

## Original Research Article

# Assessment of hearing among mobile phone users

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### ABSTRACT

**Background:** With the advent of new smart phones every day, health hazard related to it is also increasing. The usage of mobile phones has become a domineering activity of the students. Such usage have been documented to cause many health hazards like hearing loss, the mobile phone electromagnetic radiation has other potential risks like vehicular accidents, headache, and sleep disturbances, thermal effects and alteration of blood brain barrier. The objective of the study was to assess the hearing loss with pure tone audiometry due to chronic mobile phone usage among medical college students in a tertiary care hospital.

**Methods:** This was a cross sectional study conducted among the medical students from June 2018 to December 2018, with the sample size of 129. The participants were interviewed using pretested, validated questionnaire followed the participants were subjected to pure tone audiometry.

**Results:** Among the 129 participants, the majority of the study participants (58.1%) were females. The median age of the participants was 20 and almost 42.7% of the participants used in ear media while using the phone. 10.9% and 19.4% showed symptoms of tinnitus and hard of hearing respectively. On testing the participants with pure tone audiometry, around 9.3% had mild hearing loss and 3.9% had moderate hearing loss.

**Conclusions:** The health hazard caused by the mobile phone usage may not be evident for many years. The students are exposed to smart phones frequently and hence periodic screening and health education regarding the harm of using mobile phones for longer duration should be made imperative.

**Keywords:** Hearing loss, Mobile phone users, Pure tone audiometry

### INTRODUCTION

The mobile phone usage has become imperative part of our daily activities. India is the world's fastest country in developing telecommunication markets next to China.<sup>1</sup> According to World Health Organization in 2014, 6.9 billion population used mobile phones globally and it's estimated to double at the end of 2019.<sup>2</sup> India being considered as second largest country for smartphone market and it is expected to reach 60 million users by 2019.<sup>3</sup>

Although the development of mobile phones has improved the quality of life but it possesses a potential

threat in health outcomes. With advancement of telecommunication technology, the mobile phones are not only restricted to make and receive calls but it has extended its services like text messages, internet facilities, bluetooth, gaming and photography.

Mobile phones use electromagnetic field in radiofrequency bands which is transmitted from mobile to network towers to mobile and vice versa. The GSM (Global System for Mobile Communications) and CDMA (Code Division Multiple Access) mobile phones operates range of about 800 to 900 MHz which is within the acceptable range.<sup>4</sup> But the data on chronic accumulative effect of EMR (electromagnetic radiation) on human

health is still lacking. The mobile phones are particularly placed close to the head especially the ear and the effect of EMR on hearing is current interest. On prolonged exposure, the inner ear which is the direct recipient of noise, thermal energy and EMR which in turn damages the hair cells of organ of Corti leading to a significant hearing loss. Since the hair cells of Corti is delicate and without regenerative properties, the damage is permanent and irreversible.<sup>5</sup>

According to American Academy of Otolaryngology-Head and Neck Surgery Foundation's Annual Meeting & OTO EXPO in Washington, DC usage of mobile phone more than 60 minutes a day over a period of 12 months at higher frequencies had a worsened hearing than those with reduced usage.<sup>6</sup> The hearing loss is slow and progressive and people may not perceive the hearing loss until it is serious. The hearing loss is more in dominant ear which is usually used for mobile phone usage. Apart from hearing loss, the mobile phone EMR has other potential risks like vehicular accidents, headache, and sleep disturbances, thermal effects like burning around the ear, facial skin, and alteration of blood brain barrier.<sup>1,7</sup> International Agency for Research on Cancer classified mobile phone radiation as a possible carcinogenic to humans.<sup>1</sup> But the studies on the latter effects due to mobile phone usage is still lacking especially in developing countries.

This study is designed with the objective to assess the hearing loss with pure tone audiometry due to chronic mobile phone usage among medical college students in a tertiary care hospital.

## **METHODS**

### ***Study design***

The study was a cross sectional study conducted in outpatient unit of Ear Nose and Throat department at Chettinad hospital and research institute (tertiary care hospital), Kancheepuram district.

***Study duration:*** The study was conducted from June 2018 to December 2018

### ***Sample size determination***

From the previous study it was found that mean and standard deviation of hearing loss among mobile users more than two hours was 24.3 and 40.9.<sup>5</sup> Sample size calculation for cross sectional study with 24.3 standard deviation, 5% relative error and 20% non-responsive error was 129.

