

ASSESSMENT OF HEARING THRESHOLDS IN MEDICAL STUDENTS BASED ON GENDER AND USE OF HEADPHONES.

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Abstract

Introduction: The sounds we are exposed to everyday are usually at a safe level and do not affect our hearing. However, development of latest technology and frequent use of headphones has increased the proximity of sound to the ear. Adolescents and young adults who are commonly exposed to loud music/noise are at a greater risk of developing hearing impairment. Hence the adverse effects of chronic exposure to loud sounds need to be assessed.

Objectives: To determine hearing thresholds in students (Males/Females) at various frequencies and the changes in hearing thresholds associated with prolonged exposure (>90mins) to sound.

Materials and methods: The study was conducted in 148 first year MBBS students.

Materials used - ALPS Advanced Digital Audiometer AD2100, bone oscillator and headphones.

Statistical analysis was done using SPSS version 22.0 with $p < 0.05$ as significant.

Results: 1) Males have lower hearing thresholds than females except at higher frequencies where females have equal or better hearing thresholds than males.

2) The mean exposure to headphones was 115.432 ± 92.1348 mins.

Subjects with >90mins exposure had better hearing thresholds at lower frequencies but at higher frequencies showed increase in hearing thresholds.

Conclusion: Lower hearing thresholds in females at higher frequencies could be evolutionary as females are more sensitive to high pitch sounds like baby's cry. Prolonged exposure to loud sound damages hair cells at base of cochlea responsible for picking up high frequency sounds.

Key words: Hearing thresholds, noise, adolescents.

Introduction

We are exposed to different types of sounds on a daily basis. The source of these sounds may be occupational like in factory workers or musicians or non-occupational like traffic, radio, television, household appliances etc. These sounds are usually at a safe level and do not affect our hearing¹. With the development of latest technology, and invention of newer sophisticated gadgets, the proximity of sound to the ear has increased. Adolescents and young adults who are frequent users of headphones, mp3 players, mobile phones etc. are at a great risk of developing hearing impairment^{2,3}. Brief exposure to loud sound or exposure to loud sounds over an extended period of time can damage sensitive structures like the hair cells in the inner ear. Hair cells once damaged do not regenerate. This damage can result in hearing impairment, and over a prolonged duration it can result in hearing loss⁴.

Hearing loss resulting from exposure to loud sounds is called noise induced hearing loss (NIHL). Hearing loss following noise exposure may develop immediately or gradually. It may be unilateral or bilateral. Most often

noise induced hearing loss is permanent. Adequate early interventions can help to prevent hearing loss⁵. Hence the adverse effects of chronic exposure to loud sounds need to be evaluated and appropriate measures need to be taken to prevent permanent hearing loss. This study was undertaken to determine the hearing thresholds in medical students and changes in hearing thresholds associated with prolonged use of headphones.

MATERIALS AND METHODS

This cross-sectional study was done in 148 apparently healthy first year MBBS students of Goa medical college in the age group of 17-23 years. Students consent was taken and questionnaires were provided to obtain demographic data and duration of headphone use. Participants were divided into groups based on gender and duration of headphone use (<90 minutes/day and >90minutes/day).

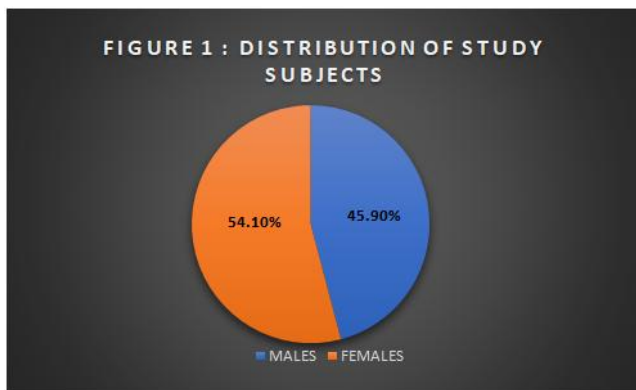
Students with history of acute or chronic middle ear disease, previous ear surgeries, ototoxic drug intake, and students diagnosed with hearing loss were excluded from the study.

Audiometric assessment was done in a silent room using the ALPS Advanced Digital Audiometer AD2100, bone oscillator and headphones. Air conduction and bone conduction of the subjects was tested at various frequencies. Air conduction was tested for frequencies between 125Hz to 8000Hz and bone conduction was tested for frequencies between 250 Hz to 8000Hz. Participants were asked to raise their hand every time a tone was audible. The mean thresholds at each frequency were compared between male and female students. The mean threshold at each frequency was also compared between individuals using headphones for less than 90 minutes per day and those using headphones for more than 90 minutes per day.

