

Original Research Article

A study on the effect of prolonged mobile phone usage on hearing among students

V. Srinivasa, Jayendiran Subramaniam*, I. Chakkravathy, Harish Vel, Sathish Kirushnan

Department of ENT, Vinayaka Mission's Medical College and Hospital, Karaikal, Puducherry, India

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*Correspondence:

Dr. Jayendiran Subramaniam,

E-mail: jayendiransubramaniam@gmail.com

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ABSTRACT

Background: Mobile phones have become integral part of our daily life. Since the number of base stations and wireless local area networks increases simultaneously the concern about possible health hazards from exposure to the radiofrequency fields by these wireless technologies also raises. The main aim of our study was to study the effect of prolonged mobile phone usage on hearing among students and to assess the percentage of sensorineural hearing loss among them.

Methods: Hundred medical students were enrolled in our study. Basic information was collected from each student using a preliminary questionnaire. All the chronic mobile users who use right ear as the dominant ear were subjected to otoacoustic emissions (OAE) and pure tone audiometry.

Results: The OAE results were normal in all the students. We also observed that none of the individuals in our study affected from significant hearing loss (more than 25 dB). But we found a minimal hearing loss in those using mobile phones for more than two hours per day.

Conclusions: We concluded that chronic mobile phone usage did not show any significant hearing loss in the study population.

Keywords: Mobile phone, Hearing loss, OAE, Pure tone audiometry, Medical student

INTRODUCTION

Mobile phones have become integral part of our daily life. In fact, they are almost like an extension of us in this modern era. This wireless technology relies upon huge network of fixed antennas or base stations.¹ These base stations relay their information with radiofrequency signals. Around 1.4 million base stations present worldwide and the number is increasing significantly with the introduction of new technologies, wireless local area networks such as high-speed internet access and services are also significantly increasing in public areas like airports, schools, colleges and residential areas. Since the number of base stations and wireless local area networks increases simultaneously the concern about possible

health hazards from exposure to the radiofrequency fields by these wireless technologies also increases.^{1,2} The main aim of our study was to study the effect of prolonged mobile phone usage on hearing among students in a medical college and to assess the percentage of sensorineural hearing loss among them.

METHODS

The study was done at the Department of ENT, Vinayaka mission medical college and hospital, Karaikal during the period of January to October in 2019. Before conducting the study, Ethical Committee clearance was obtained from the Institutional Ethics Committee. The population of study contains the students of medical college of the

institute within age group of 18 to 22 years and using mobile phones for three years or more. Students not interested for the study, students with previous ear disease, history of loud noise exposure, prolonged usage of headphones for entertainment purpose for more than 1 h/day or students with any systemic illness were also excluded. Students with a history of medications for ototoxicity, those with a history of viral infections were also excluded. Smokers and alcoholics were also excluded from the study.

All the participating students were subjected to a questionnaire related to mobile phone use. It includes total duration of mobile phone usage (years), duration of calls per day in hours, duration of the longest call in a day (hours), modes of usage (normal or speaker or headphone or Bluetooth), frequently used ears (right or left or both), usage of music media in mobile phone and any associated ear symptoms (hard of hearing, tinnitus, dizziness).

After the questionnaire, all the students underwent detailed clinical examinations including otoscopic examination of the ear. The nature of the tympanic membrane was observed and the normality was ensured before further investigation. All the candidates underwent standard tuning fork tests (Rinne's or Weber's and Absolute bone conduction tests). All the students underwent a pure tone audiometry (PTA) and graphs were plotted. Audiometry was done by an experienced audiologist at frequencies of 250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz and 8000Hz using ELKON eda 3 N 3 multi diagnostic pure tone audiometer.

All the individuals were subjected to distortion product otoacoustic emissions (DPOAE) to measure the otoacoustic emissions (OAE) which are generated from outer cochlear hair cells.

All the candidates in this study used GSM 3G and 4G mobile phones. This study was single blinded as the audiologist did not know which was the frequently used dominant ear. The audiograms were examined for the type and percentage of hearing loss.

SPSS software version 16 is used for evaluation of the results.