### ***Sampling and study population***

The study population comprised of medical students of the tertiary care hospital of both sex in the age group 18 to 30 years who were using mobile phones more than 5 years and above. The study population was selected by

simple random sampling using lottery method without replacement until required sample size is achieved. The selected study participants were subjected to a clinical examination to rule out possible causes of hearing loss.

### ***Inclusion criteria***

Medical students of age between 18 to 30 years of age without any possible cause of hearing loss were included in the study.

### ***Exclusion criteria***

Person with any possible cause of hearing loss such as perforation in the ear drum, fluid accumulation behind the drum, otosclerosis, otitis media, sudden or repeated exposure to noise without adequate protection, trauma to neck or head, ototoxicity, high or low blood pressure.

### ***Data collection procedure***

The purpose and procedure were explained to the study participants and were interviewed after obtaining the informed written consent. The participants were interviewed using pretested, validated questionnaire followed the participants were subjected to pure tone audiometry.

### ***Study instrument***

The study instrument comprises of three sections. Section-1 comprises of a questionnaire which includes sociodemographic details of study participants, duration and mode of mobile usage, symptoms of chronic mobile usage. Section-2 comprises of clinical examination of both ears using audiometry, tuning fork test, fistula test and examination of facial nerve. Section-3 includes assessment of hearing loss using pure tone audiometry (PTA).

### ***Statistical analysis***

Data was entered in Microsoft Excel spread sheet and analyzed using Statistical Package for Social Sciences (SPSS -IBM) software version 21. Mean, standard deviation and proportion was calculated. Chi square test was applied to find difference in proportions and  $p < 0.05$  was considered significant. The strength of association was assessed using multiple linear regression.

### ***Ethical consideration***

Institutional Ethical Committee approval was obtained before starting of the study. Confidentiality of study participants was maintained in all the phases of the study.

## **RESULTS**

The median age of the participants was 20 and the majority of the study participants (58.1%) were females.

Nearly 42.7% of the participants used in ear media while using the phone (Table 1).

**Table 1: Distribution of study participants according to the usage of mobile phones for calls (n=129).**

S no	Variable	Frequency	Percentage (%)
1	Duration of calls per day (hours)		
	<1	105	81.4
	>1	24	18.6
2	Duration of longest call per day (hours)		
	<1	123	95.3
	>1	6	4.7
3	Modes of usage		
	Normal	71	55
	Headphone	53	41.1
	Bluetooth	2	1.6
4	Frequently used ears for mobile phone usage		
	Both	11	8.5
	Left	25	19.4
	Right	93	72.1

**Table 2: Distribution of study participants according to the usage of music medias (n=129).**

S no	Variable	Frequency	Percentage (%)
1	Usage of music media		
	Ipods	14	10.9
	Mobiles with headphones	87	67.4
	Mobiles with speaker	16	12.4
	Mp3 player	4	3.1
	Personal computer	8	6.2
2	Duration of hearing music (hours)		
	<1	58	45
	>1	71	55
3	Loudness while listening to music		
	Loud	34	26.4
	Low to moderate	95	73.6

**Table 5: Parameters associated with hearing loss.**

S no	Variable	Hearing loss (PTA)		Odds ratio (CI)	P value
		Yes (%)	No (%)		
1	Duration of calls per day (hours)				
	<1	14 (13.3)	91 (86.7)	0.929 (0.24-3.52)	0.12
	>1	3 (12.5)	21 (87.5)		
Duration of longest call per day (hours)					
2	<1	16 (13)	107 (87)	1.338 (0.14-12.1)	0.067
	>1	1(16.7)	5 (83.3)		
	Mode of usage				
3	Normal/ Speaker	8(10.8)	66 (89.2)	1.614 (0.580-4.495)	0.85
	In ear mode	9 (16.4)	46 (83.6)		

Continued.

**Table 3: Distribution of study participants according to the history and symptoms pertaining to ears (n=129).**

S no	Variable	Frequency	Percentage (%)
1	Family history of hearing loss		
	Yes	17	13.2
2	Past history of ear infection		
	Yes	9	7
3	History of intake of ototoxic drugs		
	Yes	6	4.7
4	Presence of tinnitus		
	Yes	14	10.9
5	Presence of hard of hearing		
	Yes	25	19.4

**Table 4: Distribution of study participants according to the pure tone audiometry results (n=129).**

S no	Variable*	Frequency	Percentage (%)
1	Normal	112	86.8
2	Unilateral Mild Hearing Loss	8	6.2
3	Bilateral Mild Hearing Loss	4	3.1
4	Unilateral Moderate Hearing Loss	4	3.1
5	Bilateral Moderate Hearing Loss	1	0.8

\*According to WHO classification of pure tone audiometry.

