

## Prevalence of sensorineural hearing loss among medical students who are chronic mobile phone and earphone users in Trivandrum, South Kerala, India

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### Abstract

**Introduction:** Hearing loss occurs as age increases, but these days seen affecting young adults as well. This could be due to the current increasing trend of chronic usage of personal listening devices (PLDs) such as mobile phones and earphones, which causes damage to the inner hair cells of the ear.

**Objectives:** To study the prevalence of chronic PLD users among medical students and to assess the proportion of sensorineural hearing loss among them. To assess the perceived effects of listening to PLDs among chronic and non-chronic users of PLDs in medical students.

**Materials and Methods:** A cross sectional study was done among 420 medical students of Dr. Somervell Memorial CSI Medical College in 2016. Basic information was collected from each student using a self administered predesigned and pretested questionnaire and chronic users were selected and subjected to pure tone audiometry and otoacoustic emissions (OAE).

**Results:** Of the 420 students consented for the study, 44% were chronic users of PLDs. 120 students were subjected to audiometry and OAE. The total prevalence of sensorineural hearing loss was found to be 5% with high frequency hearing loss and 18.3% for low frequency hearing loss OAE results were normal in all individuals. The main associated complaints were poor academic performance, lack of sleep, limb pain and road side accidents.

**Conclusion:** This study concluded only mild degree sensorineural hearing loss among chronic users of PLDs. However the associated complaints such as poor academic performance and roadside accidents were comparatively more in chronic users than non-chronic users.

**Keywords:** India, Kerala, Medical students, Personal listening devices (PLDs), Sensorineural hearing loss.

### Introduction

Hearing, one of the five senses, is the complex process of picking up sound and attaching meaning to it. The human ear is fully developed at birth and hence very faint as well as loud sounds can be appreciated and responded to very well.<sup>1</sup> However hearing decreases with age and due to continuous exposure to environmental noise such as television sounds, traffic, construction sites, industrial appliances etc. Thus noise is defined as an unwanted or unpleasant sound.<sup>1</sup>

As hearing loss is a natural phenomenon with age, most commonly thought to be seen in the elderly, now a days it is also common in younger people due to the frequent usage of mobile phones and earphones.<sup>2</sup> Since centuries ago music has been one of the main forms of entertainment, whether it is for dances, concerts, functions, and radios. The genre and style of music is countless thus the admirers and lovers of music. From radios to mp3 players to music in cell phones the listeners of music have tremendously grown, especially since the availability and affordability have increased. From speakers to earphones/headphones have the trend traveled, enabling students with chaos work schedules to listen to music during free hours, travelling, or for stress relief.<sup>2</sup> The dangers of music-induced hearing loss however are seldom looked upon. When people are exposed to harmful noise for a prolonged duration of time, the hair cells present in the inner ear are damaged causing noise-induced-hearing loss (NIHL).<sup>1</sup> The hair cells (sensory cells) convert sound energy into electrical signal which reaches the auditory processing center in the brain. Once damage is caused to these cells, regeneration is not attainable.<sup>1</sup>

Music has evolved over the decades, so has the manner of communication between individuals residing in wide geographic areas.<sup>2</sup> From letters to telephones to cell phones have the communication of ideas, special moments, and events conveyed. Along with being able to talk to an individual, text messaging, e-mail, internet access, and other business application, gaming, and photography has taken its root. Thus the facilities through smart phones have increased.<sup>2</sup> For the past 20 years the mobile phone usage have increased from 12.4 million to over 5.6 billion thus forming 70% of the world population. The sizeable number of users were school and college going students.<sup>2</sup>

As about 87-90% of population in developed countries like USA use cell phones, the scenario is similar with people of India. The educated as well as the illiterate and people belonging to all age groups are daily dependent on cell phones for their day to day activities. Most phones that emit electromagnetic radiation reach the public without any prior safety testing.<sup>3</sup> Thus the radio frequency fields from mobile phones could affect the hearing of individuals.<sup>4</sup> The use without any prior knowledge to its harmful effects is lethal. Not only does the constant usage for a prolonged duration of time cause sensorineural hearing loss, but it can also have an effect on people physically and psychologically.<sup>3</sup> Exposure to loud noise can lead to hearing impairment as personal audio electronics such as mobile phones and headsets can produce sounds up to 120 db which is injurious to hearing.<sup>1</sup> Thus we decided to conduct a study among personal listening devices using medical students of Dr. SMCSI Medical College.

