

## EFFECT OF PURE TONE AUDIOMETRY AMONG YOUNG ADULTS USING EARPHONES

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## Abstract

**Background:** It is important to analyze listening habits and promote awareness among adults to prevent noise-induced hearing loss. Thus, we assessed the prevalence and determined the factors associated with noise-induced hearing loss among medical students using earphones. **Materials and Methods:** A cross-sectional study was conducted on 422 medical students at Dhanalakshmi Srinivasan medical college and hospital, Perambalur, Tamil Nadu, for six months. All the subjects were interviewed for socio-demographic details, and 16-item questionnaires were given to the participants regarding earphones and their usage. Each participant was clinically examined for external auditory canal pathology and planned for PTA. **Result:** The majority of subjects belonged to the 20 and 21 years age group. Among the subjects, 276 (64.04%) were female, and 155 (35.96%) were male. Further, 98.1% of participants were using earphones/headphones, and 95.8% agreed that wearing earphones long time would be harmful. Among the subjects, 408 (94.66%) had normal PTA, and 23 (5.34%) had 4K dips in PTA. The difference in PTA between different usages of earphones was statistically significant ( $p < 0.05$ ). The mean duration of usage of earphones among 4K Dip was 7.66, and among normal was 4.16, and the difference was statistically significant ( $p < 0.008$ ). PTA distribution among study subjects indicated a non-significant difference concerning age groups and gender categories. **Conclusion:** As noise exposure has cumulative negative effects on hearing, the young generation should be aware of potential health hazards related to noise exposure and prevention.

## INTRODUCTION

Personal Music Devices (PMD) have become a common and integral part of everyday life. A dramatic increase in the use of PMD leads to exposure to high sound levels during leisure time.<sup>[1]</sup> Nowadays, most youngsters are using PMD, and the average usage among them is reported to be a minimum of 2 hours per day.<sup>[2-5]</sup> Various studies have shown auditory side effects and non-auditory effects upon prolonged exposure to noise.<sup>[6]</sup> WHO reported 1.1 billion teens and young adults worldwide are at risk of hearing loss from unsafe usage and listening to loud music. Temporary or permanent threshold shifts and tinnitus (either temporary or permanent) have been reported on long-term exposure to loud noise.<sup>[6]</sup> Pure-tone audiometry is a “gold” standard test and is the most commonly done audiological examination. The role of this test is to determine whether hearing

is normal or impaired. Using headphones, air conduction thresholds are measured for frequencies that range from 0.125 kHz to 8 kHz. Then, bone conduction hearing thresholds are also measured at the range of frequencies from 0.25 to 4 kHz with the use of headphones. The graph obtained by plotting and connecting all hearing threshold values for all frequencies tested is called a “pure-tone audiogram,” hearing thresholds are measured in dB HL units. Noise-induced hearing loss is a cumulative process. It often presents as a temporary or permanent notch around 3, 4, or 6 kHz in the audiogram, but higher frequencies can also be affected.<sup>[7,8]</sup> Thus, analysing listening habits and promoting awareness among adults is important to prevent noise-induced hearing loss. In the present study, we assessed the prevalence and determined the factors associated with noise-induced hearing loss among medical students using earphones.

## MATERIALS AND METHODS

For six months, a cross-sectional study was conducted on 422 young adults (medical students exposed to earphones) at Dhanalakshmi Srinivasan medical college and hospital, Perambalur, Tamil Nadu. Institutional Ethics Committee (IEC) clearance was obtained, and the study was conducted. Informed consent was obtained from all participants before initiating the study.

### Inclusion Criteria

Those voluntarily willing to participate in the study were included.

### Exclusion Criteria

Those unwilling to participate and those already diagnosed with severe hearing loss were excluded.

The subject was interviewed for socio-demographic details, including age, gender, and education. 16-item questionnaires were given to the participants regarding earphones and their usage. Each participant was clinically examined for external auditory canal pathology and planned for PTA.

