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Frequent Cell Phone Users have Sensorineural Hearing Loss: An Observational Study

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Abstract **Original Research Article**

***Background*:** Mobile phone use is prevalent, and there have been concerns raised about its long-term safety. Electromagnetic fields from mobile devices can enter the brain and deposit energy as deep as 4-6 cm into the brain, heating the tissue. ***Methods*:** A prospective cross-sectional study carried out at General Hospital, Rangamati during the period from January 2022 to January 2023. The study population includes patients who visit the ENT department at General Hospital, Rangamati and have used mobile phones for three years or more. Participants who were uninterested in the study, respondents with a history of ear disease, respondents with a history of loud noise exposure, or students who used headphones for entertainment reasons for more than 1 hour per day were also excluded. ***Results*:** The majority of participants (42.47%) had been exposed to mobile phone use for 4-5 years, whereas 26 (42.47%) had been exposed for 3 years and 16 (21.92%) for >5 years. Nearly three-fourths (31.51%) of the subjects had exposure to mobile phones for two to three hours each day, whereas 12 (16.44%) of the patients had more than three hours. For the right and left ears, respectively, pure tone averages of 13.695.64 dB and 14.375.49 dB were discovered. 5 dB loss was observed in 25.0%, 10 dB loss in 12.5%, and 15 dB loss in 12.5% of participants who used mobile phones for more than three hours each day. ***Conclusion*:** The OAE results of all respondents were normal. We also discovered that none of the participants in our study experienced significant hearing loss (greater than 25 dB). As the young population gets increasingly attached to this expensive multipurpose device, mobile phones may become a risk issue in the near future.

Keyword: OAE, sensorineural hearing loss, cell phone users.

INTRODUCTION

Mobile phones have become an indispensible component of our daily lives. As the number of base stations and wireless local area networks grows, so does concern about potential health risks from radiofrequency fields emitted by these wireless technologies [1].

Microwave radiation from mobile phones, which is sent and received at frequencies between 800 and 2000 MHz, has thermal and non-thermal effects on people by causing water molecules and some organic molecules to rotate. Headache, ear burning or warmth, a burning sensation in the skin of the face, and alterations in the blood-brain barrier are only a few of the thermal effects of mobile phones that have been reported. Hearing may be the most vulnerable organ to both thermal and nonthermal impacts because of how close the auditory system is to the mobile phone [2]. It would appear from the results of an increasing number of research on the effects of microwave radiation from cellular phones and base stations that this radiation is not statistically dangerous [3].

Hearing loss is a normal aging condition that is most typically noticed in the elderly, but it is now also widespread in younger people due to the frequent use of mobile phones and headphones [4]. Music has long been a popular kind of entertainment, whether for dances, concerts, gatherings, or radio broadcasts. The genres and styles of music are numerous, as are the enthusiasts and lovers of music. Music listeners have increased dramatically, thanks to advancements in technology such as radios, mp3 devices, and music in cell phones. The trend has moved from speakers to earphones/headphones, allowing students with hectic job schedules to listen to music during free hours, while traveling, or for stress relief [4]. However, the consequences of music-induced hearing loss are rarely discussed. When humans are subjected to hazardous

noise for an extended period of time, the hair cells in the inner ear are destroyed, resulting in noise-induced hearing loss [5].

MATERIALS AND METHODS

A prospective cross-sectional study carried out at General Hospital, Rangamati during the period from January 2022 to January 2023. The population of study contains the patients who attend the ENT department of the General Hospital, Rangamati within age group of >18 to 30 years and using mobile phones for three years or more. Participants not interested for the study, respondent 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. Respondent 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 was 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 respondents 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 participants 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 the frequently used dominant ear was. The audiograms were examined for the type and percentage of hearing loss. SPSS software version 25 is used for evaluation of the results.

