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Original Research Article

RELATIONSHIP OF EARPHONE USAGE WITH THE EMERGENCE OF HEARING LOSS AND HEALTH PROBLEMS IN MEDICAL STUDENTS OF SOUTH PUNJAB

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Abstract: *Noise-induced hearing loss (NIHL) is a rising concern, particularly in the young adult population who frequently use personal listening devices (PLDs) such as earphones. Medical students are at risk of having hearing-related problems due to the high usage of PLDs for both academic and recreational purposes. This study aimed to assess the prevalence of hearing loss, symptoms associated with earphone use, and the relationship between earphone usage patterns and hearing thresholds among medical students in South Punjab, Pakistan.* ***Objective:*** *To evaluate the prevalence of hearing loss and associated symptoms (headache, tinnitus, otalgia, fatigue) about earphone usage habits, including daily duration, volume, and frequency of use, among undergraduate medical students.* ***Methods:*** *This cross-sectional study was conducted at Nishtar Medical University and CMH Institute of Medical Sciences (CIMS), Multan from October 2023 to August 2024. A total of 267 medical students aged 18-26 years participated in this study. Participants were categorized into two groups: mild users (≤1 hour/day) and Intense users (>1 hour/day) of PLDs. Data were collected using a self-administered questionnaire on demographics, earphone usage patterns, and associated symptoms. Audiometric testing was performed using Pure Tone Audiometry (PTA) to assess hearing thresholds at 250 Hz to 8000 Hz. Descriptive statistics, t-tests, chi-square tests, and Pearson correlation were used to analyze the data.* ***Results:*** *The majority of participants (55.4%) were aged 21-23 years, with a balanced gender distribution (52.4% male, 47.6% female). Intense users (53.2%) had significantly higher hearing thresholds at all frequencies compared to mild users, particularly at higher frequencies (4000 Hz and 8000 Hz). In the right ear, the prevalence of hearing loss is 3.2% for mild users and 13.3% for intense users whereas in the left ear, it is 4.8% and 12.7% for mild and intense users respectively. The most common form of hearing loss was mild sensorineural hearing loss at 4000Hz. Intense users reported higher rates of symptoms, including headache (35.9% vs. 16%), fatigue (47.2% vs. 17.6%), otalgia (46.5% vs. 22.4%), and tinnitus (34.5% vs. 17.6%), with statistically significant associations between symptom prevalence and usage duration and volume.* ***Conclusion:*** *Prolonged earphone usage is significantly associated with the emergence of hearing loss and increased prevalence of auditory symptoms among medical students. Despite being aware of the risks, many students do not follow safe listening practices, underscoring the need for educational initiatives. Promoting the "Rule of 60" and encouraging regular breaks during usage are essential steps to mitigate the risk of NIHL.*

Keywords: Noise-Induced Hearing Loss, Personal Listening Devices, Headphones, Earphones, Personal Listening Devices, Pure Tone Audiometry, Hearing Impairment, Medical Students, Associated Symptoms

Introduction

Hearing involves the intricate process of detecting sound and imputing meaning to it (1). Hearing loss is a partial or total inability to hear. It negatively affects the communication and quality of life. It can be caused by the physiological process of ageing, ototoxic drugs, infections, genetic mutations, and exposure to loud noises (2). It is characterized by changes in the hearing thresholds over time. Listening to music either in live concerts or through earphones can generate intense sound pressure levels (SPLs) (3). Exposure to such intense noise can lead to a Temporary Threshold Shift (TTS) or a Permanent Threshold Shift (PTS) along with changes in auditory nerve function and can result in Noise-Induced Hearing Loss (NIHL).

NIHL is an acquired condition that results from exposure to sudden, excessively loud sounds or continuous moderately loud noise. The extent of hearing loss depends on the intensity and duration of the sound exposure (5). It is primarily caused by damage to cochlear hair cells and synaptopathy. TTS results from reversible damage to hair cell stereocilia or synapses, while PTS indicates permanent loss or damage to hair cells and synapses. This damage occurs due to the accumulation of reactive oxygen species and activation of stress pathways which lead to cell death. Permanent cochlear neuron damage also plays a role in NIHL (2).