Around 26.4% hear music loudly and around 55% of the study participants used to hear music for more than 1 hour (Table 2).

S no	Variable	Hearing loss (PTA)		Odds ratio (CI)	P value
		Yes (%)	No (%)		
4	Loudness while listening to music				
	Loud	5 (14.7)	29 (85.3)	0.839 (0.27-2.58)	0.094
	Low to moderate	12 (12.6)	83 (87.4)		
5	Tinnitus				
	Yes	3 (21.4)	11 (78.6)	0.508 (0.126-2.048)	0.934
	No	14 (12.2)	101(87.8)		
6	Hard of hearing				
	Yes	5 (20)	20 (80)	0.522 (0.16-1.64)	1.261
	No	12 (11.5)	92 (88.5)		

Only 10.9% and 19.4% showed symptoms of tinnitus and hard of hearing respectively (Table 3).

On testing the participants with pure tone audiometry, around 9.3% had mild hearing loss and 3.9% had moderate hearing loss (Table 4).

Among those who hear music loudly, 14.7% and among those who used in ear media while using phones, 16.4% had hearing loss (Table 5).

## DISCUSSION

Since the mobile phone usage has been enormously increased, concern about the effect of electromagnetic radiation of mobiles and its health impact has been raised. Only fewer studies have established the mobile phone as one of the risk factors for hearing loss. Hence this study is conducted to identify mobile phones as one the prominent factor leading to hearing loss and other symptoms using pure tone audiometry.

The mean age of the study participants were 20 years and majority where females (58.7%) which was similar with the study conducted by Karthikeyan et al.<sup>9</sup> The hearing loss is present in both males and females and there is no significant difference in hearing loss among the gender. 105 (81.4%) participants used mobile phones less than one hour per day which was higher when compared with the results of Philip et al, where only 33.3% of participants exposed to 0-1 hours to mobile/day.<sup>10</sup> The hearing loss is predominant in the participants who used mobile more than one hour/day, which suggests duration of mobile usage has a dominant role in the progression in pathology of hearing loss.<sup>5</sup>

72.1% participants used right ear for using mobile phone which is coherent with results of Ramya et al where 80% of study participants preferred right ear for using mobile phones.<sup>11</sup> There is no significant difference in hearing loss is observed in dominant and non-dominant ear of using mobile phones. But the hearing loss is present in participants who uses mobile phone in dominant ear which could be explained maximum exposure to electromagnetic radiation in terms of longer duration and

frequency in dominant ears leading to damage to organ of Corti.<sup>9</sup>

Mobile phones extend its purpose from receiving and making calls to internet facilities. Hence the users are exposed to same considerable health risk due to electromagnetic radiation. In our study majority of participants used mobile with headphones as music media. About 55% of study participants used music media more than one hour a day and 26.4% preferred loudest volume for media which was much higher than the results of Clercq et al.<sup>12</sup>

10.9% of participants reported symptoms of tinnitus and 19.4% of participant's reported hard of hearing while or after using mobile phones. Similarly, Hegde et al reported symptoms of blocked sensation (15%) followed tinnitus (10%) and difficulty in hearing (3.3%) among the study participants.<sup>13</sup>

In our study the participants were assessed for hearing loss using WHO classification of pure tone audiometry.<sup>8</sup> Among the study participants 3.1% were found mild bilateral hearing loss and 0.8% were found bilateral moderate hearing loss. Similarly, in a study conducted by Karthikeyan et al 8% of mobile users had right ear hearing loss and 4% had left hearing loss in PTA.

In multivariate analysis, the hearing loss in PTA is not significantly associated with duration of calls, mode of usage, loudness while listening to music, tinnitus and hard of hearing. The present study suggest that there is mild to moderate hearing loss but a weak relationship between mobile phone usage and hearing loss. This may due to primary association of interest of study was estimated using cross sectional study than comparative study between mobile phone users and non-users since we have exponential users of mobile phones.

## CONCLUSION

Mobile phones became a part and parcel of modern lifestyle. There has been many boon and bane in using the phones. Though studies concerning about electromagnetic radiation from mobile phones, the studies concentrating on mobile phone usage as a risk

factor for hearing loss is limited. The damage inflicted today by their usage may not be evident till many years. Since students are exposed to smart phones, frequent screening and health education regarding the harm of using mobile phones for longer duration should be stressed.

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