International Journal of Otorhinolaryngology and Head and Neck Surgery
Katiyar VMH et al. Int J Otorhinolaryngol Head Neck Surg. 2019 Mar;5(2):434-439
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20190776

A cross sectional study of hearing thresholds in medical students

V. M. Hemlata Katiyar[1], D. Elango[2]*, Vincent Prasanna[2]

Department of ENT, [1]Government Medical College, Palakkad, Kerala, [2]Tagore Medical College and Hospitals, Chennai, Tamil Nadu, India

Received: 04 December 2018
Revised: 17 January 2019
Accepted: 18 January 2019

***Correspondence:**
Dr. D. Elango,
E-mail: elango_d@yahoo.com

ABSTRACT

Background: The hearing thresholds of young adults with no known hearing loss or noise exposure is expected to be closer to 0 dB HL, though with the increasing usage of recreational noise through personal amplification devices there is shift in thresholds noted. Some studies have highlighted the effect of these devices on the hearing thresholds and a general shift of thresholds towards 25 dB. Objective was to determine the audiometric thresholds of a screened sample of medical students with presumed normal hearing.
Methods: A total of 103 medical students in the age group of 20 to 23 years were screened and subjected to PTA. The Pure tone average was calculated for air conduction (AC) and bone conduction (BC) separately and also for high frequencies (HF). The average for the female students was compared with that of male students. The right ear average was compared with that of left ear.
Results: There was a statistically significant difference with higher thresholds for males in BC and HF, however the difference in AC was not significant. Between the right and left ears, there was statistically significant elevation observed in BC average in the right ear, but no significant difference was found in the HF and AC thresholds.
Conclusions: There is evidence of thresholds especially BC, shifting more towards 25 dB HL in young adults considered to have normal hearing. Early screening will help in identifying this and prevent further elevation by judicious use of mobile phones, personal music players and personal listening devices.

Keywords: Hearing thresholds, Pure tone audiometry, Air conduction, Bone conduction, Personal music players

INTRODUCTION

In diagnostic audiology it is assumed that hearing level of a young adult with no known hearing loss or history of noise exposure should be 0-25 dB HL. However in clinical practice hearing threshold elevation above 0 dB HL are generally considered as hearing loss, especially in young adults. Recent studies have suggested that thresholds of 0 dB may be an optimistic assumption for this population due to increased recreational noise in our society.

Borchgrevink suggested that median hearing thresholds within the 18 to 25 year old population may be closer to +5 dB HL rather than the expected 0 dB HL norms.[1] Some studies report no threshold differences between those that use personal music players (PMPs) and those that do not.[2-5] A few studies have reported small differences in conventional pure-tone audiometric thresholds.[6,7]

A few studies have been done in the Indian subcontinent. Karthikeyan et al concluded that the intensity of hearing loss found in the study population to be directly proportional to the duration of usage and sound exposure of more than that regulated as safe, among mobile users.[8] Studies focused on the student population aged 20 to 30 years concluded there was a significant increase in hearing thresholds in mobile phone users associated with duration of usage.[9-11]

It can be observed that most of the above studies have been done presuming the normal audiometric threshold is closer to 0 dB. However given the present scenario where the exposure to recreational noise in the form of PMP (personal music players), mobiles, blue tooth devices, ear phones/speakers etc. it is required to assess the average hearing threshold in young adults with presumed normal hearing. This may be helpful in identifying the asymptomatic hearing loss and give a guide to the degree of elevation in the expected hearing thresholds among young students. In addition it may be possible to suggest the value of screening audiometry in young adults to detect early increase in hearing thresholds.

Objectives were to determine the audiometric thresholds of a screened sample of medical students with presumed normal hearing.

METHODS

This is cross sectional study of the medical students who volunteered to participate in the study. Study was carried out at Tagore Medical College and Hospital, during the period of September 2016 to February 2017 and Mar 2018 to Jun 2018 at the department of ENT. All medical students who identified themselves as having normal hearing and volunteered to take part in the study were included in the initial screening.

A detailed history regarding the aural symptoms like tinnitus, fullness, ear discharge and itching, any medications and previous ear surgeries was taken. Also details on noise exposure and usage of PMPs, mobile and speakers were recorded.

Ear examination was carried out using otoscope to assess the status of the external auditory canal and tympanic membrane. Only students with normal tympanic membrane were included in the study. The students included in the study were subjected to pure tone audiometry (PTA).