RESULTS

More than half (52.0%) subjects belonged to age 21-30 years with mean age was found 20.2±3.8 years. Majority (60.27%) were male and 29(39.73%) were female. Male female ratio was 1.5:1 (Table-1). Majority (16.44%) subjects had tinnitus followed by 4(5.48%) had far fullness, 3(4.11%) had ear discomfort and 3(4.11%) had vertigo (Table-2). Majority (42.47%) subjects had 4-5 years of exposure, 26(42.47%) had ≤3 years and 16(21.92%) had >5 years exposure to mobile phone used (Table-3). Almost three fourth (31.51%) subjects had 2-3 hours of exposure, 19(26.03%) had <1 hour, 19(26.03%) had 1-2 hours and 12(16.44%) had >3 hours exposure to mobile phone used per day (Table-4). Pure tone average was found 13.69±5.64 dB and 14.37±5.49 dB for right and left ears respectively (Table-5). Out of 5 subjects who had hearing loss, 1 used mobile phones for 2-3 hour and 4 used mobile phones for >3 hours per day. Using mobile phones 2-3 hours daily 5 dB loss in 6.25%. Among subjects using mobile phones >3 hours daily, 5 dB loss was noted in 25.0%, 10 dB loss in 12.5% and 15 dB loss in 12.5% (Table-6).

Table 1: Demographic characteristics of the study participants (n=73)

Demographic characteristics	Frequency	Percentage
Age (years)		
≤20	35	47.95
21-30	38	52.05
Mean±SD	20.2±3.8	
Sex		
Male	44	60.27
Female	29	39.73

Table 2: Symptomatology of the study participants (n=73)

Symptomatology	Frequency	Percentage
Tinnitus	12	16.44
Ear fullness	4	5.48
Ear discomfort	3	4.11
Vertigo	3	4.11

Table 3: Duration of mobile phone usage of the study participants (n=73)

Duration of mobile phone usage (years)	Frequency	Percentage
≤3	26	35.62
4-5	31	42.47
>5	16	21.92

Table 4: Average daily exposure of mobile phone usage of the study participants (n=73)

Average daily exposure of mobile phone usage (hours)	Frequency	Percentage
<1	19	26.0
1-2	19	26.0
2-3	23	32.0
>3	12	16.0

Table 5: Average pure tone in right and left ear of the study participants

	Right	Left
	Mean±SD	Mean±SD
Average pure tone	13.69±5.64	14.37±5.49

Table 6: Relationship between hours of exposure and degree of hearing loss among the study participants

Average daily exposure of mobile phone usage (hours)	Frequency	dB loss	Percentage
2-3	1	5	6.25
	2	5	25.0
>3	1	10	12.5
	1	15	12.5

DISCUSSION

In this study observed more than half (52.05%) subjects belonged to age 21-30 years with mean age was found 20.2±3.8 years. Majority (60.27%) were male and 29(39.73%) were female. Male female ratio was 1.5:1. Hegde *et al.,* [6] observed that age group of 18 to 30 years. Thomas *et al.,* [7] also reported similar observation they showed the mean age of the students were 20.6±1.55 years, ranging from 17 to 26 years. 65.5% were females and 34.5% males. Sahoo and Sebastian observed mean age was found 32 years with range from 20 to 45 years. Their study consisted of 62 male participants and 38 female participants [8]. Madane *et al.,* observed the mean age was 23.35±2.99 years [9].

Current study showed the majority (16.44%) subjects had tinnitus followed by 4(5.48%) had far fullness, 3(4.11%) had ear discomfort and 3(4.11%) had vertigo. Madane *et al.,* [9] reported heating sensation of ears (27%) followed by blocked sensation in ears (16%), tinnitus (10%) and difficulty in hearing (4%). Al-Khlaiwi and Meo [10] percentage for presenting complaints were headache (21.6%), sleep disturbance (4%), tension (3.9%), fatigue (3%) and dizziness (2.4%). Srinivasa *et al.,* [1] reported 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.

In this study showed majority (42.47%) subjects had 4-5 years of exposure, 26(42.47%) had ≤3 years and 16(21.92%) had >5 years exposure to mobile phone used. Srinivasa *et al.,* [1] reported 33 subjects had three years of exposure, 42 had four years of exposure and 25 had 5 years of exposure to mobile phones. Madane *et al.,* [9] observed mean period of exposure to mobile phones was 2.47±0.65 years. Jadia *et al.,* [2] reported maximum 233 (46.6%) subjects were using mobile since last 4–6 year and 134 (26.8%) were using mobile since last 7–9 year.

In this study showed that almost three fourth (31.51%) subjects had 2-3 hours of exposure, 19(26.03%) had <1 hour, 19(26.03%) had 1-2 hours and 12(16.44%) had >3 hours exposure to mobile phone used per day. Srinivasa *et al.,* [1] reported 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. Sahoo and Sebastian observed duration of mobile phone use ranged from 5 min to 120 min per day [8]. Madane *et al.,* [9] reported 48(40%) subjects had 1 – 2 hours of exposure, 48(40%) had 2 – 3 hours and 24(20%) had 3 – 4 hours exposure to mobile phone per day. Jadia *et al.,* [2] reported maximum 344 (68.8%) subjects were using mobile 1–3 h/day and 145 (29.0%) were using mobile 4–6 h/day.

