

Prolonged Mobile Phone Usage and Hearing Status in Medical Students: A Cross-Sectional Study**Antarikhya Borah¹, Shiv Shanker Kaushik², Richa Gupta³, Kashmira Kumawat⁴**¹Resident, Department of ENT, PMCH, Udaipur, Rajasthan, India²Associate Professor, Department of ENT, PMCH, Udaipur, Rajasthan, India³Professor and HOD, Department of ENT, PMCH, Udaipur, Rajasthan, India⁴Assistant Professor, Department of ENT, Sundar Lal Patwa Government Medical College, Madhya Pradesh, India

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Conflict of interest: Nil

Abstract

Background: With the rapid proliferation of mobile phones, their impact on health, particularly auditory function, has garnered increasing attention. Prolonged exposure to electromagnetic radiation, acoustic overload, and thermal effects from mobile phone use may pose risks to hearing, especially among young adults who are frequent users. Previous studies have reported mixed findings on the association between mobile phone usage and hearing loss, with some highlighting high-frequency hearing impairments in the dominant ear. This study investigates the impact of prolonged mobile phone usage on hearing thresholds in medical students, emphasizing differences in air and bone conduction across frequencies.

Objective: To evaluate the effect of prolonged mobile phone usage on hearing status and to determine the correlation between the duration of mobile phone use and auditory function.

Methodology: A total of 146 medical students were included for a prospective observational study was conducted at ENT Department, PMCH, Udaipur, over a period of 1 year between March 2024 and Feb 2025 to explore the relationship between mobile phone usage and hearing status in medical students.

Result: The study revealed that prolonged mobile phone usage (>60 minutes daily) was significantly associated with mild hearing loss in the right ear, commonly used for calls. Among prolonged users, 40% exhibited mild hearing loss in the right ear compared to only 1% among short-duration users (<60 minutes daily) ($p < 0.0001$). Air conduction thresholds showed significant elevation at 4000 Hz, with the left ear exhibiting higher thresholds than the right ($p < 0.0001$). Bone conduction thresholds also showed significant differences at specific frequencies, particularly 250 Hz ($p = 0.038$) and 4000 Hz ($p = 0.004$). The findings suggest that prolonged mobile phone usage contributes to high-frequency hearing impairment, particularly in the dominant ear.

Conclusions: Prolonged mobile phone usage is linked to mild high-frequency hearing loss, especially in the dominant ear commonly used for calls. This study emphasizes the potential auditory health risks associated with extended mobile phone use and underscores the importance of preventive strategies, such as limiting call duration and promoting hands-free devices, to safeguard hearing among frequent users.

Keywords: Mobile Phones, Hearing Loss, Medical Students, Audiometric Assessment, Prolonged Usage.

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Introduction

In the contemporary era, mobile phones have become ubiquitous tools, integral to academic, social, and professional communication, particularly among young adults and students [1]. With a significant increase in the use of smartphones, concerns have grown regarding their potential adverse health effects, especially on auditory health. Mobile devices emit electromagnetic radiation and can facilitate exposure to loud audio, which may contribute to noise-induced hearing loss (NIHL), a prevalent yet

preventable form of sensorineural hearing impairment [2]. Young adults, including medical students, often engage in prolonged usage of mobile phones for various activities such as listening to music, attending online classes, and social media interactions. Such activities can involve exposure to high volume levels for extended periods, potentially damaging delicate cochlear structures responsible for hearing [3]. Despite the widespread use, there exists limited empirical data on the specific impact of

prolonged mobile phone usage on the hearing health of this demographic group. Previous studies have indicated that exposure to noise levels above 85 dB for prolonged periods may lead to temporary or permanent hearing threshold shifts [4]. Mobile devices, when used at high volumes, can contribute to similar risk levels, especially in young individuals who may perceive themselves as resilient to auditory damage. Additionally, the informal nature of mobile listening environments and personal habits—such as use in noisy settings and during sleep—may exacerbate this risk [1].

Given the increasing dependence on mobile technology among medical students—a population characterized by high academic pressure and extensive device use—it is pertinent to investigate whether prolonged mobile phone usage influences hearing health within this group. Early detection of hearing impairments can prevent progression and inform preventive strategies. Therefore, this study aims to evaluate the association between the duration of daily mobile phone use and hearing status among medical students, utilizing audiometric assessments to identify early signs of hearing impairment.