Exclusion criteria

- History of diagnosed hearing loss.
- History of acute or chronic middle ear disease.
- History of chronic noise exposure and ototoxic drugs.
- Any previous ear surgeries.
- Occluded ear canal on the day of testing.
- Any tympanic membrane abnormality on otoscopy.
- On PTA if any evidence of hearing loss.

All selected students were subjected to PTA in a double-walled sound-treated room with Inventis Harp plus diagnostic audiometer. Air conduction thresholds were measured at 250, 500, 1000, 2000, 4000 and 8000 Hz frequencies and Bone conduction thresholds were measured at 250, 500, 1000, 2000 and 4000 Hz frequencies using 5 up 10 down steps. All the participants were carefully instructed about the response criteria. If the air conduction average was more than 25 dB they were excluded from the study. Those participants with air–bone gap of more than 10 dB and those with difference of more than 15 dB between the two ears were also excluded from the study.

The air conduction and bone conduction average was calculated for each ear separately by taking the average of AC and BC thresholds at all frequencies respectively. The right ear average was compared to the left ear average to look for any significant difference. The combined average of both ears with regard to AC and BC for female students was compared to that of male students. The high frequency (HF) average was calculated by taking the average of AC threshold at 4 and 6 kHz and BC thresholds at 4 kHz for the right and left ears separately and compared. The combined right and left ear HF thresholds were used to compare the average of the female students with that of male students.

Institutional ethics committee clearance was taken vide letter number IEC No: 5/March 2016.

The statistical analysis of the data was done using SPSS ver11. The independent sample t test was used wherever the data was normally distributed. Wherever this was not applicable non parametric tests Kruskal Wallis H test or Wilcoxon rank test were done to determine the statistical significance.

RESULTS

A total of 103 students participated in the study. All the participants were using mobile phones and 38 students were using personal listening devices and/or personal music players. All the participants were aged between 20 and 23 years. Among these 53 were female students and 50 were male students (Figure 1).

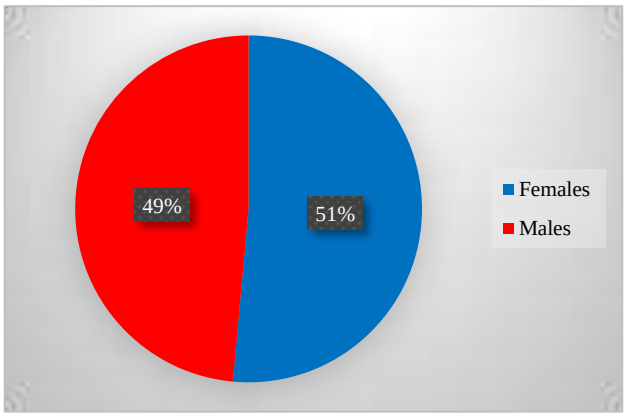

Figure 1: Sex distribution of study participants.

The air conduction and bone conduction thresholds were measured and recorded. The highest air conduction (AC) threshold measured for the right ear was 40 dB at 4 kHz in a male student, whereas for the left ear it was 30 dB at

500 Hz in a female student. The average air conduction thresholds at each frequency for both right and left ears among female students are shown in Figure 2.

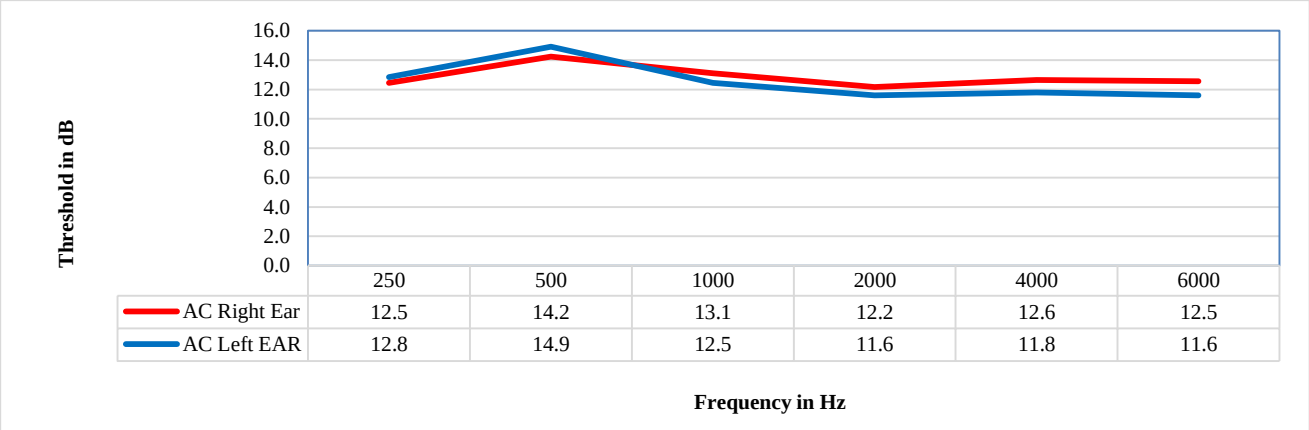

Figure 2: AC average of female participants.