## Objectives

Primary objectives: To study the prevalence of chronic Personal listening device users among medical students and to assess the proportion of sensorineural hearing loss among medical students who are chronic mobile phone, and earphone/headset users.

Secondary objectives: To assess the type and degree of hearing loss and the perceived effects of listening to PLDs among chronic and non-chronic users of PLDs among medical students.

## Materials and Methods

A cross-sectional study was conducted among undergraduate medical students of Dr. Somervell Memorial CSI Medical College and Hospital, Karakonam in Trivandrum district of Kerala state in South India from December 2015 – October 2016 of which two months June – July 2016 was used for data collection. Using the prevalence of 18% medical students who self reported to be chronic PLDs users as per the criteria of using PLDs continuously for more than 1 hour duration per day (Unpublished data from dept of Community Medicine), considering an error of 20%, 455 undergraduate medical students were required to conduct this study. Students from 2012 to 2016 batches were available in the campus during the data collection period. Each batch the intake of students were 100. Of the available students in the campus only 420 students consented to participate in the study. Thus the non-response rate was 7.7%. Medical students who didn't give consent and students with previous history of ear discharge, ear surgeries, or any other illness, diseases, states or events that are contributing to ear disease, hard of hearing, or sensorineural hearing loss were excluded from the study. Written permission was obtained from the principal of the institution and the study was conducted only after obtaining Institutional Ethics Committee clearance (No.SMCSIMCH/EC(PHARM)8/2016 dated 26.05.2016). After explaining the purpose of the study a written informed consent was obtained from all the students who were willing to participate in the study. Using a predesigned and pretested self administered structured questionnaire socio-demographic details and use and associated symptoms with personal audio electronics (mobile phones/headphones) were collected. Among these students, only students who were using PLDs for more than 1 hour duration continuously per day were considered as chronic users. Those students identified as chronic users were then subjected to pure tone audiometry and otoacoustic emissions to detect and grade the degree of sensorineural hearing loss. Both pure tone audiometry and Otoacoustic emission test was performed to the students by trained audiometrist from department of ENT. The fund for performing the test was provided from Comprehensive Rehabilitation Project working for differently abled people in the community supported by Christophel Blinden Mission. The data thus collected was entered in excel and analyzed using SPSS Software trial version 16.0. All quantitative variables were analyzed for mean and standard deviation. All qualitative

variables were analyzed for proportions. Odds ratio was done to assess the perceived effects of listening to PLDs among chronic and non-chronic users of PLDs among medical students. The study would benefit the students by creating awareness about the hazards of chronic mobile phone usage as in sensorineural hearing loss, physical trauma, and psychological illness. It would facilitate early detection and prevention of sensorineural hearing loss in young age groups. Any student identified with defect will be counseled and treated appropriately by experts from the department of ENT.

## Results

420 undergraduate medical students participated in the study. The mean age of the students were  $20.6 \pm 1.55$  years, ranging from 17 to 26 years. 65.5% were females, and 34.5% males. The participants mostly consisted of 1<sup>st</sup> years, about 47.6%, 2<sup>nd</sup> years 20.5%, 3<sup>rd</sup> years 17.4%, and 4<sup>th</sup> years 13.8%, and 0.7% interns. (Table 1). The Participants were considered as chronic PLDs users if there was continuous usage of either mobile phones or headphones for more than 1 hour per day. 44% of the participants were found to be chronic PLDs users. (Table 2).

