were mostly caused by middle and inner ear pathologies [2]. Currently, cases of hearing loss have increased in the young population. The reason is mp3 player. According to WHO 2015 data, one billion teenagers and young adults are at risk of hearing impairment due to the harmful noise received by the daily use of a personal music listening device [4].

Periaural music players are rather popular in the world around. The maximal sound intensity in players reaches 100-120 dB [6,7]. The users mostly use the devices in the noisy environments: when walking through the streets, when transporting over, etc. In such situations the outer noise level approximates conventionally to 90 dB [5]. To follow the applied melody, the music intensity in players should thus exceed 90 dB that appearing harmful for delicate inner-ear structures [8]. At the initial stage, pathological changes do not affect speech frequencies (500; 1000; 2000; 4000 Hz), but prevent a complete understanding of speech in a difficult-to-hear environment [9].

The aim of the study was to diagnose hidden hearing impairment in users of personal music listening devices (MPMMs).

Materials and Methods

In order to achieve the set goal, a one-moment, cross-sectional study was conducted on the basis of the National Center of Audiology and S. Khechinashvili University Hospital. A population of 18 to 30 years of age was included in the study – 40 subjects and 15 individuals in the age group (50 to 55 years) were selected based on their willingness to participate in the study based on non-random complaint complaints at the clinic. The main group included 22 (40%) MP3 users, while the control group included 18 (33%) non – users and 15 (27%) persons in the middle age group. Of these, 37 (67%) were female and 18 (33%) were male.

Participants in the study underwent otoscopic examination, tonal, superficial, subjective audiometry, speech audiometry in noise, registration of short-term latent potentials caused by hearing of the brain stem.

Potential participants of the research underwent initially otoscopy. If finding cerumen or any outer – and middle-ear pathology, the subject was not included in the study. Individuals filled then the particular questionnaire. The subjects were excluded from the sample if indicating the history of auditory trauma, and/or of the use of ototoxic drugs, and/or of a family history of a hearing loss at early ages. Special attention was given to the duration of the music player usage: how many years, how many days, and how many hours per day are involved the participants in music habits.

Hearing thresholds were determined in a soundproof chamber. The pure-tone audiometry was conducted by GCI-16 Audiometer. Hearing acuity indices were determined monaurally at 0.125, 0.25, 0.5, 0.75, 1, 2, 4, 8, 9, 10, 11.2, 12.5, 14, 16 kHz frequencies. The study was conducted on all three groups of participants in the study. In a noisy environment, speech audiometry in noise was performed to test the ability to correctly distinguish words. We used the Speech Reception Threshold modifier for this purpose. The examination was conducted in a specialized soundproof cabinet. The speech audiometer was placed one meter away from the participant. A pre-recorded word recording device was attached to it. The number of words recorded was 100. Speech intensity was recorded in the range of 20-80 dB, although in the study we used only one intensity, 60 dB, which corresponds to the speech intensity. The investigator was repeating the heard word in the background of noise. We used to mark the repeated words in a pre-compiled special table, which we finally processed statistically. The noise source was programmatically connected to a computer and was located one meter behind the examinee. The noise included sounds of different frequencies and intensities in the street. Noise and word recording were measured using the Decibel X version'7.0.0 (5365) mobile application. We took about 82 dB as the noise intensity, according to the street noise intensity (Fig.1).

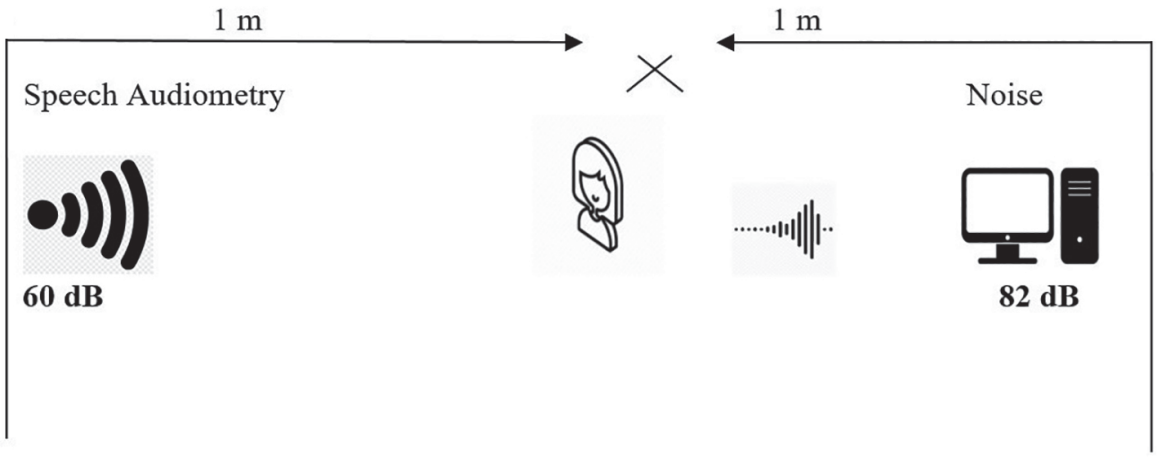

Fig. 1. Study scheme.