RESULTS

A total of 100 students were included in this study. Out of 100 students, 64 were males and 36 were females. The ages ranged from 18 years to 22 years with mean age of 20 years. All the candidates were evaluated using Questionnaire with special emphasis on duration, usage pattern, frequently used ear, type of mobile phone. In our study all the students frequently used right ear as the dominant ear while using mobile phones.

Students were asked for otological symptoms like decreased hearing, tinnitus, vertigo, ear discomfort or

fullness. Out of 100 students who were screened with pre-texted questionnaire, 9 students complained tinnitus after using mobile phone, 7 students had ear fullness, 5 students had vertigo and 6 students developed ear discomfort.

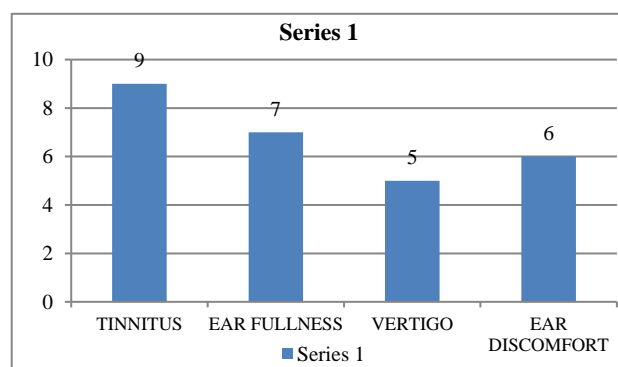


Figure 1: Symptomatology of students.

In our study 33 subjects had three years of exposure, 42 had four years of exposure and 25 had 5 years of exposure to mobile phones. Based on the evaluation in our Questionnaire, 26 students had 1 to 2 hours of exposure, 31 students had 2 to 3 hours and 15 students had 3 to 4 hours of exposure to mobile phones every day.

Table 1: Duration of mobile phone usage among students (n=100).

Years of exposure	No of students
3	33
4	42
5	25

Table 2: Average daily exposure of mobile phone usage among students.

Hours of exposure	No of students
1 to 2	26
2 to 3	31
3 to 4	15

Table 3: Relationship between hours of exposure and degree of hearing loss among students.

Hours of exposure	dB loss	Percentage (%)
2 to 3	5	12.9
2 to 3	10	6.45
3 to 4	5	20
3 to 4	10	13.3
3 to 4	15	6.6

In this study those of the candidates using mobile phones daily for 2 to 3 hours 5 dB loss first found in 12.9%, 10 dB in 6.45% and none of them had 15 dB loss. Among subjects using mobile phones 3 to 4 hours daily, 5 dB loss was noted in 20%, 10 dB loss in 13.3% and 15 dB loss in

6.6%. This minimum hearing loss is found only in all the dominant ear of the students.

DISCUSSION

Mobile phones have become integral part of our daily life. In fact, they are almost like an extension of us in this modern era. This wireless technology relies upon huge network of fixed antennas or base stations.¹ These base stations relay their information with radiofrequency signals. The wide spread establishment of base stations have led to huge concern about possible hazardous effect of radiofrequency emissions. There are two possible reasons by which radiofrequency field exposure may lead to health hazards. Thermal effect caused by keeping mobile phones close to the body and conversions over a long period of time may cause health hazards. Another possibility could be non-thermal effect both from base stations and mobile phones particularly hazards to the people staying near base stations.³⁻⁵

But radiofrequency emissions from the mobile phones are below the guidelines of the international commission on non ionizing radiation protection. Such radiofrequencies are not sufficient enough to produce toxic effects like DNA mutations.^{6,7} The exposure to electromagnetic field in mobile phone users can be expressed in terms of SAR (specific absorption rate). The unit of SAR is W per kg. The ear being in the closest proximity to the mobile phones during use leads to high specific absorption rate (SAR) as compared to the remaining parts of the body. Particularly the inner ear is more vulnerable for the electromagnetic radiation deposition. The organ of corti contains delicate hair cells which do not have regenerative properties. So, if the hair cells are damaged, the chance of recovery is very less.⁸ Numerous studies have been conducted to assess the hazards effect of mobile phone on health. The existing data suggest that mobile phones usage for long term can cause health related problems like headache, dizziness, fatigue, sleep disturbances, etc. However only limited information is available regarding effects of mobile phone on human auditory system and hearing. The main aim of our study is to understand the effects of long term mobile use on hearing.

