

## Original Research Article

# Audiological evaluation of medical students of tertiary care center and its relation with mobile phone use

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## ABSTRACT

**Background:** In the modern era mobile phone uses is constantly increasing day by day after its commercial availability from 1983. The mobile is an electromagnetic device which work on radiofrequency band, it receives and send signals.

**Methods:** In this study we selected tertiary level centre students for hearing evaluation including higher frequency in chronic mobile user. Volunteers from medical college students between 20 to 30 were included who have been using mobile phone for more than a year.

**Results:** Among the 200 subjects male candidates were 118 and female candidates were 82. Age of the volunteers was between 20 years and 30 years. After careful assessment of audiogram obtained from the volunteers segregation done in two groups, one with no hearing loss and other with hearing loss. 69% of total volunteers had no hearing impairments that is 138 volunteers where as 31% had hearing impairments that is 62 volunteers. If we compare these two groups the age of group having hearing loss was near 30 years

**Conclusions:** In our study we observed that pronged mobile phone uses predispose to the hearing loss at the dominant ear. This hearing loss was noticed on long term use of hearing and since it involve the unilateral ear we presumed mobile phone use is the responsible factor. We observed that more the duration of mobile phone use more will be hearing loss.

**Keywords:** High frequency hearing loss, Mobile use, Audiological evaluation

## INTRODUCTION

In the modern era mobile phone uses is constantly increasing day by day after its commercial availability from 1983. The mobile is an electromagnetic device which works on radiofrequency band, it receives and send signals. In present scenario majority of mobile works on the GSM (Global System for Mobile communication) which is operating at 900 to 1800 MHz frequency band. This electromagnetic emission is within the standard accepted range but its effects on the human body in the long term are still unknown. As mobile phone is communication device in which ear is directly

involved, the whole ear specially inner ear is at most risk because of proximity of the mobile phone which receives EMR (electromagnetic radiation) directly. The delicate hair cells in the organ of Corti does not have regenerative properties, thus damages are often permanent with little chance of recovery in advanced stages. Hair cells are known to be sensitive to chronic exposure to loud noise.<sup>1</sup> Therefore, the ear is at risk of exposure to noise from the mobile phone as well as the electromagnetic radiation waves emitted by the phone.<sup>2</sup>

In the past many studies were done to evaluate the effect of EMR on hearing however conclusion was not

confirmative.<sup>3-5</sup> More over effect of EMR on higher frequency that is above 8000 Hz is less investigated. General PTA are assessing hearing from 250 to 8000 Hz thus in this study we assesses not only the impact of mobile phone usage of the frequencies above 8 to 16 kHz in a multicultural society but also the effect of duration of usage in terms of minutes per day and years of usage of mobile phone.

## METHODS

The study was a cross sectional observation study conducted at SSIMS (Shri Shankaracharya Institute of Medical Science) Junwani Durg Chhattisgarh. In this study we selected tertiary level centre students for hearing evaluation including higher frequency in chronic mobile user. The study was conducted from April 2019 to July 2019.

### Inclusion criteria

Volunteers from medical college students between 20 years to 30 years of age were included in the study. They were using mobile phone for more than an hour per day for a year.

### Exclusion criteria

Following candidates were excluded from the study having history of chronic ear disease, history of recent upper respiratory infection, exposure to loud noise, history of any chronic medication and past illness.

### Ethical committee clearance

Permission from ethical committee was taken, written and informed consent taken from volunteers prior to the test.

### Procedure

Since mobile uses are so wide among every people, non-users could not found. Majority of individuals uses mobile phone in one ear only depends on dextricity is called dominant ear and less used ear as non-dominant ear. Dominant ear will be considered as study ear and non-dominant ear as control group.

Standard questionnaires were prepared for the volunteers in whom average duration of their daily use of mobile phone and their dominant ear was asked. Detailed history was asked about the ear nose and throat complaints. Detailed ear nose and throat examination was done by ENT surgeon, otoscopic examination was done to see clear External auditory canal and normal tympanic membrane. After confirmation the high frequency hearing test was performed by an experienced audiologist at frequencies of 250, 500, 1,000, 2,000, 4,000, 8,000, 10,000, 12,000, 14,000 and 16,000 Hz. Subjects were considered to have normal hearing if verified by Pure Tone audiometry to have no loss

exceeding 20 dB between 250 and 16,000 Hz and classified as having hearing loss if any of the hearing thresholds are above 20 dB between 250 and 16,000 Hz. In this study audiologist was not aware about the non-dominant and dominant ear. Audiogram result was assessed in the form of dB loss at particular frequency.

## RESULTS

After screening of volunteers 200 students were included in the study. Among the 200 subjects male candidates were 118 and female candidates were 82 (Table 1). Age of the volunteers was between 20 years and 30 years. After careful assessment of audiogram obtained from the volunteers segregation done in two groups, one with no hearing loss and other with hearing loss. 69% of total volunteers had no hearing impairments that is 138 volunteers where as 31% had hearing impairments that is 62 volunteers (Table 2). This hearing impairments was more than 20 dB in 10000 to 16000 Hz frequency, lower frequency was not affected (Table 3). If we compare these two groups, the age of group having hearing loss was near 30 years. The duration of mobile phone use was up to 3-4 hours per day sometimes continuous and sometimes with some gap between uses. Hearing loss group is having more long duration of mobile phone use compare to the non-hearing loss volunteers (Table 4). These subjects were not aware about their hearing impairments as the hearing impairment is belong to the higher frequency and routine audiometry does not pick them.