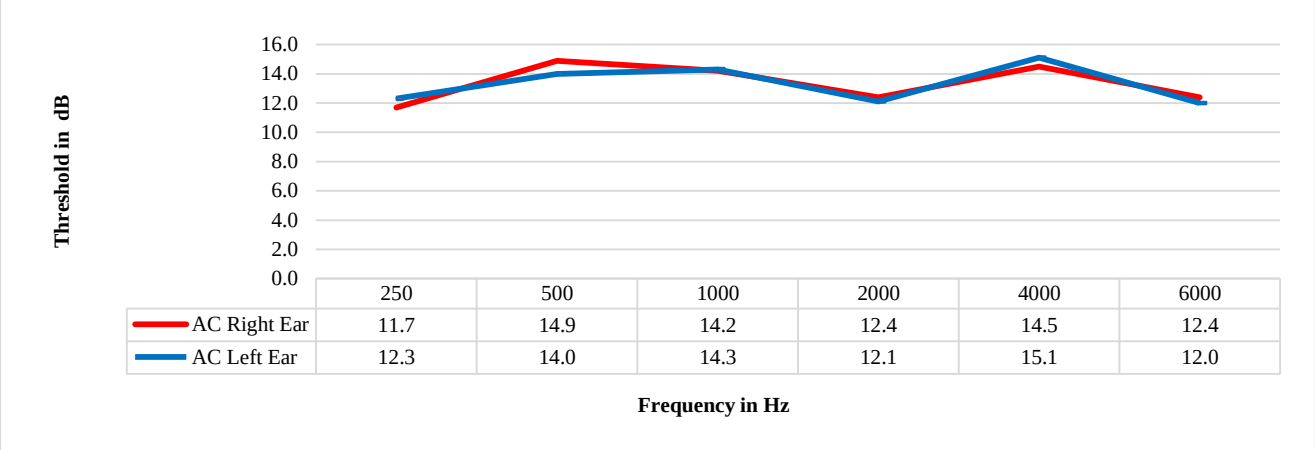

Figure 3: AC average of male participants.

It can be noticed from the figures 2 and 3 that the average air conduction thresholds are closer to 15 dB than 0 dB and the measured thresholds are higher for males compared to females. The average of the combined thresholds of both ears shows that the males have a higher average compared to females (Figure 4).

Statistical analysis of the combined AC average for females was compared to that of males. The independent samples t-test showed no statistically significant difference between the AC thresholds observed in males compared to that of females ($p > 0.05$).

Among bone conduction (BC) thresholds measured for the right ear, 20 dB at 500 Hz, 2 kHz and 4 kHz was the highest, whereas for the left ear it was 25 dB at 1 kHz and 2 kHz. The average bone conduction thresholds at each frequency for both right and left ears among female students are shown in Figure 5.

The average air conduction thresholds at each frequency for the both right and left ears among male students are shown in Figure 3.

The average bone conduction thresholds at each frequency for the right and left ears among male students are shown in Figure 6.

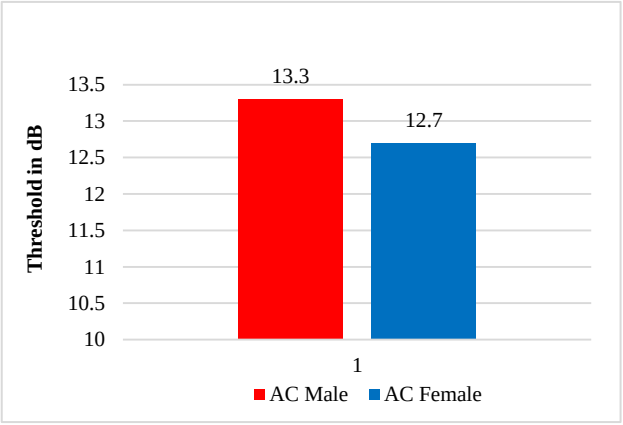

Figure 4: AC average of both ears males vs. females.