In recent years, the use of earphones has become progressively more widespread. Prolonged earphone usage is associated with a notable increase in hearing loss due to uninterrupted loud noise exposure. The impairment typically presents as mild, bilateral, and sensorineural, and involves higher frequency ranges in prolonged earphone users (4). The shift from conventional education to online learning has resulted in an upward trajectory in the use of Personal Listening Devices (PLDs) e.g. headphones, Bluetooth earphones, wired earphones etc. These devices are capable of making noises louder than 125dB (6). According to the WHO, approximately 1.1 billion young population are susceptible to hearing loss due to prolonged

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exposure to loud sounds through PLDs (personal listening devices) (7). An eight-hour daily noise exposure that exceeds the permissible exposure limit of 85dB can cause NIHL (8). Furthermore, listening to 60% of the volume for over 60 minutes continuously also increases the risk of NIHL (9).

There is a notable lack of awareness regarding the potentially irreversible harm caused by overusing personal listening devices (PLDs) over time. According to a study, almost 50% of teens and young people in middle and high-income countries are subjected to hazardous levels of sound due to PLD usage with around 40% of them prone to potentially damaging sounds (10). This study aims to find the prevalence of prolonged headphone usage, determine associated hearing loss and other symptoms such as headache, otalgia, fatigue, tinnitus etc. that are associated with earphone usage, and analyze the correlation between usage duration/volume and severity of hearing loss and health problems among medical students in South Punjab, to raise awareness and recommend preventive measures.

Methodology

After obtaining approval from the Ethical Review Board (IERB) of Nishtar Medical University (NMU), Multan, a cross-sectional study was conducted using stratified random sampling among the undergraduate medical students of Nishtar Medical University and CMH Institute of Medical Sciences (CIMS) Multan from October 2023 to August 2024. Inclusion criteria were MBBS students from 1st year to 5th year, both male and female, aged between 18-26 years, who gave informed consent willingly, had normal hearing and were regular users of PLDs. Whereas, exclusion criteria comprised students with prior diagnosis of hearing impairments, acute or chronic ear-related infections, allergic rhinitis, history of ototoxic drug usage, family history of hearing loss and those living in noisy areas. The students who had been exposed to extraordinarily loud noise within the last 24 hours also did not participate in this study. A related study reported a prevalence of 27.1% hearing loss among headphones using medical students.13 Using this information in the Open Epi calculator at 95% confidence interval (CI) and error of ±5%, a sample size of 256 was obtained. After obtaining informed consent from the participants, a self-reported questionnaire was administered to gather information about the history of usage patterns of PLDs. Sociodemographic data included age, gender, year of study and residence. The questionnaire also inquired about the content for which students used PLDs, the type of headphones, any symptoms associated with the use of headphones (tinnitus, otalgia, fatigue, headache etc.), and awareness about NIHL and hearing health. The use of PLDs was categorized as continuous usage of headphones, total hours per day use, volume setting and overall usage in years to get more precise information about duration and level of noise exposure. Then according to the data obtained by the questionnaire, the participants were divided into two almost equal groups based on continuous use of headphones. Those using headphones less than 1 hour continuously daily were labelled as “mild users” while those using headphones more than 1 hour continuously daily were referred to as “Intense users”. Audiometric testing was performed after 24 hours of administration of the questionnaire. All students were informed to avoid loud noise exposure for the next 24 hours to exclude any temporary threshold shift caused by loud noise. Pure Tone Audiometry (PTA) was performed for the hearing screening of every participant of the study sample in the ENT OPD of Nishtar Hospital Multan by trained audiologists. Maico MA 41 Audiometer (MAICO Diagnostics, Berlin, Germany) was used to perform PTA. Students were informed about the procedure of PTA. In PTA, the pure-tone signals (a sound comprising of a single frequency component) are delivered to the ear via air conduction and bone conduction at a variety of frequencies and the patient responds to the sound by signalling the examiner with a button or by raising a hand. PTA was done in a soundproof booth to prevent any disturbance by background noise. An otoscopic examination was done before PTA for the presence of occluded wax or any other pathological condition, affecting hearing acuity. Auditory thresholds for air conduction in both ears were obtained through conventional octave frequencies between 250 Hz-8000 Hz (pure-tone thresholds for low and mid frequencies were computed at 250, 500, 1000 and 2000 Hz respectively and for high frequencies were calculated at 4000 and 8000 Hz). A bone conduction test was carried out to differentiate between conductive and sensorineural hearing loss. Test frequencies for bone conduction were ranged from 500 Hz to 4000 Hz. Air-bone gap (the gap between air and bone conduction thresholds in an audiogram) of more than 10 dB was considered significant for the presence of the SNHL WHO grading system for hearing impairment (1991) and was used to classify the degree of hearing loss (Organization, 1991). Normal hearing thresholds up to 25 dB, mild hearing loss from 26-40 dB, moderate from 41-60 dB, severe from 61-80 dB while profound hearing loss including deafness was 81dB or greater.26 Data entry and analyses were conducted using SPSS Software, version 27 (IBM Corp.). Descriptive statistical analyses were run to obtain the frequencies, mean and standard deviation (S.D.). Shapiro-Wilk test of normality was applied to find the pattern of distribution of data. An Independent t-test was employed to compare the means at octave frequencies among the mild and intense users. The Chi-square test was used to find the association of earphone usage habits (hours per day usage, volume level, and years since the subject has been using headphones regularly) with symptoms associated with headphone usage. Pearson correlation was utilized to find the strength and direction of the correlation between earphone usage habits with associated symptoms. The odds ratio was done to assess the perceived effects of listening to PLDs among Intense and mild users of PLDs. P value <0.05 and 95% CI was kept as a level of statistical significance.