Pure-tone audiometry was performed in a soundproof booth (parameters are defined in International Organization for Standardization (ISO) norm (ISO 11957:1996, 1996). The test equipment and stimuli were calibrated before testing according to ISO standards. A rest period of at least 16 hours after the last exposure to noise was advised to avoid TTS influence on the audiometric test result.

Results of Pure tone audiometry were documented, and data were entered into MS excel and analyzed using SPSS software. Categorical variables were expressed in frequency and percentages and visualized using bar charts and pie charts. Numerical variables were expressed in mean, and standard deviation and significance levels were tested using the Chi-square and T-tests.

## RESULTS

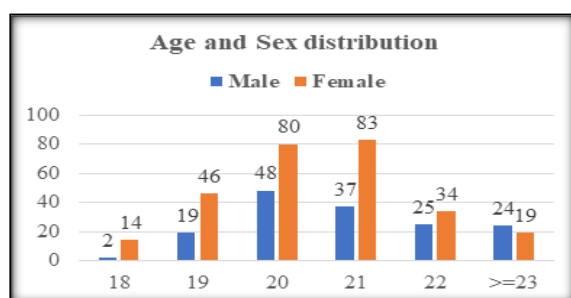


Figure 1: Age and sex distribution among study subjects

Among the study population with age group distribution, 128 (29.7%) had 20 years age group, followed by 120 (27.84%) had 21 years age group, and least 16 (3.71%) had 18 years age group. Among the subjects, 276 (64.04%) were female, and 155 (35.96%) were male [Figure 1].

[Table 1] describes the earphone usage characteristics among study subjects, indicating that

98.1% of participants were using earphones/headphones, and 95.8% agreed that wearing earphones for a long time would be harmful. Reasons for using earphones include making themselves peace (36.4%), followed by to make themselves not being influenced by the noise outside (29.5%), hearing a higher quality voice (20.2%), and letting other people know nothing about what they are doing (13.9%). 36.2%, 31.1%, and 28.8% felt that role of music in their life was important, very important, and quite important, respectively. 56.8% of participants used earphones to get to sleep [Table 1].

### PTA Distribution

Among the subjects, 408 (94.66%) had normal PTA, and 23 (5.34%) had 4K dips in PTA [Figure 2].

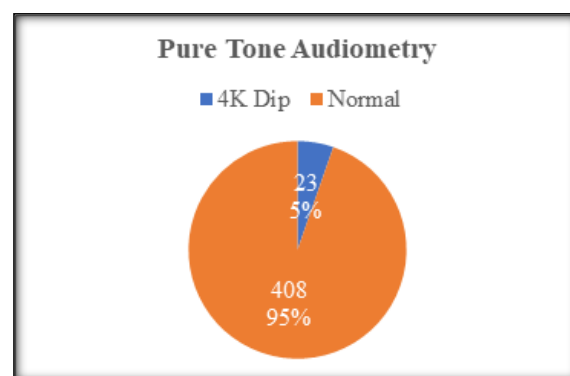


Figure 2: PTA distribution among the subjects

The mean duration of the usage of earphones among the subjects was  $4.35 (\pm 4.04)$ , ranging from 0 to 20 [Table 2].

Considering the usage of earphones by the subjects with PTA distribution, very often usage had a higher proportion at 13.79%, followed by usual usage at 4.4%, sometimes at 4.3%, and least in never usage at 0%. The difference in PTA between different usages of earphones was statistically significant ( $p < 0.05$ ). The remaining earphone usage characteristics do not have any significant association with PTA [Table 3].

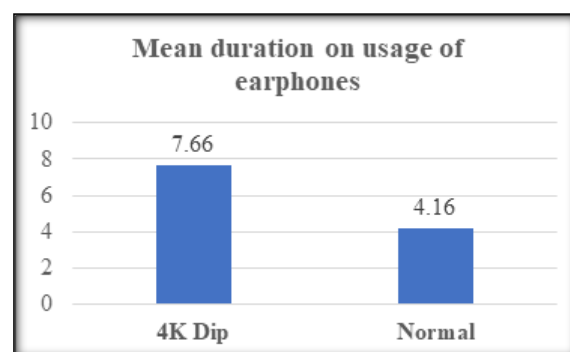


Figure 3: Distribution of duration on the usage of earphones with PTA among the study population

The mean duration of usage of earphones among 4K Dip was 7.66, which is higher than the mean duration of usage of earphones among normal,

which was 4.16, and the difference was statistically significant ( $p < 0.008$ ) [Figure 3].