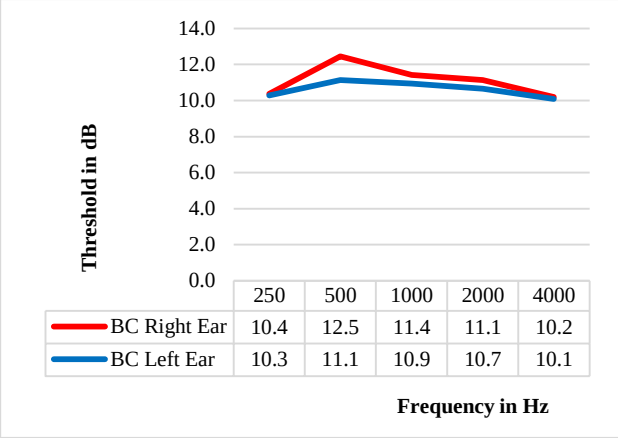

Figure 5: BC average of female participants.

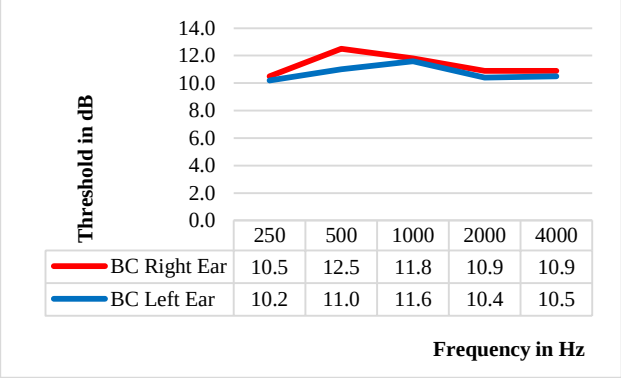

Figure 6: BC average of male participants.

The average of the combined BC thresholds of both ears shows higher threshold levels for males compared to that of females (Figure 7).

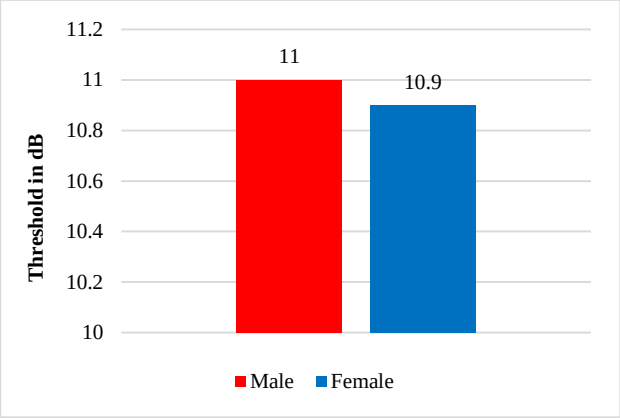

Figure 7: BC average of both ears males vs. females.

Statistical analysis of the combined BC average for females was compared to that of males using independent samples t-test showed male students had a statistically significant elevation in the BC thresholds compared to that of females ($p<0.05$).

The high frequency (HF) average was calculated using the AC threshold at 4 and 8 KHz and BC thresholds at 4 kHz of the right and left ears. It was noted that the HF average for male students was higher than that of the female students (Figure 8).

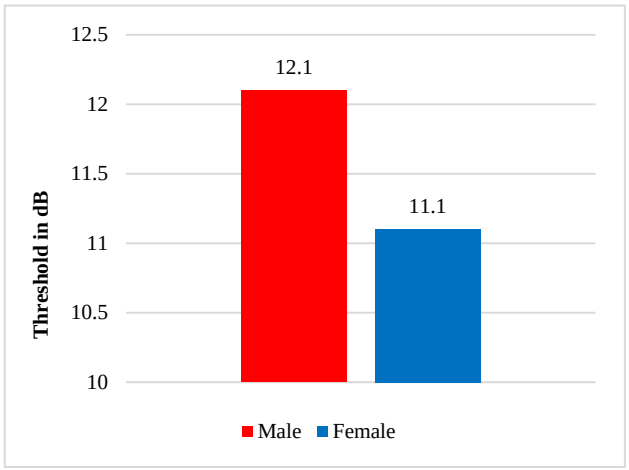

Figure 8: HF average combined AC+BC males vs. females.

The statistical analysis of the HF frequency average showed that male students had a statistically significant elevation of HF thresholds compared to that of females ($p<0.05$).