Results

A total of 267 participants were included in this study. The participants aged 18-20 years comprised 39.3% (n=105) of the sample, 21-23 years accounted for 55.4% (n=148), and 24-26 years made up 5.2% (n=14). The gender distribution comprised 52.4% males (n=140) and 47.6% females (n=127) in the sample. 31.1% (n = 83) first-year students, 20.6% (n = 55) second-year students, 13.9% (n = 37) third-year students, 27.0% (n = 72) fourth-year students, and 7.5% (n = 20) final-year students were included in the study. 57.3% (n = 153) of the participants were hostilities while 42.7% (n = 114) were day scholars. The participants

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were divided into two groups based on continuous usage of earphones for one hour, a group of mild users (n=125) who used earphones continuously for less than one hour and a group of Intense users (n=142) who used earphones continuously for more than one hour.

Both groups were subjected to Pure Tone Audiometry to assess their hearing thresholds and the results for both right ear (RE) and left ear (LE) at different frequencies were compared. The results of PTA are given in Table 1 and Table 2. In the right ear, the prevalence of hearing loss is 3.2% for mild users and 13.3% for intense users whereas in the left ear, it is 4.8% and 12.7% for mild and intense users respectively. In total, 4.8% of mild and 13.3% of chronic users had hearing loss in either one or both ears. The statistical analysis of hearing thresholds was conducted through independent t-tests to compare the hearing thresholds between mild and intense earphone users across various frequencies. (Table 3).

