

Hearing Loss Among Excessive Mobile Phone Users; A Cross Sectional Study At Bahawal Victoria And Civil Teaching Hospitals Bahawalpur

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ABSTRACT

Objective: To assess the hearing loss among the subjects using excessive mobile phone.

Methodology: 50 subjects were entered for this study with age ranging from 20 to 40 years using mobile phone for more than 5 years. 25 subjects who used mobile phone for less than (<) 60 min /day formed one group, while 25 subjects who used cell phone for more than (>) 60 min /day formed the second group. The hearing levels of all the subjects were tested using Pure Tone Audiometry (PTA). Duration of mobile phone usage was assessed by questionnaires.

Results: There was a significant increase (*p*-value .00006) in the hearing thresholds at all frequencies in air conduction and bone conduction in right ear in test group compared with the control group. Similar result was found in the left ear except for bone conduction at frequency 4 and 6 (kilo hertz) kHz. Excessive use of mobile phone caused Sensory neural hearing loss and the prevalence was 84% in group who used mobile phone for > 60 min / day and 20% in group who used for < 60 min / day.

Conclusion: Excessive use of mobile phone may cause increase in pure tone threshold associated with the duration of usage. The use for more than 5 years with more than 60 minutes daily can produce harmful effects on human hearing.

Key Words:: Mobile phone, Hearing loss, Hearing threshold, Pure tone Audiometry

INTRODUCTION:

Mobile phone as a communication tool has become an indispensable necessity of our life these days. At the end of 2011 there were 6 billion people using mobile phones calculated by the international telecommunication union which is equal to 87% of the world population and according to this survey Pakistan is 5th in the Asia and 8th in top ten countries worldwide in mobile phone subscribers. The figure of mobile phone users in Pakistan is as much as 131 million.

As compared to the ionizing radiations electromagnetic waves of mobile phones cannot break chemical bonds and damage DNA for being less powerful but these are capable of penetrating the skull and can deposit energy up to 4-6cm

deep into the brain. This can result in the increase of tissue temperature up to 0.1°C¹.

Speech frequencies are usually located between 250-8000 Hz. Low frequencies (250-2000 Hz) are hearing noise whereas the high frequencies (2000-8000 Hz) are to understand this². The damage in terms of hearing loss caused by prolonged and persistent noise exposure from chronic mobile use or by electromagnetic waves emitted by the mobile phone is still a matter of controversy².

There are various other medical hazards associated with chronic use of mobile phones like dizziness, lack of concentration, skin burns and hypertension^{3,4}. Different type of cancers like leukemia, lymphoma acoustic neuroma and brain tumors have also been linked with excessive use of mobile phone^{5,6,7}. Neurological diseases like sleep disturbances, epileptic seizures and Alzheimer's disease are also associated in the literature^{8,9}. As ear is the closest organ amongst others to the electromagnetic radiations of mobile phone so it has been a source of deep concern and debate regarding the hazardous effects^{10,11}. A cohort study on 200 subjects shows significant increase in pure tone thresholds among mobile phone users¹². While another study states no significant difference in the thresholds of different audiometric tests between the mobile phone users and those who were not exposed to harmful electromagnetic waves of mobile phones. However increasing trends of abnormal thresholds were noted among those subjects who were exposed to the electromagnetic waves of mobile phone for longer duration and time (> 4 years and > 60 minutes / day)¹³. A study on students using mobile phones with 1 to 2 hours exposure per day reveals the development of headache and tinnitus in few ones while students from other group who used

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mobile phone with duration of 3 to 4 hours per day developed headache tinnitus otalgia and limited high degree of hearing loss¹⁴. Another study showed, no significant difference was noted in the hearing thresholds between dominant (user) and nondominant (non user) ear¹⁵.

We considered it important to conduct a similar pilot study in our setting and the rationale was to establish a relationship between excessive mobile phone usage and hearing loss.

METHODOLOGY:

A total of 50 subjects from 20 to 40 years of age who did not give any subjective complaint of hearing difficulty or discomfort in the history were included in this study. The sampling technique was non-probability convenience type.

The inclusion criteria was all those subjects who were using mobile phones for more than 5 years after taking informed consent from them. Out of the 50 subjects taken, 25 were those who used mobile phones for more than 60 min / day, placed in one group and 25 subjects who used mobile phone for less than 60 min / day in the second group. All these patients were healthy attendants coming to the ENT Department.

Exclusion criteria were all those subjects who gave history of ?Hypertension, Diabetes Mellitis, use of ototoxic drugs, recent ear nose and throat infection, Noise-induced hearing loss (with history of occupational exposure), smoking, tobacco chewing and any known cardiovascular disease.

A questionnaire was designed and used for data collection. Questions were asked from the subjects according to the proforma after taking their written informed consent. Pure-tone audiometry (PTA) was performed on these subjects in a sound proof room to assess the hearing threshold of each ear. Air conduction thresholds were measured and plotted on a graph for tones of 250, 500, 1000, 1500, 2000, 4000, 6000, and 8000Hz and bone conduction thresholds for 250, 500, 1000, 1500, 2000, and 4000 Hz and an audiogram was achieved after plotting the graph. Bone conduction thresholds were the measure of cochlear function of that side. The difference in the thresholds of air and bone conduction (A-B gap) was a measure of degree of conductive deafness. All the collected data was analyzed by using SPSS version 10 software. Odds ratio was calculated and statistical test of significance (chi square) was applied.