The AC average of all participants for the right and left ear is shown in Figure 9. Taking into account the AC average of all participants, the right ear average was compared with that of left ear using Wilcoxon rank test. No statistically significant difference was found between the two ears for AC average threshold ($p>0.05$).

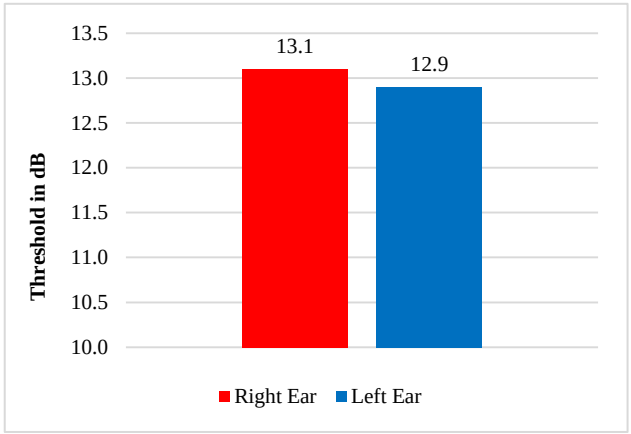

Figure 9: AC average of right ear vs. left ear.

The bone conduction average for all students is shown in figure 10. The BC thresholds observed for the right ear was significantly higher compared to that of left ear ($p<0.05$).

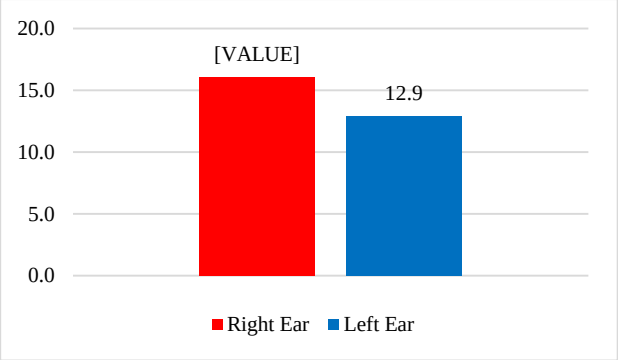

Figure 10: BC average right ear vs. left ear.

The high frequency average of right and left ears for all the students is shown in Figure 11. No statistically significant difference between the right and left ear was found for the HF average (p>0.05).

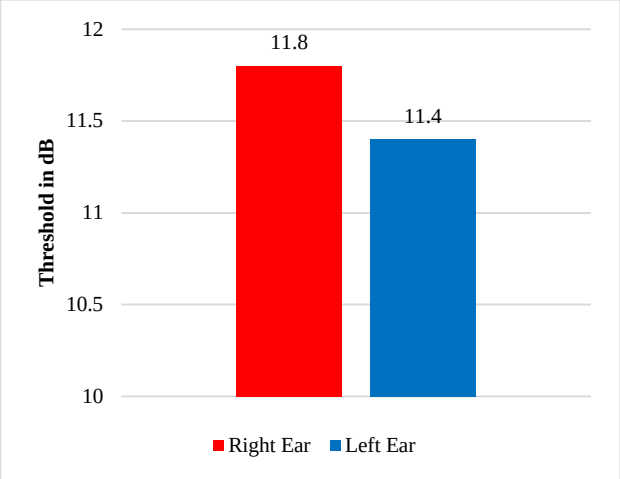

Figure 11: HF average right ear vs. left ear.

DISCUSSION

In this study there were more female students compared to male students. This is similar to the study on 122 students using PMPs and mobiles with ear phones, by Manisha et al.[10] It was found that there is a statistically significant difference in the average BC thresholds between males and females in this study, with males having more elevation compared to females. The difference noted in AC thresholds was not statistically significant. Though there is no study comparing the AC average and BC average separately, Rice et al, Williams and Torre in three different studies showed gender-based differences in hearing loss in young adult populations with reference to usage of PMPs.[12-14] It was suggested that this difference may be because males may prefer louder volume levels than females.

However a study by Karthikeyan et al did not find any significant relationship between hearing loss and gender.[8] This study showed a statistically significant increase in HF average in males compared to females. The typical dip at 4 kHz was not found in any participant. It is a known fact that noise induced hearing loss affects HF earlier than other frequencies. Mean differences of 2–3 dB at 4–6 kHz have been reported by West PD and Evans EF, although the group differences were not statistically reliable in that study.[15] Peng et al in their study on the risk of damage to hearing from personal listening devices in young adults, found the hearing thresholds in the 3 to 8 kHz frequency range were significantly increased in the PLD listeners.[16] But gender difference was not a part of this study.