RE= Right Ear, LE= Left Ear, df = Degree of freedom

* Significant impact when the p-value is < 0.05 for the right ear, Intense users had higher mean thresholds at 250 Hz ($p = 0.013$), 500 Hz ($p = 0.001$), 1000 Hz ($p = 0.002$), 2000 Hz ($p = 0.001$), 4000 Hz ($p = 0.001$), and 8000 Hz ($p = 0.005$). Similarly, for the left ear, Intense users had significantly higher thresholds at 250 Hz ($p < 0.001$), 500 Hz ($p < 0.001$), 1000 Hz ($p < 0.001$), 2000 Hz ($p < 0.001$), 4000 Hz ($p < 0.001$), and 8000 Hz ($p = 0.001$). Associated symptoms were assessed using a self-structured questionnaire. Headache was reported by 35.9% of Intense users and 16% of mild users, fatigue was observed in 47.2% of Intense users and 17.6% of mild users, otalgia was reported in 46.5% of Intense users and 22.4% of mild users and tinnitus was reported by 34.5% of Intense users and 17.6% of mild users respectively. The odds of experiencing symptoms were higher among intense users compared to mild users. The odds ratio for headache was 2.94, for fatigue 4.18, for otalgia 3.00, and for tinnitus 2.47. Prolonged earphone use was significantly associated with increased risks of headache, fatigue, otalgia, and tinnitus. (Table 4). Chi-square tests were applied to find correlations between symptoms and factors such as volume level, hours of daily earphone usage, and years of regular use. Results are given in Table 5. For headache, significant associations were found with volume level and daily usage ($p < 0.001$) in both groups, but not with years of earphone use. Fatigue showed significant correlations with volume level and daily usage ($p < 0.001$) in both groups; years of use correlated with fatigue in mild users only ($p = 0.005$). Otalgia was significantly associated with volume level and daily usage ($p < 0.001$) but not with years of use. Tinnitus showed significant correlations with volume level and daily usage ($p < 0.001$), with no significant relation to years of use. Df = Degree of freedom * Significant impact when the p-value is < 0.05 The research findings show detailed patterns of headphone and earphone usage. Out of the respondents, 140 (52.4%) prefer Bluetooth handsfree devices, followed by 116 (43.4%) who use insert-type earphones, and a smaller group of 4 (1.5%) use supra-aural headphones, with 7 (2.6%) opting for other types. Most participants, 224 (83.9%), connect their headphones to smartphones, while 28 (10.5%) use laptops or computers, 6 (2.2%) use tablets, and 9 (3.4%) use music players.

In terms of usage, 120 (44.9%) primarily use headphones for listening to music for entertainment, while 113 (42.3%) use them for studying or working. Only 3 (1.1%) use headphones during commuting or travelling, and 31 (11.6%) cited other purposes. Video content is the most consumed, with 137 respondents (51.3%) using headphones for this purpose, followed by 96 (36.0%) for music, 8 (3.0%) for podcasts, 6 (2.2%) for audiobooks, and 20 (7.5%) for other content.

When it comes to awareness of risks, 221 respondents (82.8%) are aware of the risks of using headphones, while 46 (17.2%) are not. A striking 252 (94.4%) believe that headphones can lead to hearing problems, whereas only 15 (5.6%) do not. However, despite this awareness, only 44 (16.5%) are familiar with the “WHO 60/60 rule" while 223 (83.5%) are not. It is a widely recommended guideline by audiologists and hearing health professionals to minimize the risk of noise-induced hearing loss. It advises users to: Limit the volume to no more than 60% of the maximum volume. Limit listening time to 60 minutes at a time without a break As for measures to limit usage, 129 (48.3%) take steps to reduce their headphone usage to prevent potential hearing damage, but 138 (51.7%) do not. Sharing headphones is common, with 167 (62.5%) admitting to sharing, while 100 (37.5%) do not. Regarding hygiene practices, 115 (43.1%) clean their headphones daily, 61 (22.8%) clean them weekly, 55 (20.4%) clean them monthly, and 108 (13.8%) never clean them at all.

Table 1. Pure Tone Audiometry Findings of Right Ear

Mild Users (use earphones continuously for <1 hour)					Intense Users (use earphones continuously for >1 hour)				
Frequency	**1-25 dB**	**26-40 dB**	**40-60 dB**	**60-80 dB**	**Frequency**	**1-25 dB**	**26-40 dB**	**40-60 dB**	**60-80 dB**
250 Hz	125	0	0	0	250 Hz	129	13	0	0
500 Hz	125	0	0	0	500 Hz	129	13	0	0
1000 Hz	125	0	0	0	1000 Hz	129	13	0	0
2000 Hz	124	1	0	0	2000 Hz	129	13	0	0
4000 Hz	123	2	0	0	4000 Hz	123	19	0	0
8000 Hz	121	4	0	0	8000 Hz	131	9	1	0

Table 2. Pure Tone Audiometry Findings of Left Ear

Mild Users (use earphones continuously for <1 hour)					Intense Users (use earphones continuously for >1 hour)				
Frequency	**1-25 dB**	**26-40 dB**	**40-60 dB**	**60-80 dB**	**Frequency**	**1-25 dB**	**26-40 dB**	**40-60 dB**	**60-80 dB**
250 Hz	125	0	0	0	250 Hz	129	13	0	0
500 Hz	125	0	0	0	500 Hz	129	13	0	0