Pure tone audiometry was done on 120 students who were identified as chronic users (65%). The limitation found in data collection was few students could not make up for audiometry and OAE testing due to exams and other personal reasons. Also the busy hospital work hours and the afternoon time allotted for the testing as well as the number of students those could be tested each day within the 2 months for actual data collection was at interference. Thus high frequency hearing loss was very minimal as no hearing loss was detected at 1K and 2K, while only 0.8% loss was found in the right ear at 4K, and 1.7% in the left ear. 8K findings were 1.7% in right ear, and 2.5% in left ear. However table 3 shows minimal low frequency hearing loss among medical students. In 250 Hz 5% hearing loss was found in the right and left ear. In 500 Hz 12.5% had hearing loss in the right ear, and 7.5% had hearing loss in the left ear. (Table 3)

Considering the degree of hearing loss based on pure tone audiometry findings frequencies  $\geq 4$ KHz was considered as high frequency hearing loss and frequencies  $< 4$ KHz as low frequency hearing loss. Thus among the 120 Chronic PLDs users of medical students prevalence of hearing loss was found among 22%. However 4% of students were found to have high frequency hearing loss and 22% of the students had low frequency hearing loss. (Table 4)

Bone conduction test was done in all the students that showed sensorineural hearing loss. In high frequencies only 2.5% had a dip in bone conduction at 4K, while in low frequencies 5% had dip in 250 Hz, and 9.2% had dip in 500Hz. (Table 5)

All 120 (100%) of the medical students who were chronic mobile phone users subjected to otoacoustic emissions passed it which means that the cochlear status was found normal.

Considering the perceived symptoms associated with chronic PLDs usage, it was found that poor academic performance was found more in chronic users 15.7% than non chronic users only 6.4%, the chronic users are 2.73 times more at risk than non users and this finding is statistically significant (CI -1.42-5.26). The other symptom is lack of sleep, 5.5% in non chronic users, and 17.8% in chronic users, and they are 3.71 times more at risk than non users and it is statistically significant (CI- 1.89-7.28). Neck pain was another perceived risk factor of 1.76 times seen more in chronic users (17.3%) than in non chronic users (10.6%) and this was near to statistical significance (CI-

1.00-3.09). Limp pain was also complained by students due to mobile phone and ear phones uses, as 4.9% of chronic users complained more than 1.3% of non users, and chronic users being at 3.96 greater risk of getting limp pain, and this was also found to be statistically significant (CI- 1.06-14.82). Another great event and risk factor that can be seen in the results are the occurrence of road side accidents due to lack of awareness due to the usage of PLDs, there is 6.66 times more risk seen in chronic users (5.4%) than non chronic users (0.9%) this is statistically significant as well(CI- 1.44-3.77).(Table 6)

**Table 1:** Socio-demographic characteristics of the medical students (n=420)

Socio-demographic Characteristics of medical students	Frequency	Percentage (%)
Age in Years (Mean & SD)	20.6(1.55)	
<b>Gender</b>		
Male	145	34.5
Female	275	65.5
<b>Education</b>		
1 <sup>ST</sup> Years	200	47.6
2 <sup>nd</sup> years	86	20.5
3 <sup>rd</sup> years	73	17.4
4 <sup>th</sup> years	58	13.8
Interns	3	0.7

**Table 2:** Proportion of Chronic users of PLDs among the study participants (N= 420)

Type of PLD users based on duration of use	Frequency	Percentage (%)
Chronic users (>1 hr)	185	44
Non Chronic Users (<1hr)	235	56
Total	420	100

**Table 3:** Prevalence of Sensorineural hearing loss among Chronic PLDs using medical students based on Pure tone audiometry findings (N=120)

Hearing loss based on Pure tone audiometry in hertz	Right ear Frequency (%)	Left ear Frequency (%)
250 Hz	6 (5.0)	6 (5.0)
500Hz	15 (12.5)	9 (7.5)
1K	0	0
2K	0	0
4K	1 (0.8)	2 (1.7)
8K	2 (1.7)	3 (2.5)

**Table 4:** Prevalence of Sensorineural hearing loss in terms of high and low frequency among Chronic PLDs using medical students based on Pure tone audiometry findings (N=120)

Frequency of hearing loss	Present n (%)
High frequency (≥4K)	5 (4.2)
Low frequency (< 4K)	21(17.5)
Total	26 (21.6)

**Table 5:** Prevalence of hearing loss among Chronic PLDs using medical students based on Bone conduction test (N=120)

Hearing loss based on Bone conduction test in decibels	Frequency	Percentage
250 Hz	6	5
500Hz	11	9.2
1K	0	0
2K	0	0
4K	3	2.5