In this study those of the candidates using mobile phones daily for 2 to 3 hours 5 dB loss first found in 12.9%, 10 dB in 6.45% and none of them had 15 dB loss. Among subjects using mobile phones 3 to 4 hours daily, 5 dB loss was noted in 20%, 10 dB loss in 13.3% and 15 dB loss in 6.6%. This minimum hearing loss is found only in all the dominant ear of the students. All the 100 students were evaluated using distortion product otoacoustic emission (DPOAE) prior to pure tone audiogram. All the candidates subjected to OAE passed it which is suggestive of integrity of cochlear outer hair cells. In our study 0 to 25 dB hearing loss is taken as normal according to WHO guidelines. Our study among mobile phone users did not show any significant hearing abnormality.

Various studies published so far have failed to establish a correlation between hearing impairment and chronic mobile phone usage.

Panda et al, evaluated audiological disturbances in chronic mobile phone users.⁹ The subjects in their study showed high frequency hearing loss. In a study conducted by Sahoo et al, sensorineural hearing loss was prevalent in the habitual mobile phone users and found that, the hearing loss was directly correlated with duration of mobile phone usage.¹⁰

In a study conducted by Oktay et al, to study the effect of mobile phone radiations on the hearing showed higher degree of hearing loss among mobile phone users.¹¹

Karthikeyan et al conducted a study to evaluate hearing in mobile phone users.¹² They found a variable degree of hearing loss in the mobile phone users in pure tone audiometry, brain stem evoked response audiometry and distortion product otoacoustic emissions. Around 73% of the study population was found to use mobile phones at least 30mins or even more for each call. They concluded that duration of mobile usage is directly proportional to the intensity of hearing loss.

In a study conducted by Kerekhanjanarong et al, the hearing threshold in the dominant most ear in the candidates who used mobile phone is worser than the non dominant ear.¹³

Ramya et al concluded that longer duration of mobile usage was associated with significant increase in hearing threshold.¹⁴

The study conducted by Joshi et al, showed increased auditory threshold shift in the frequently used ear among mobile phone users.¹⁵

In a study conducted by Philip et al the hearing loss is more in the individuals who used mobile more than one hour per day.¹⁶ They suggested that duration of mobile phone use has a predominant role in the progression of hearing loss

On the other hand, several studies show that chronic mobile phone usage is not associated is with significant hearing loss similar to our study.

The investigations made by Sievert et al showed that mobile phones do not have any harmful effect on the inner ear and auditory system.¹⁷

The results of the study conducted by Davidson et al concluded that mobile phone usage has no effect on the auditory and vestibular system.¹⁸

Uloziene et al conducted a study to assess the effect of 10 minutes of exposure of EMFs emitted from a mobile phone on hearing.¹⁹ They found that EMFs emitted from a mobiles had no effect on pure tone audiometry and

transient evoked OAE in young subjects. No significant hearing loss was detected.

Chander et al conducted a study to determine the physical and functional effect of mobile phone usage on ear and the hearing pattern among mobile phone users.²⁰ It was observed that a hearing loss less than 15 dB was in the subjects using mobiles. None of them had significant hearing loss.

Similarly, Hegde et al conducted a study to assess the effect on hearing in 120 mobile phone users and non-users between the age group of 18 to 30 years.⁵ They observed a minimal hearing loss of 5 to 15 dB among mobile phone users but did not show any significant hearing loss. The present study findings are match able with the above-mentioned studies.

CONCLUSION

Hundred medical students were enrolled in our study. Basic information was collected from each student using a preliminary questionnaire. All the chronic mobile users who use right ear as the dominant ear were subjected to OAE and pure tone audiometry. The OAE results were normal in all the students. We also observed that none of the individuals in our study affected from significant hearing loss (more than 25 dB). But we found a minimal hearing loss in those using mobile phones for more than two hours per day. So, we cannot come to a definitive conclusion regarding the harmful effect of mobile phones on hearing. Since, young population is becoming more addicted to this fancy multipurpose device, mobile phones may emerge as a risk factor in near future. Hence a long term follow up study with large population is required.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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