Dominant ear was having more hearing impairment then the non-dominant ear may be because of volunteers were habitual to use mobile phone in that particular ear depends on their dexterity getting more exposure of EMR (Table 5).

**Table 1: Male and female ratio (n=200).**

| Gender | N (%)    |
|--------|----------|
| Male   | 118 (59) |
| Female | 82 (41)  |

**Table 2: Hearing loss (n=200).**

| No hearing impairments (%) | Hearing impairments (%) |
|----------------------------|-------------------------|
| 138 (69)                   | 62 (31)                 |

**Table 3: The frequency of specific hearing loss among the symptomatic hearing loss.**

| Frequency (kHz) | No of volunteers with hearing loss | %     |
|-----------------|------------------------------------|-------|
| 10              | 12                                 | 19.35 |
| 10 and 12       | 33                                 | 53.22 |
| 10,12,14        | 52                                 | 83.8  |
| 10,12,14,16     | 62                                 | 100   |

**Table 4: Duration of mobile use daily and years of uses.**

|   | Hearing status (N)    | Average |
|---|-----------------------|---------|
| <b>Usage (min/day)</b>                      | No hearing loss (138) | 30      |
|   | Hearing loss (62)     | >80     |
| <b>Years of mobile phone usages (years)</b> | No hearing loss (138) | 4       |
|   | Hearing loss (62)     | 7       |

**Table 5: Occurrence of hearing loss among the volunteers, sorted by ear preference.**

|                          | Dominant ear | No preference | Total |
|--------------------------|--------------|---------------|-------|
| <b>No hearing loss</b>   |              |               |       |
| Right                    | 80           | 34            | 138   |
| Left                     | 24           |               |       |
| <b>With hearing loss</b> |              |               |       |
| Right                    | 41           | 5             | 62    |
| Left                     | 16           |               |       |

## DISCUSSION

In the modern era due to wide availability of mobile phones, its effect on human body is under screening. Since mobile was invented for auditory communication its effect on ear is more as it is in closest proximity with mobile and receives maximum EMR. Inner ear hair cells are very delicate and venerable for radiation and noise exposure, they can't be regenerated once damage.

In the past many studies were done to assess the effect of mobile phone on hearing. In one study in beginning era of mobile uses when control group of non-users were present shows difference in threshold between users and non-users though it was within the normal limit.<sup>3</sup> Other study also suggested that impairments of hearing in frequency between 500-4000 Hz were present.<sup>4</sup> In contrast to this study another study described no effect on hearing after 10 minutes exposure of mobile phone uses. But in our study our aim was to see the effect of chronic exposure of mobile radiation on hearing.

Mobile phones generate electromagnetic radiation in two ways. First, from the antennae that are present around our towns and secondly from the telephones themselves. Present international standards permit GSM 900 mobile phones to transmit at a pulsed power of 2 W with an average output of 0.25 W.<sup>6</sup> Mobile phones have been found to generate electromagnetic radiation well below the guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP).<sup>7</sup> In a study it has been observed that the radiofrequency emitted by mobile phones are not powerful enough to create a mutation at the DNA level. In recent time multiple studies had been done about the effect of mobile phone radiation on

human body but there is no long term study available because wide spread use of mobile was started after the 1990. In recent time children are getting more and more mobile phone exposure in the form of online gaming, carton, movies etc. but there are very less study available to the effect of radiation on them.<sup>8</sup> Theoretically they are more vulnerable for radiation as their bones are thin with less density.

The most common cause of sensory neural hearing loss is loud sound in which higher frequency is affected first because base of the cochlea process high frequency and the apex low frequency. Repeated exposure of loud sound is responsible for damage to the hair cells leading to deafness. At the time of mobile phone use it remains approximately 3 cm away from the inner ear hair cells. The electromagnetic radiation emitted from the mobile is within the accepted range and we do not know what factor is responsible for hair cells damage on chronic uses. Unfortunately there has been no easy way for researchers to access and study the hair cells.

Study suggested that EMR absorption is maximum on the side of mobile phone held and it decreases to one tenth on opposite side.<sup>7</sup> The ear which is frequently used by the individual is called dominant ear. In this study we found that the dominant ear is having significant hearing impairments then the non-dominant ear. It has been observed that longer the duration of use the more significant the hearing loss will be, the total use may be daily use or use for years.

## Limitation

In our study few limitation has been observed, we need to do it on more numbers on larger population, because of wide spread use of mobile control group could not found, subject included in the study need to follow-up for longer period for documentation and to see effect on hearing, and because of difficulty in access of hair cell, study could not evaluate the effect at the level of hair cells.

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

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