**Table 6:** Perceived effects of listening to PLDs among the study participants (n= 420)

Perceived Symptoms/ risks	Chronic users (n= 185)	Not chronic users (n=235)	Odds ratio	95% CI
	Frequency (%)	Frequency (%)		
Headache	49(26.5)	69 (29.5)	0.87	0.56- 1.33
Migraine	15(8.1)	11(4.7)	1.80	0.81- 4.01
Irritability	27(14.6)	23(9.8)	1.58	0.87-2.85
Lack of concentration	42(22.7)	39(16.6)	1.48	0.91-2.40
Lack of academic performance	29(15.7)	15(6.4)	2.73	1.42-5.26
Lack of sleep	33(17.8)	13(5.5)	3.71	1.89-7.28
Fatigue	15(8.1)	10(4.3)	1.99	0.87-4.53
Tiredness	26(14.1)	23(9.8)	1.51	0.83-2,74
Loss of appetite	7(3.8)	6(2.6)	1.50	0.50-4.54
Neck Pain	32(17.3)	25(10.6)	1.76	1.00-3.09
Limp pain	9(4.9)	3(1.3)	3.96	1.06-14.82
Back Pain	14(7.6)	17(7.2)	1.05	0.50-2.19
Tinnitus	15(8.1)	12(5.1)	1.64	0.75-3.59
Road side accidents	10(5.4)	2(0.9)	6.66	1.44-3.77

## Discussion

This study was conducted to evaluate the sensorineural hearing loss among medical students who are chronic mobile phone and ear phone users and the associated symptoms that pertained to PLDs usage. The age groups selected for this study were medical students between 17-26 years, the mean age being 20.6 years. Similar studies were done in Uttar Pradesh, and Karnataka with medical students of both genders and age group of 15-25 years and 18-30 yrs respectively.<sup>5,4</sup> Both these studies concluded that significant hearing loss was not found among these age groups. The normal values in both these studies for hearing loss were taken as below 25 dB. In our study, 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. These findings in low frequency could have been due to any other underlying pathology or due to any external disturbances. A study done in Tamil Nadu with age groups of 20-45yrs, sensorineural hearing loss was found with 3% prevalence.<sup>6</sup> However in their study they included individuals that gave symptoms of vertigo, ear discomfort, and fullness of the ear, which could have attributed to the hearing loss, while our study excluded individuals who gave history of vertigo, ear discomfort, family history of hearing loss, individuals on oto-toxic drugs, fullness of ear, any ear block with wax, or any other underlying ear pathology.

The individuals were assessed on chronic usage of PLDs, that is usage for more than 1 hour per day, our findings was that non chronic users (56%) were more than chronic users (44%). This results were contrary to results obtained in the study done in Mangalore<sup>7</sup> where 77.7% were chronic users.

The associated symptoms pertaining to the use of PLDs revealed the highest risk factors were students complaining of poor academic performance among chronic users (15.7%) compared to non chronic users (6.4%). The other risk factor being lack of sleep (17.8%) in chronic users was much more than 5.5% in non chronic users. Another physical symptom seen is neck pain and limp pain due to the usage of PLDs. Road side accidents were also common due to the lack of environmental awareness being (5.4%) and only (0.9%) in non chronic users that is 6.66 times more risk factor is seen in chronic users than in non chronic users. This data is supported by a study done in Hyderabad where in general the symptoms were assessed and 51.47% had headache, irritability (50.79%), Lack of concentration 47.4%, Poor academic performance, insomnia (35.4%), tiredness (32.7%), and physical symptoms such as body ache etc (32.19%).<sup>3</sup>

Otoacoustic emissions were done for all the 120 individuals and they all passed which was in good correlation to the study done in Germany, where 88 subjects influenced by leisure-time noise exhibited no measurable pure tone hearing loss.<sup>8</sup>

## Conclusion

455 medical students were enrolled in this study out of which 420 responded, thus with the non responsive rate of 7.7%. Among 420 students, 185 students were chronic PLDs users and 120(64.8%) of them were subjected for audiometry and OAE. 4% of students were found to have high frequency hearing loss and 22% of the students had low frequency hearing loss. All the subjects fell under the pass category for OAE. The main associated symptoms were lack of academic performance, irritability, lack of sleep, neck pain, limb pain, and history of accidents in road environments among chronic users compared to non-chronic users of PLDs.

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**Conflict of Interest:** None.

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