Materials and Methods

Study Design and Setting: A prospective observational study was conducted at ENT Department, PMCH, Udaipur, over a period of 1 year between March 2024 and Feb 2025 to explore the relationship between mobile phone usage and hearing status in medical students. Informed consent was taken from all participants.

Study Population: A total of 146 medical students were recruited.

Inclusion criteria included:

- Medical students aged 18 to 32 years.
- Regular use of mobile phones for more than 5 years.
- Consent to participate in audiometric testing.

Exclusion Criteria Included:

- No previous infective ear pathology
- Pre-existing systemic illness (diabetes, Hypertension, family history of hearing loss)
- History of loud noise exposure.
- History of ototoxic drug intake.
- Not willing to participate in study.

Clinical Assessment Procedure: Each participant underwent a detailed history with meticulous physical examination of the ear followed by Audiometric tests. Hearing thresholds were measured using a calibrated pure-tone audiometer in a soundproof room. Participants underwent testing at six frequencies: 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz. Results were categorized based on the World Health Organization (WHO) classification:

Normal: 0-25 dB HL.

Mild Hearing Loss: 26-40 dB HL.

Moderate Hearing Loss: 41-60 dB HL.

Data were anonymized and compiled for analysis.

Results and Discussion

The study included 66 females (45.20%) and 80 males (54.79%), with an average age of 25 years (± 2 years). The majority of participants reported using mobile phones for more than 60 mins daily.

Participants reported an average daily usage of 3.8 hours (± 1.2 hours), with 87(59.5%) frequently using earphones. Music and video streaming comprised 40% and voice calls accounted for 35% of total usage.

Audiometric assessments revealed:

Normal hearing thresholds:

- Right ear-114
- Left ear-32

Mild hearing loss:

- Right ear-141
- Left ear- 5

Table 1: Comparison of right side and left side with usage of mobile phone duration using Puretone audiometry.

Pure Tone Audiometry	<60 min (N %) N=69	>60 min (N %) N=77	Total (N %) N=146	X ² - value	p-value
Right side					
Normal	68(99.0)	46(60)	114(78)	29.8	<0.0001
Mild	01(1)	31(40)	32(21.9)		
Left side					
Normal	68(99.0)	73(95)	141(96.5)	0.62	0.431
Mild	01(1)	4(5)	5(3)		

Table 2: Comparison of air conduction by pure tone audiometry between right and left ear among the candidates

Air conduction Frequency (Hz)	Right Ear Mean \pm SD (N=146)	Left Ear Mean \pm SD (N=146)	t-value	p-value
250K	22.80 \pm 9.10	21.90 \pm 8.70	1.2	0.230 (ns)
500K	15.50 \pm 6.90	15.20 \pm 6.30	0.74	0.460 (ns)
1000K	16.40 \pm 7.10	15.90 \pm 5.20	1	0.320 (ns)
2000K	20.00 \pm 13.80	20.50 \pm 13.40	-0.8	0.420 (ns)
4000K	21.00 \pm 12.30	26.50 \pm 8.50	-4	0.000***
8000K	19.50 \pm 6.50	20.00 \pm 8.10	-0.7	0.487 (ns)
Pure Tone Audiometry	18.50 \pm 6.10	17.50 \pm 5.20	1.4	0.160 (ns)

Table 3: comparison of bone conduction by pure tone audiometry between right and left ear among the candidates

Bone conduction Frequency (Hz)	Right Ear Mean \pm SD (N=146)	Left Ear Mean \pm SD (N=146)	t-value	p-value
250K	20.00 \pm 6.80	18.50 \pm 8.50	2.1	0.038*
500K	20.00 \pm 6.00	19.30 \pm 6.50	0.95	0.343 (ns)
1000K	19.70 \pm 5.90	18.90 \pm 6.60	1.15	0.250 (ns)
2000K	19.30 \pm 5.80	18.60 \pm 6.30	0.97	0.330 (ns)
4000K	20.20 \pm 5.60	22.80 \pm 8.50	-2.9	0.004***
8000K	25.50 \pm 13.80	24.00 \pm 9.30	1.2	0.230 (ns)
Pure Tone Average	19.80 \pm 6.10	18.90 \pm 6.40	1.3	0.190 (ns)
Air Bone Gap	7.50 \pm 4.40	7.80 \pm 2.50	-1	0.318 (ns)