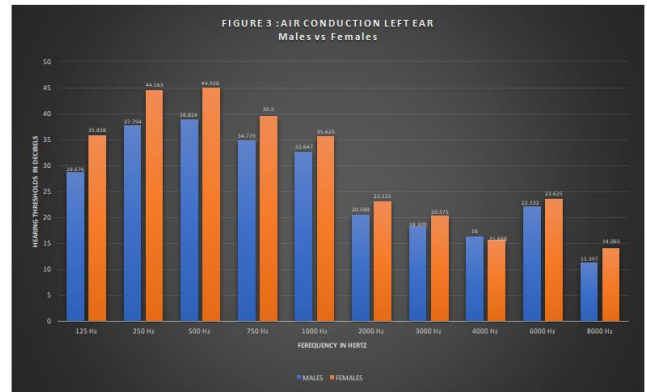
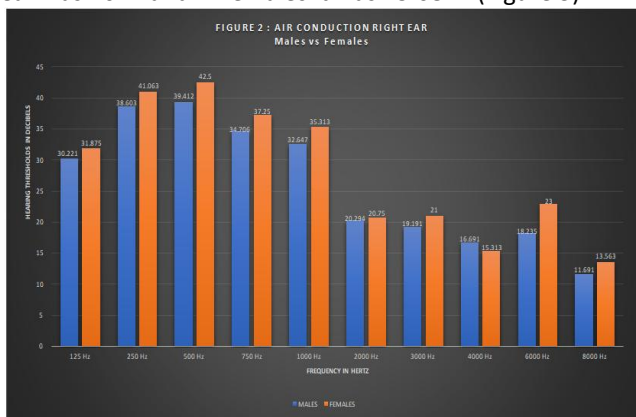
Statistical analysis was done using the SPSS software version 22.0 with p value of ≤ 0.05 as significant.

RESULTS

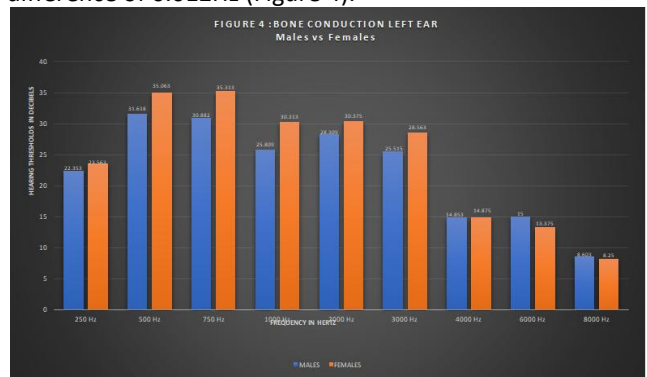
In our study, out of the 148 participants 80 were females (54.1%) and 68 were males (45.9%) (Figure 1).



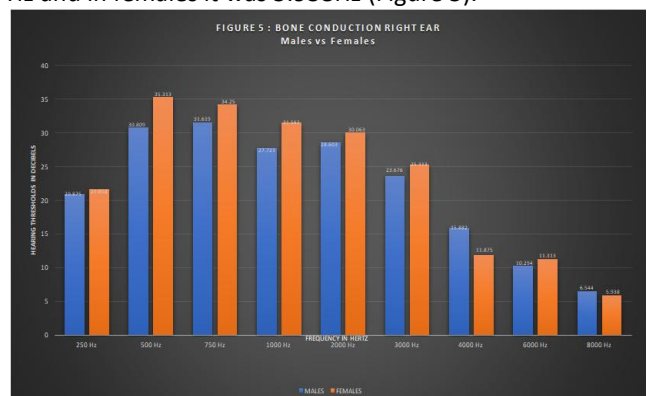
When air conduction thresholds were compared between males and females it was seen that males had better hearing acuity i.e. lower hearing thresholds at most frequencies except at 4000Hz where a decrease in the hearing thresholds was seen in females. The average hearing threshold in males in the right ear at 4000Hz was 16.691Hz and in females it was 15.313 Hz (Figure 2), whereas the average hearing threshold for males in the left ear was 16Hz and in females it was 15.68Hz (Figure 3).