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1000 Hz	125	0	0	0	1000 Hz	129	13	0	0
2000 Hz	124	1	0	0	2000 Hz	129	13	0	0
4000 Hz	123	2	0	0	4000 Hz	123	19	0	0
8000 Hz	121	4	0	0	8000 Hz	131	9	1	0

Table 3. Independent t-test findings

Frequency (Hz)	Group	N	Mean	Std. Deviation	t	df	p-value	Mean Difference	95% Confidence Interval
RE 250 Hz	Mild Users	125	22.00	0.508	-2.513	265	0.013	-0.197	-0.352, -0.043
	Intense Users	142	22.20	0.736					
RE 500 Hz	Mild Users	125	21.99	0.155	-3.305	265	0.001	-0.353	-0.563, -0.143
	Intense Users	142	22.35	1.185					
RE 1000 Hz	Mild Users	125	21.06	0.387	-3.112	265	0.002	-0.564	-0.920, -0.207
	Intense Users	142	21.62	1.992					
RE 2000 Hz	Mild Users	125	20.05	0.249	-3.368	265	0.001	-0.684	-1.085, -0.284
	Intense Users	142	20.73	2.259					
RE 4000 Hz	Mild Users	125	21.14	0.664	-3.470	265	0.001	-1.019	-1.597, -0.441
	Intense Users	142	22.15	3.223					
RE 8000 Hz	Mild Users	125	21.34	1.454	-2.800	265	0.005	-1.001	-1.705, -0.297
	Intense Users	142	22.35	3.757					
LE 250 Hz	Mild Users	125	21.76	0.987	-4.222	265	<0.001	-0.986	-1.447, -0.526
	Intense Users	142	22.75	2.442					
LE 500 Hz	Mild Users	125	19.97	0.491	-3.664	265	<0.001	-1.011	-1.554, -0.468
	Intense Users	142	20.98	3.049					
LE 1000 Hz	Mild Users	125	19.92	0.691	-3.883	265	<0.001	-1.108	-1.670, -0.546
	Intense Users	142	21.03	3.124					
LE 2000 Hz	Mild Users	125	20.87	1.016	-4.006	265	<0.001	-1.142	-1.703, -0.581
	Intense Users	142	22.01	3.041					
LE 4000 Hz	Mild Users	125	20.88	2.176	-4.113	265	<0.001	-1.627	-2.406, -0.848
	Intense Users	142	22.51	3.923					
LE 8000 Hz	Mild Users	125	22.74	1.959	-3.453	265	0.001	-1.228	-1.928, -0.528
	Intense Users	142	23.97	3.525					

Table 4. Perceived effects of listening to earphones among the study population

Symptoms	Mild Users (n=125)	Intense Users (n=142)	Odds Ratio	95% CI
	Frequency (%)	Frequency (%)		
Headache	20 (16)	51 (35.9)	2.94	1.63-5.29
Fatigue	22 (17.6)	67 (47.2)	4.18	2.3-7.37
Otalgia	28 (22.4)	66 (46.5)	3.00	1.76-5.13
Tinnitus	22 (17.6)	49 (34.5)	2.47	1.39-4.39

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Table 5. Chi-square correlations of earphone usage habits and associated symptoms

		Mild Users (n=125)					Intense Users (n=142)				
		Pearson Chi-Square (X2)	d f (X2)	p-value (X2)	Pearson's R	p-Value (R)	Pearson Chi-Square (X2)	d f (X2)	p-value (X2)	Pearson's R	p-Value (R)
Headache	Volume level	32.715	2	<0.001	0.377	<0.001	32.971	2	<0.001	0.476	<0.001
	Hours per day usage	27.900	3	<0.001	0.431	<0.001	44.114	3	<0.001	0.549	<0.001
	Years since regular use of earphones	3.579	3	0.311	0.062	0.494	3.236	3	0.357	0.074	0.379
Fatigue	Volume level	52.598	2	<0.001	0.561	<0.001	20.719	2	<0.001	0.346	<0.001
	Hours per day usage	40.638	3	<0.001	0.527	<0.001	66.908	3	<0.001	0.660	<0.001
	Years since regular use of earphones	12.809	3	0.005	0.113	0.211	2.871	3	0,412	0.042	0.629
Otalgia	Volume level	47.171	2	<0.001	0.562	<0.001	24.493	2	<0.001	0.408	<0.001
	Hours per day usage	27.095	3	<0.001	0.413	<0.001	54.893	3	<0.001	0.604	<0.001
	Years since regular use of earphones	5.418	3	0.144	0.100	0.268	2.565	3	0.464	0.046	0.588
Tinnitus	Volume level	38.437	2	<0.001	0.447	<0.001	14.785	2	<0.001	0.261	0.002
	Hours per day usage	24.554	3	<0.001	0.410	<0.001	40.528	3	<0.001	0.505	<0.001
	Years since regular use of earphones	17.351	3	<0.001	-0.34	0.705	4.016	3	0.260	0.156	0.064