PTA distribution among study subjects indicated a non-significant difference concerning age groups and gender categories [Table 4].

**Table 1: Earphones usage characteristics among study subjects**

Earphones usage characteristics		Count	%
Earphones/headphones use	No	8	1.9%
	Yes	423	98.1%
Earphones/headphones use	Never	5	1.2%
	Seldom	23	5.3%
	Sometimes	186	43.2%
	Usually	159	36.9%
	Very often	58	13.5%
Reason for using earphones	To hear a higher-quality voice	87	20.2%
	To let other people know nothing about what I am doing	60	13.9%
	To make myself not be influenced by the noise outside	127	29.5%
	To make myself peace	157	36.4%
Agree wearing earphones long time will be harmful	No	18	4.2%
	Yes	413	95.8%
Role of music in your life.	Important	156	36.2%
	Not important	17	3.9%
	Quite important	124	28.8%
	Very important	134	31.1%
Use an MP3 player on a mobile phone to listen to music on the go	No	167	38.7%
	Yes	264	61.3%
Use earphones to get to sleep	No	159	36.9%
	Sometimes	27	6.3%
	Yes	245	56.8%

**Table 2: Duration of usage of earphones**

	N	Mean	Std. Deviation	Minimum	Maximum
Duration of usage of earphones (hours/day)	431	4.35	4.04	0.0	20.0

**Table 3: Earphones usage characteristics and PTA distribution among study subjects**

		PTA				p-value
		4K dip		normal		
		Count	%	Count	%	
Do you use any types of earphones/headphones?	No	1	12.5%	7	87.5%	0.358
	Yes	22	5.2%	401	94.8%	
How often do you wear earphones?	Never	0	0.0%	5	100.0%	0.047
	Seldom	0	0.0%	23	100.0%	
	Sometimes	8	4.3%	178	95.7%	
	Usually	7	4.4%	152	95.6%	
	Very often	8	13.8%	50	86.2%	
Why do you use earphones?	To hear a higher-quality voice	3	3.4%	84	96.6%	0.664
	To let other people know nothing about what I am doing	2	3.3%	58	96.7%	
	To make myself not be influenced by the noise outside	8	6.3%	119	93.7%	
	To make myself peace	10	6.4%	147	93.6%	
Do you agree that wearing earphones long time will be harmful to us?	No	2	11.1%	16	88.9%	0.248
	Yes	21	5.1%	392	94.9%	
How important a role does music play in your life.	Important	12	7.7%	144	92.3%	0.273
	Not important	0	0.0%	17	100.0%	
	Quite important	4	3.2%	120	96.8%	
	Very important	7	5.2%	127	94.8%	
Do you use an MP3 player or mobile phone to listen to music on the go?	No	9	5.4%	158	94.6%	0.969
	Yes	14	5.3%	250	94.7%	
Do you ever use earphones while trying to get to sleep?	No	7	4.4%	152	95.6%	0.261
	Sometimes	0	0.0%	27	100.0%	
	Yes	16	6.5%	229	93.5%	

**Table 4: PTA distribution among study subjects according to age and gender**

		PTA				p-value
		4K Dip		Normal		
		Count	%	Count	%	
Age group	18	1	6.3%	15	93.8%	0.427
	19	2	3.1%	63	96.9%	
	20	9	7.0%	119	93.0%	
	21	9	7.5%	111	92.5%	

	22	1	1.7%	58	98.3%	
	>=23	1	2.3%	42	97.7%	
Gender	Male	11	7.1%	144	92.9%	0.223
	Female	12	4.3%	264	95.7%	

## DISCUSSION

Nowadays, young adults are continuously exposed to loud noise in the form of music, cell phones, and mp3 players for long periods and are unaware of its health hazards. A study by Widen et al. showed the mean age was 13.6 years (ranging from 10 to 18 years).<sup>[9]</sup> In our study population with age group distribution, 128 (29.7%) had 20 years age group, followed by 120 (27.84%) had 21 years age group, and least 16 (3.71%) had 18 years age group.