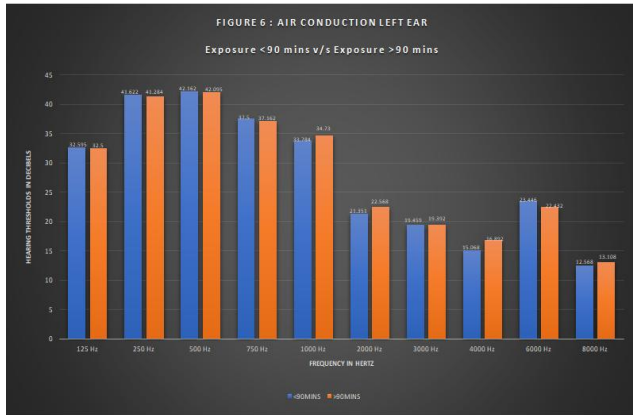
Comparison of bone conduction thresholds showed that males had lower hearing thresholds than females in the frequency range of 250Hz to 3000Hz in both ears. However, in the left ear at higher frequencies of 6000Hz and 8000Hz a decrease in the hearing thresholds was seen in females. The average hearing threshold in males at 6000Hz was 15Hz and in females it was 13.375Hz, whereas at 8000Hz the average hearing threshold in males was 8.603Hz and in females it was 8.25Hz. decrease in hearing threshold was not observed at 4000Hz but the hearing thresholds were almost comparable with a minute difference of 0.012Hz (Figure 4).



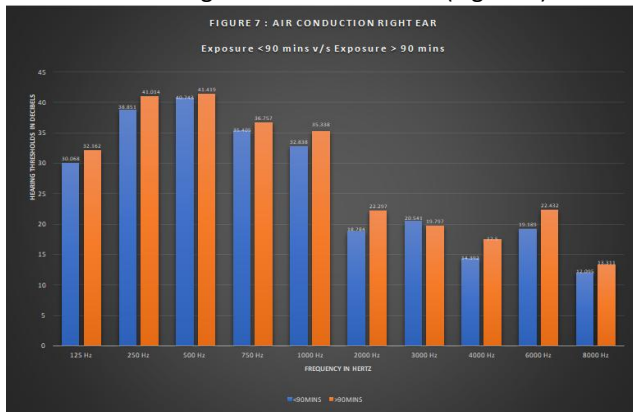
In the right ear a dip in the hearing thresholds was seen in females at higher frequencies of 4000Hz and 8000Hz. The average hearing threshold in males at 4000Hz was 15.882Hz and in females it was 11.875Hz, whereas at 8000Hz the average hearing threshold in males was 6.544 Hz and in females it was 5.938Hz (Figure 5).



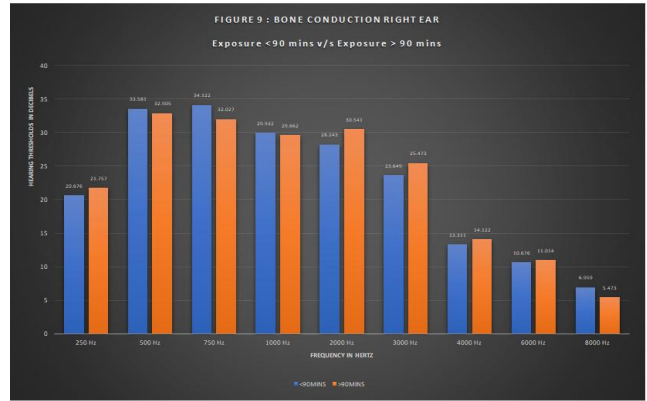
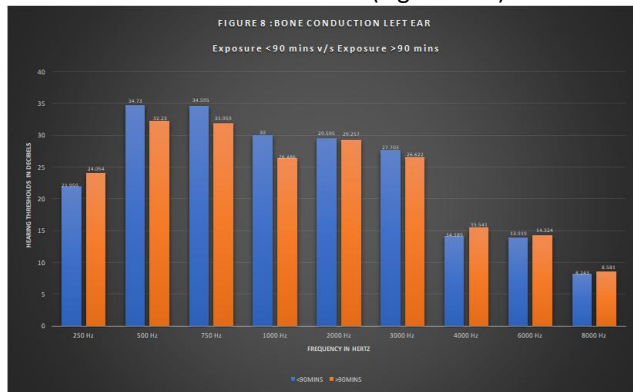
Mean exposure to headphones was 115.432±92.1348 minutes. When hearing thresholds were compared in subjects using headphones for >90 minutes and less than 90 minutes it was seen that the subjects using headphones for >90 minutes had better hearing acuity at lower frequencies but at higher frequencies of 1KHz,2 KHz,4 KHz,8 KHz showed increase in air conduction hearing thresholds in the left ear (Figure 6).