Hearing Status Comparison between Short and Prolonged Mobile Phone Users: The analysis of hearing status revealed significant differences between short-duration users (<60 minutes daily) and prolonged users (>60 minutes daily). In the right ear, 99% of short-duration users exhibited normal hearing, compared to only 60% among prolonged users. Conversely, mild hearing loss was observed in 1% and 40% of short and prolonged users, respectively, a difference that was statistically significant ($\chi^2 = 29.80$, $p < 0.0001$). For the left ear, 99% of short-duration users and 95% of prolonged users exhibited normal hearing, while mild hearing loss was noted in 1% and 5%, respectively. However, this difference was not statistically significant ($\chi^2 = 0.62$, $p = 0.431$). These findings align with the study by Prajapati et al. (2015)[5], which reported a significant association between prolonged mobile phone usage and mild hearing loss, especially in the dominant ear. Similarly, Velayutham et al. (2014)[6] identified high-frequency hearing loss in the dominant ear among mobile phone users, supporting our observation of right-ear vulnerability in prolonged users. However, Srinivasa et al. (2020) [7] found no significant association between prolonged usage and hearing impairment, highlighting variability in outcomes across studies.

Air Conduction Thresholds across Frequencies: Air conduction thresholds varied notably between the right and left ears, with the most significant difference observed at 4000 Hz. The mean threshold at this frequency was higher in the left ear (26.50 \pm 8.50 dB) compared to the right ear

(21.00 \pm 12.30 dB), and the difference was statistically significant ($t = -4.00$, $p < 0.0001$). However, other frequencies (250 Hz, 500 Hz, 1000 Hz, 2000 Hz, and 8000 Hz) did not show significant differences between ears, with p-values ranging from 0.230 to 0.487. The mean pure tone audiometry average was slightly higher for the right ear (18.50 \pm 6.10 dB) than the left ear (17.50 \pm 5.20 dB), but this was not statistically significant ($t = 1.400$, $p = 0.160$). These results align with Gaur and Chandel (2019)[8], who noted a significant increase in high-frequency thresholds in the dominant ear, with thresholds correlating with duration of mobile phone usage. However, the systematic review by Auvinen et al. (2021)[9] did not find consistent evidence linking mobile phone use to high-frequency hearing loss, emphasizing variability in findings due to differences in study design and participant demographics.

Bone Conduction Thresholds across Frequencies: Bone conduction thresholds showed a statistically significant difference at 250 Hz, with the right ear (20.00 \pm 6.80 dB) having higher thresholds than the left ear (18.50 \pm 8.50 dB) ($p = 0.038$). At 4000 Hz, the left ear exhibited higher thresholds (22.80 \pm 8.50 dB) compared to the right ear (20.20 \pm 5.60 dB), which was also significant ($t = -2.900$, $p = 0.004$). Other frequencies and the pure tone average did not show significant differences between ears, with p-values ranging from 0.190 to 0.343. The air-bone gap was marginally higher in the left ear (7.80 \pm 2.50 dB) compared to the right ear (7.50 \pm 4.40 dB), but the

difference was not statistically significant ($t = -1.000$, $p = 0.318$).

These findings correspond with Velayutham et al. (2014), who reported a statistically significant difference in bone conduction thresholds at higher frequencies among prolonged mobile phone users. The localized elevation of thresholds in the dominant ear suggests potential cochlear damage or fatigue due to extended exposure to mobile phone use, as noted in prior studies.

Mechanisms and Implications: The observed high-frequency hearing loss, particularly in the dominant ear, may be attributed to several mechanisms. Electromagnetic radiation (EMR) from mobile phones can impact cochlear hair cells, while acoustic overload from prolonged calls may lead to cochlear fatigue. Thermal effects, arising from extended device use, may also contribute to subtle inner ear damage. The findings of this study underscore the importance of limiting mobile phone usage to reduce auditory risks. Young adults, who are typically heavy users, should adopt preventive strategies, such as using hands-free devices, limiting call durations, and undergoing regular audiometric evaluations to detect early hearing impairments.

Conclusion

The results of this study demonstrate that prolonged mobile phone usage (>60 minutes daily) is associated with a higher prevalence of mild hearing loss in the right ear, which is commonly used for mobile phone calls. While air conduction thresholds at high frequencies (particularly 4000 Hz) were significantly higher among prolonged users, other frequencies and bone conduction thresholds did not show consistent significant differences between the groups. These findings suggest that high-frequency hearing loss in the dominant ear may be an early indicator of auditory

damage due to prolonged exposure to mobile phone usage.

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