The program IMB SPSS Statistics 20 was applied for the quantitative processing of obtained results. The primary data analyses, e.g. revealing of ratios and estimation of mean values, were descriptive. The comparison of the test vs. the control intergroup categorical variables was performed utilizing the Person Chi-Square Test.

Results and Discussion

The mean values of the hearing threshold in the frequency range 0.125 to 16 kHz were divided into two groups, between MP3 player users and non-users, and with the MP3 player users and adults group. Because all subjects in the study had subjectively normal hearing, their hearing thresholds at conversion frequencies of 0.125 to 8 kHz were within the normal range and were less than 20 db. The latter disparity was statistically significant ($p<0.001$). There were different data in all three groups at high frequencies from 9 to 16 kHz. At first glance, the average threshold values for MPM users and non-users did not exceed 25 dB, the difference was a total of 3.5 dB, but a study of individual data from MP3 users found that 23% of MP3 users ranged from 9 to 16 kHz. Had more than 25 dB, and 5% of non-users. As for the age group, at high frequencies at 100% the hearing threshold from 9 to 12 kHz was more than 25 dB and the 14 and 16 kHz were not understood at all. (Fig. 2)

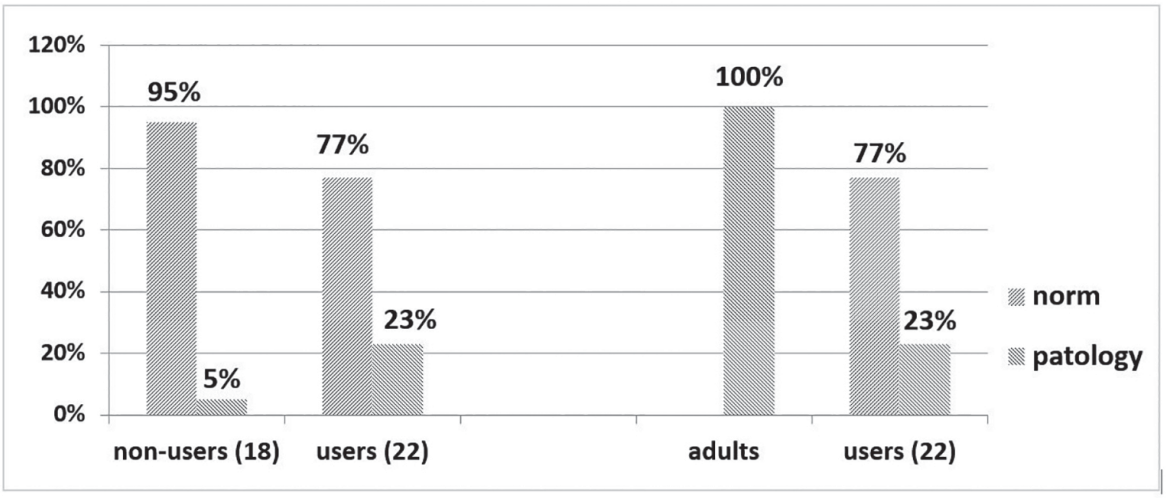

Fig. 2. Percentage of hearing thresholds at frequencies from 9 to 16 kHz at 25 dB for MP3 users, non-users and the adults.

Significantly, in those individuals with high-frequency hearing thresholds of more than 25 dB, 14% were observed in one ear and 9% in both ears. In the elderly group, this process is symmetrical in both ears, and the vast majority – 100% had more than 25 dB in both ears. (Fig.3)