RESULTS:

The mean age among the subjects of group using mobile phone for >60 min /day was 24.2 ± 1.5 years and among those in the group using mobile phone for <60 min /day was 29.2 ± 2.1years. In both the test and control groups male subjects were more than females with 80% in the test and 72% in control group. 83% of the subjects were having right ear dominance than left who were 17 % in both the groups. A significant increase (p-value .00006) was observed in the hearing thresholds at all frequencies in air and bone

conduction in right ear in the first group subjects who used mobile phone for >60 min / day in comparison with the second group subjects with <60 min / day use (Table 1). Similar significant increase in the thresholds (in db) at all frequencies in air and bone conduction was noted in left ear except for bone conduction at frequency of 4 and 6 KHz

| Threshold | Subjects who use > 60 min/day | Subjects who use < 60 min/day |
|--|-------------------------------|-------------------------------|
| Normal (<25dB hearing threshold) | 4 | 20 |
| Hearing loss (<25dB hearing threshold) | 21 | 5 |
| Total | 25 | 25 |

Table 1: Relationship between hearing threshold increase and duration of daily mobile phone use

| Frequency in Hz | Mean Air Conduction Threshold in db | | Mean Bone conduction Threshold in db | |
|-----------------|-------------------------------------|-------------|--------------------------------------|-------------|
| | >60 min/day | <60 min/day | >60 min/day | <60 min/day |
| Left Ear | | | | |
| 250 | 15.0 ± 3.81 | 26.4 ± 4.45 | 9.40 ± 4.44 | 22 ± 5.05 |
| 500 | 18.6 ± 4.3 | 28 ± 4.08 | 13.2 ± 4.17 | 26.5 ± 6.7 |
| 1000 | 19.8 ± 4.39 | 29.8 ± 2.69 | 14.8 ± 3.55 | 26.9 ± 4.30 |
| 2000 | 17 ± 4.39 | 26.2 ± 4.71 | 11.4 ± 4.2 | 24.4 ± 6.17 |
| 4000 | 17.4 ± 11.02 | 35.4 ± 4.45 | 14.60 ± 4.8 | 29.6 ± 2.3 |
| 6000 | 18.± 8.61 | 38.8 ± 6.17 | 15 ± 4.15 | 32.2 ± 2.53 |
| 8000 | 20.8 ± 4.62 | 39.8 ± 6.23 | NA | NA |
| Right Ear | | | | |
| 250 | 14.4 ± 5.46 | 28.4 ± 4.31 | 10.0 ± 3.81 | 24.4 ± 3.33 |
| 500 | 16.4 ± 3.06 | 29.4 ± 2.62 | 13.0 ± 2.5 | 26 ± 3.53 |
| 1000 | 14.6 ± 4.81 | 31.8 ± 6.13 | 12.2 ± 2.53 | 27 ± 4.33 |
| 2000 | 17.2 ± 2.91 | 33 ± 3.53 | 13.4 ± 2.5 | 29 ± 3.81 |
| 4000 | 19 ± 7.2 | 29.8 ± 7.4 | 15.4 ± 3.06 | 24.6 ± 3.90 |
| 6000 | 19.4 ± 9.38 | 33.8 ± 4.05 | 16. 6 ± 3.62 | 28 ± 3.81 |
| 8000 | 24.8 ± 6.09 | 38.8 ± 7.25 | NA | NA |

Table 2: Comparison of Auditory thresholds (Air and Bone conduction) between the two groups

| Complaints | Frequency | Percentage |
|---------------------|-----------|------------|
| Warm sensation | 15 | 30% |
| Aural fullness | 07 | 14% |
| Ringling in the ear | 02 | 4% |
| No complaint | 26 | 52% |
| Total | 50 | 100% |

Table 3: Associated complaints among the subjects under study

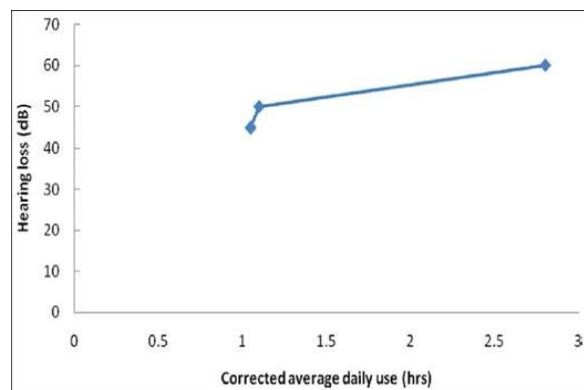


Figure 1. Severity (Degree) of Deafness with daily use of mobile

(Table 2). Three subjects in our study (6%) were found to have moderate to severe sensory neural deafness due to excessive use of mobile phone. First subject was having 45 db hearing loss at 2 KHz with the duration of seven years of mobile phone usage with average of 45 min per day use. Second subject was noted with hearing loss of 50 db at 2 KHz with of 1 hour per day daily use for the last 5.5 years. Third person gave the history of tinnitus and had hearing loss of 60 db at 4 KHz. The mobile phone was used for two hours per day for the period of seven years.