In this study observed pure tone average was found 13.69±5.64 dB and 14.37±5.49 dB for right and left ears respectively. Similar observation was found Madane *et al.,* [9] reported pure tone average right ears was found in 13.71±5.61 dB and left ears in 14.5±5.44 dB. Thomas *et al.,* [7] reported out of 420 students participated, 120 audiometry and OAE was done, in that high frequency hearing loss was considerably less than anticipated, as no individuals had hearing loss at 1k or 2k, but 0.8% (right ear) dip 1.7% (left ear) was seen in 4K. In 8 K 1.7% (right ear) and 2.5% (left ear) was seen. The other findings were for low frequencies that is for 250Hz (Right/Left ear) 5% and 500Hz, right ear with 12.5% loss, and left ear 7.5% loss.

In this study showed out of 5 subjects who had hearing loss, 1 used mobile phones for 2-3 hour and 4 used mobile phones for >3 hours per day. Using mobile phones 2-3 hours daily 5 dB loss in 6.25%. Among subjects using mobile phones >3 hours daily, 5 dB loss was noted in 25.0%, 10 dB loss in 12.5% and 15 dB loss

in 12.5%. Jadia *et al.*, [2] reported hearing loss was found in 9 (1.8%) cases and 491 (98.2%) were normal. Philip *et al.*, [11] observed among participants who used mobile phones for 0–1 h daily, 5 dB hearing loss was noted in 1 participant, whereas 5 dB hearing loss was noted in 4 participants among those using mobile phones for 2–3 h daily and 5 dB hearing loss is noted in only 1 participant among those using mobile phones for 3–4 h daily. Bisaria *et al.*, [12] reported sensorineural hearing loss was seen among 7 in group I (>1 hour per day), 3 in group II (<1 hour per day) and 1 in group III (<1 hour per week). Side was left cases 3 and 2 in group I and II respectively. Side was right cases 4, 1 and 1 in group I, II and III respectively. The difference was significant (P< 0.05). Srinivasa *et al.*, [1] reported 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. Hegde *et al.*, [6] observed a minimal hearing loss of 5 to 15 dB among mobile phone users but did not show any significant hearing loss. Panda *et al.*, [13] evaluated audiological disturbances in chronic mobile phone users. The subjects in their study showed high frequency hearing loss. In a study conducted by Sahoo *et al.*, [8] 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. Oktay *et al.*, [14] to study the effect of mobile phone radiations on the hearing showed higher degree of hearing loss among mobile phone users. Karthikeyan *et al.*, [15] conducted a study to evaluate hearing in mobile phone users. 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. Ramya *et al.*, [16] concluded that longer duration of mobile usage was associated with significant increase in hearing threshold. Another study Joshi *et al.*, [17] showed increased auditory threshold shift in the frequently used ear among mobile phone users. Davidson *et al.*, [18] concluded that mobile phone usage has no effect on the auditory and vestibular system. Chander *et al.*, [19] conducted a study to determine the physical and functional effect of mobile phone usage on ear and the hearing pattern among mobile phone users. It was observed that a hearing loss less than 15 dB was in the subjects using mobiles. Sahoo and Sebastian observed the duration of mobile phone use was 7 years with an average daily use of 45 min per day [8]. Second subject had hearing loss of 50 dB at 2000 Hz with duration of use of 1 h per day for the last 5.5 years. Third person complained of tinnitus and had 60 dB hearing loss at 4000 Hz. The mobile phone use was 2 h per day for 7 years [8].

CONCLUSION

OAE and pure tone audiometry were performed on all chronic mobile users who utilize their right ear as their dominant ear. All of the responders' OAE results were normal. We also discovered that none of the people in our study had major hearing loss (more than 25 decibels). However, we discovered a minor hearing loss in individuals who used mobile phones for more than two hours every day. As a result, this study cannot reach a firm conclusion about the negative effect of mobile phones on hearing. Mobile phones may become a risk issue in the near future as the young population becomes increasingly addicted to this expensive multipurpose equipment. As a result, a long-term follow-up study with a large population is needed.

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