While comparing the right ear with the left ear, no significant difference was found between the two sides in the AC thresholds and HF thresholds, but in BC thresholds the difference was significant with right ear showing more elevated thresholds than left. In the study by Karthikeyan et al, though PTA did not show any difference between the two sides, DPOAE and BERA showed difference in both groups, between the two sides.[8] However while comparing the parameters of right and left side, no possible discrepancy is found to exist between them (p>0.05). The difference noted in this study, with significant elevation of BC thresholds in the right ear, may be because all the study participants were right handed and mobile users. The usage of other devices was 37%.

CONCLUSION

All the participants in this study use mobile phones and other devices on regular basis. In spite of this recreational noise exposure all the participants considered themselves to have normal hearing thresholds. It can be stated that there is a shift in hearing thresholds more towards 25 dB which can be considered a warning signal, given the fact the study population is young adults with age ranging from 20 to 23 years. Right ear BC thresholds getting significantly elevated may point towards mobile usage in that ear. But the influence of other factors like race, smoking, co-morbidities, other noise exposures etc. cannot be ruled out. Further study will be required taking into account all the factors affecting the hearing thresholds. It is suggested that early screening may help in identifying and correcting the risky behaviour may prevent further hearing loss.

ACKNOWLEDGEMENTS

Authors would like to thank all the staff of ENT department for the help extended during study period and students who had participated in the study. Authors would also like to acknowledge the support given by Mrs. Mohanalakshmi in carrying out the pure tone audiometry.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Borchgrevink HM. Does health promotion work in relation to noise? Noise Health. 2003;5:25–30.
2. Wong TW, Van Hasselt CA, Tang LS, Yiu PC. The use of personal cassette players among youths and its effects on hearing. Public Health. 1990;104:327–30.
3. Mostafapour SP, Lahargoue K, Gates GA. Noise-induced hearing loss in young adults: the role of personal listening devices and other sources of leisure noise. Laryngoscope. 1998;108:1832–9.
4. Kumar A, Mathew K, Alexander SA, Kiran C. Output sound pressure levels of personal music systems and their effect on hearing. Noise Health. 2009;11:132–40.
5. Shah S, Gopal B, Reis J, Novak M. Hear today, gone tomorrow: an assessment of portable entertainment player use and hearing acuity in a community sample. J Am Board Fam Med. 2009;22:17–23.
6. Meyer-Bisch C. Epidemiological evaluation of hearing damage related to strongly amplified music (personal cassette players, discotheques, rock concerts)-high-definition audiometric survey on 1364 subjects. Audiology. 1996;35:121–42.
7. Kim MG, Hong SM, Shim HJ, Kim YD, Cha CI, Yeo SG. Hearing threshold of Korean adolescents associated with the use of personal music players. Yonsei Med J. 2009;50:771–6.
8. Karthikeyan P, Christian JS, Audhya A. Hearing evaluation in mobile phone users at a tertiary care hospital. Indian J Otol. 2014;20:24-8.
9. Reddy GRK, NarayanaRao P, Kumar BS, Sridhar M. Effect of cell phone usage on hearing threshold. J Evolution Med Dental Sci. 2013;2(27):4963-5.
10. Manisha N, Mohammed NA, Somayaji G, Kallikkadan H, Mubeena. Effects of Personal Music Players and Mobiles with Ear Phones on Hearing in Students. IOSR-JDMS. 2015;14(2):31-5.
11. Hegde MC, Shenoy VS, Kamath PM, Rao RA, Prasad V, Varghese BS. Mobile phones: Its effect on hearing. Indian J Otol. 2013;19:122-6.
12. Rice CG, Rossi G, Olina M. Damage risk from personal cassette players. Br J Audiol. 1987;21:279–88.
13. Williams W. Noise exposure levels from personal stereo use. Int J Audiol. 2005;44:231–6.
14. Torre P. 3rd Young adults' use and output level settings of personal music systems. Ear Hear. 2008;29:791–9.
15. West PD, Evans EF. Early detection of hearing damage in young listeners resulting from exposure to amplified music. Br J Audiol. 1990;24:89–103.
16. Peng JH, Tao ZZ, Huang ZW. Risk of damage to hearing from personal listening devices in young adults. J Otol. 2007;36(3):179-83.

Cite this article as: Katiyar VMH, Elango D, Prasanna V. A cross sectional study of hearing thresholds in medical students. Int J Otorhinolaryngol Head Neck Surg 2019;5:434-9.