With advanced music devices, sounds can be played at a high level for a long duration. According to Kim et al., 80% of subjects aged 13 -18 listen to music using headphones for 1- 3 hours daily.<sup>[10]</sup> In a study by Widen et al., 80% of adolescents listened for 30 minutes to 2 hours on every occasion, whereas 20% listened for 3 hours or more.<sup>[9]</sup>

A study by Zia et al. found hearing loss in 11(19.6%) participants using earphones for 3-4 hours and 36 (64.2%) using earphones for 5-6 hours.<sup>[11]</sup> In our study, the mean duration of usage of earphones among the subjects was 4.35 hours ( $\pm$  4.04). The study by Widen et al.<sup>[9]</sup> showed symptoms of noise exposure, such as reduced hearing, tinnitus, sound sensitivity, fatigue, distortion, or occlusion. Whereas in our study, subjects did not experience any symptoms.

A study by Peng et al.<sup>[12]</sup> showed that hearing thresholds in the high-frequency range were significantly poorer in the group using PMPs. In our study, the duration of usage of earphones among those participants who had 4K and higher frequency Dip was 7.66, which is higher than the mean duration of usage of earphones among Normal PTA, which was 4.16 and the difference was statistically significant ( $p < 0.05$ ). However, the results of our study were not supported by the study of Kim et al.<sup>[10]</sup> conducted in the Korean population and the study conducted by Keppler et al.<sup>[13]</sup>

A study by Sulaiman et al.<sup>[14]</sup> and Widen et al.<sup>[9]</sup> concluded that those participants who used earphones for more than 3 hours had poor hearing thresholds. Results were also comparable with that of Taneja et al.<sup>[15]</sup> In our study, considering the usage of earphones by the subjects with PTA distribution, very often usage had a higher proportion at 13.79%, followed by usual usage with 4.4%, and sometimes usage with 4.3%. The difference in PTA between different usages of earphones was statistically significant ( $p < 0.05$ ). The remaining earphone usage characteristics did not show any significant association with PTA.

A study by Vaidya et al.<sup>[16]</sup> found that using PMD with either earphones or headphones for two hours is sufficient for subsequent hearing impairment. Among our subjects, 408 (94.66%) had normal

PTA, and 23 (5.34%) had a 4K dip in PTA. In reviewing an audiometric test of Vaidya et al.<sup>[16]</sup> mean hearing threshold levels in the test group were higher than in the control group at high and low frequencies in the right and left ear.

A study conducted by Widen et al.<sup>[9]</sup> showed that a symmetrical hearing threshold with increased high-frequency hearing thresholds in the range of 6000 to 8000 Hz was observed in both ears. The standard deviations were slightly more for the right ear. In our study, out of 23, ten participants had right-sided 4K Dip, and thirteen had Left-sided 4K Dip. All 23 participants had elevated hearing thresholds not only in 4k HZ but also in higher frequencies.

A study by Peng et al.<sup>[12]</sup> showed that hearing thresholds in the 3 to 8 kHz frequency range was significantly low in the group using PMDs. Similar results are obtained in the study conducted by Portnuff,<sup>[17]</sup> and Ogbe et al.<sup>[18]</sup> held on Nigerian male and female headphone users and non-users.

## CONCLUSION

Exposure to sounds at high levels for a prolonged period can cause permanent hearing damage (in which 4K dip/ boilermaker's notch is a forerunner for noise-induced hearing loss). As noise exposure has cumulative negative effects on hearing, the young generation should be aware of potential health hazards related to noise exposure and prevention. Simple lifestyle modifications can help us live healthy life preventing these lifestyle diseases.

### Limitation

Data collected was solely based on participants' self-reported measures regarding the duration of usage of PMDs.

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