Air conduction thresholds in the right ear were increased across all the frequencies in subjects using headphones for >90 mins except at higher frequencies of 3000Hz where a decrease in hearing thresholds was seen (Figure 7).



When bone conduction thresholds were compared, subjects using headphones for >90 minutes had worse hearing at 250Hz ,4 KHz, 6 KHz and 8 KHz in the left ear, whereas in the right ear the increase in hearing thresholds was observed at 250Hz and 4 KHz (Figure 8&9).



DISCUSSION

Though the results of this study were variably significant, they were consistent with previously done studies which stated that females had better hearing acuity than males at higher frequencies⁶. In a study done by Park et al in south Korean population, it was found that as age increased the hearing thresholds increased irrespective of gender with significant worsening of hearing thresholds in males being observed at 3KHz,4KHz and 6 KHz as compared to females. The largest difference in hearing thresholds was seen at 4KHz⁷. studies done by Bahng et al in 263 people showed significant differences in hearing thresholds between males and females at frequencies of 1KHz,2 KHz,3 KHz,4 KHz,6 KHz and 8 KHz⁸. In our study however, the differences in hearing acuity were only seen at 4 KHz, 6 KHz and 8 KHz. The differences in hearing acuity are small in children and increase throughout adolescence and adulthood. It has been hypothesized that the gender differences in hearing thresholds are due to socio-environmental factors as males are exposed to more noise than females and tend to indulge in noisy leisure activities at an early age⁹. Certain biological factors may also contribute to the better hearing acuity in females, as studies have indicated that females produce more and greater amplitude OAEs as compared to males of the same age indicating more sensitive cochlear amplification. Cochlear length, head size and hormonal differences between genders may also contribute to the differences in hearing threshold¹⁰. The better hearing acuity in females at higher frequencies could also be evolutionary as females are more sensitive to high pitch sounds like baby's crying^{11,12}. Results from this study showed increase in hearing thresholds in subjects using headphones for >90 minutes at higher frequencies as compared to subjects using headphones for <90 minutes. Study done in Nigerian university students also showed similar results with decrease in hearing acuity in headphone users as compared to non-headphone users¹³. In our study 95% of the subjects were right-handed and only 5% were left-handed. Our study also showed increase in air conduction thresholds for almost all frequencies in the right ear.

Similar results were also seen in a study done in healthy volunteers at a tertiary care hospital where a greater decrease in hearing thresholds was seen in the dominant ear than the non-dominant ear and a correlation was established between duration of headphone use and hearing loss¹⁴⁻¹⁵. Some studies have reported that there is no alteration in hearing acuity following prolonged exposure to loud sound¹⁶⁻¹⁷. Our study findings however were not consistent with these studies.

Prolonged exposure to noise can result in transient threshold shift or permanent threshold shift in hearing acuity. Though recovery following transient threshold shift is seen within 24-48 hours, it is associated with accelerated age related hearing loss¹⁸. Pathologically NIHL is characterised by loss of outer hair cells at the base of the cochlea. These hair cells are responsible for picking up high intensity sounds and hence are more susceptible to noise induced damage¹⁹. The damaged cochlear hair cells do not regenerate and are associated with degenerative changes in the auditory nerve ultimately resulting in permanent irreversible hearing loss²⁰.

CONCLUSION:

Our present study showed variably significant differences in hearing thresholds between males and females. Also changes in the hearing thresholds was observed in subjects using headphones for >90 minutes at higher frequencies. Increase in hearing thresholds associated with prolonged use of headphones may point towards early onset of Noise Induced Hearing Loss (NIHL). Though gradual in onset, NIHL is irreversible. Hence, appropriate measures to prevent worsening of hearing acuity need to be undertaken. Adolescents should be made aware of the adverse effects of prolonged headphone use and must be advised to limit headphone usage on a daily basis. Protective equipment should be used to prevent chronic exposure to occupational noise. The variations in results seen in our study could be due to limited sample size, or not considering related aspects like sound intensity, subjects' preference for one ear over the other. Our study was also only limited to first year medical students. Hence further studies taking into consideration all related aspects and involving diverse groups of the general population need to be done.

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