In addition other complaints like aural fullness, warm sensation and ringing sensation were also noted in the long duration mobile phone users (Table 3). The relationship between average use of mobile phone on daily basis and severity of hearing loss was also observed and established (Fig 1). Odds ratio was also calculated which was 21. In other words a person who used mobile phone for more than 60 minutes was 21 times more likely to have increase hearing thresholds than to a person who used mobile phone for less than 60 minutes per day. Chi square test was also applied and calculated value of 20.5 was greater than Critical region of 3.84 so the null hypothesis stating “Mobile phone use for >60 min /day has no effect on hearing threshold” was rejected so it became clear that there was a significant increase in hearing thresholds in the subjects who used mobile phone for >60 minute /day.

DISCUSSION:

Electromagnetic radiations of mobile phone and health issues have been increasingly considered, especially after the remarkable increase in the use of mobile phones throughout the world population. Because of the fact that mobile phones transmit and receive microwave radiations at frequencies of about 900 and 1800 MHz which can excite the rotations of water and organic molecules and eventually attribute to thermal and non-thermal effects¹⁶. The auditory system, especially the outer hair cells of cochlea, is considered highly sensitive against electric and magnetic fields which can generate some kind of hearing sensation¹⁷.

Specific absorption rate (SAR) is the measure of radiation

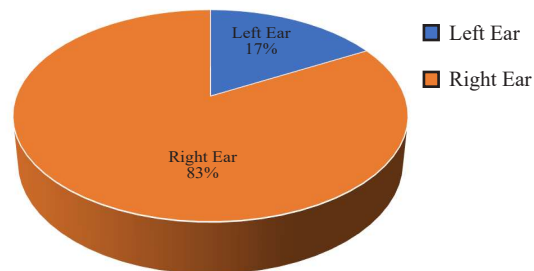


Figure 2. Dominate Ear in Mobile Phone users in Control & Test Group

coming from mobile phone and measured by cellular radiation detectors. By the help of this radiofrequency exposure of mobile phones can be assessed which helps in achieving the safety limits. Because of the closest proximity to the mobile phone, ear is the most susceptible body part for high SAR deposition¹⁸.

The findings of this study are consistent with that of many others mentioned in the literature. Shayani and colleagues have found significant increase in the hearing thresholds among mobile phone users comparing with non-users in a cohort study¹². Another study conducted by Ramaya et al has also shown a significant rise in the hearing thresholds at all frequencies in air and bone conduction for both right and left ear between test and control group except for bone conduction at higher frequencies like 4 to 6 KHz¹⁹. In a research presented at the American academy of otolaryngology head and neck surgery foundation's annual meeting and OTO EXPO in Washington DC, 100 people who were using mobile phones for period of more than a year developed increasing degree of hearing loss mainly at higher frequencies over the period of twelve months. This study also found that people who had used mobile phones for a duration more than 60 minutes a day were having a worse hearing threshold than those who used less².

In one study conducted by Velayutham, Gopala and colleagues in India on 100 subjects assessing high frequency hearing loss among prolonged mobile phone users found significant hearing loss in the dominant ear as compared to the non-dominant ear²⁰.

In our study there is also significant increase in pure tone thresholds of hearing at nearly all frequencies except for bone conduction at high frequencies in left ear (non-dominant ear). Another study conducted on medical students by Youssef et al establishing the relationship between the excessive mobile phone usage and ear problems, has described statistically significant relationship causing gender specific ear problems like vertigo dizziness and tinnitus²¹.

This study also describes some complaints like aural fullness, ringing and warm sensation present in the test group due to long term use of mobile phone along with significant increase in hearing thresholds showing a relationship between mobile

phone use and threshold increase among the subjects using mobile phone excessively. The negative and excessive use of mobile phone by young adults with problematic consequences has also been found by Amita and colleagues in their study at Haryana India²². Similar study is conducted in Dow Medical college, Civil hospital and Jinnah Medical hospital Karachi in which medical related issues including ear problems were inquired from medical practitioners and paramedical staff via questionnaire disclosing different ideas on human health issues caused by excessive mobile phone use²³. Another study conducted in Karachi on teenagers using excessive mobile phone with hand free has described hearing and musculoskeletal problems in them warning the fatal consequences in future²⁴.

The limitations of this study are small sample size and non-consideration of different brands of mobile phones as these differ in their specific absorption ratio (SAR). Further case control or cohort prospective studies should be conducted on larger sample size establishing a cause effect relationship between excessive mobile phone use and prevalence of hearing loss. Furthermore, population-based health education seminars should be arranged in order to aware the public regarding hazardous effects of excessive use of mobile phones.

CONCLUSION:

The incidence of hearing loss in studied population was found to be 84% in group who used mobile phone for >60 min /day and 20% in group using mobile phone for <60 min/day. The severity of the hearing loss looks directly proportional to the duration of the mobile phone use.

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