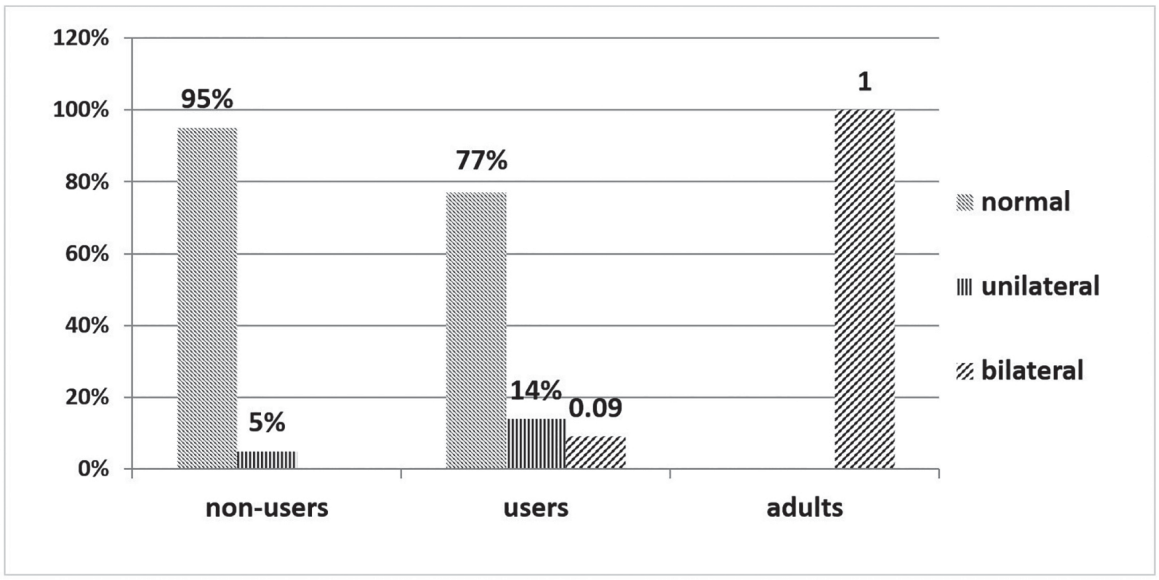

Fig. 3. On high frequency hearing thresholds in MP3 users, MP3 non-users and adult group.

Examining the results of speech audiometry, it was found that out of 100 words heard, MP3 users understood an average of 53% of the words correctly, non-users – 74%, and the adults group – 63%. (Fig.4).

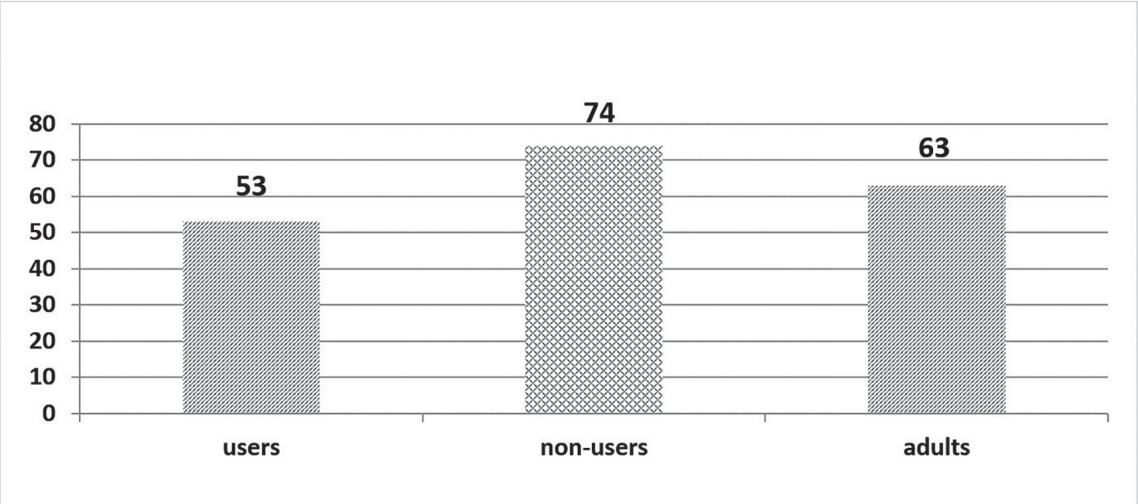

Fig. 4. Percentage of words understood by speech audiometry in all three groups.

Conclusion

- There is no hearing impairment in listeners at 0.5, 1, 2 and 8 kHz, in the conventional speech spectral zone;
- Some mp3 player users develop synapsopathy in the inner ear, which is accompanied by hidden hearing loss, which is manifested in a weakening of the ability to distinguish words;
- Latent hearing impairment could not be diagnosed either by a subjective procedure of tonal audiometry;
- Speech audiometry against the background of noise can be considered as the gold standard for the detection of latent hearing impairment.

Practical recommendation

In order to prevent the harmful effects of listening music, on the one hand, the limit of its daily consumption and, on the other hand, the intensity of the music must be observed, which means listening to it at 60 dB for 60 minutes.

Acknowledgements

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