Discussion

This study aimed to assess NIHL among medical students who frequently use PLDs, the related symptoms associated with their use and to assess and raise awareness regarding the potentially harmful effects of PLDs. A total of 267 medical students aged between 18-26 years were included in this study, with a majority aged between 21-23 years (55.4%). A similar range was mentioned in comparable studies.1, (11). Gender distribution was relatively balanced, with slightly more males (52.4%) than females (47.6%). This demographic spread aligns with previous studies focusing on young adult populations, where the use of PLDs is widespread due to increased reliance on technology for education and entertainment (12, 13). However, in other studies, the population of females was relatively larger than males. It signifies due to relatively more female students being admitted to medical colleges (1). The predominance of first and fourth-year students (31.1% and 27.0% respectively) suggests that earphone usage may vary by year of study, potentially influenced by academic pressures that encourage prolonged study sessions and leisure activities involving audio content.

By using the criteria of Intense usage of PLDs, which was continuous use for one hour, 46.8% of participants constituted a group of mild users (n=125) and 53.2% were regarded as a group of Intense users (n=142). This distribution is contrary to the study conducted by *Ceepa et al*. in which mild users (56%) were more than intense users (44%) (1). A standard octave frequency range from 250Hz to 8000Hz was used to obtain auditory thresholds for air conduction in both ears. Pure-tone thresholds for low, mid and high frequencies were computed at 250, 500, 1000, 2000, 4000, 6000, and 8000 Hz (14). For the right ear, in mild users (n=125), no user showed hearing loss at frequencies 250, 500 and 1000Hz. Mild hearing loss was reported in 0.8 %(n=1), 1.6 %(n=2) and 3.2 %(n=4) of users at 2000, 4000 and 8000Hz respectively. For the left ear, 0.8% (n=1) at 250Hz, 0.8% (n=1) at 4000 Hz and 4.8% (n=6) at 8000 Hz of mild users had hearing loss. In total, 4.8% of mild users had mild hearing loss in one or both ears. No mild user was reported having hearing thresholds above 40dB.

For the right ear, among Intense users, at 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz, 9.2% (n=13) of users had mild hearing loss. The low-frequency hearing loss reported in this study might be due to some underlying pathology or any external disturbance (1). At 4000 Hz, 13.4% (n=19) of users showed mild hearing loss. At 8000 Hz, 6.3% (n=9) exhibited mild hearing loss, and 0.7% (n=1) had moderate hearing loss (40–60 dB). For the left ear, among Intense users, at 250 Hz 1.4% (n=2), at 500 Hz 5.6% (n=8), at 1000 Hz, 7.0% (n=10) at 2000 Hz, 7.7% (n=11), at 4000 Hz, 12.7% (n=18), at 8000 Hz, 12.0% (n=17) showed mild hearing loss. At 8000Hz, 0.7% (n=1) exhibited moderate hearing loss. In total, 4.8% of mild and 13.3% of chronic users had hearing loss in either one or both ears.

The most predominant type of hearing loss found in this study was mild hearing loss (25-40dB). A similar mild hearing loss pattern was observed in a study conducted by *Sadaf et al*. with 73.2% of subjects having mild hearing loss (15). Haruna et.al in Northwestern Nigeria found mild hearing loss in almost 90% of subjects among earphone users (16). *Suleiman et al.* also found mild hearing loss in 92.3% of subjects which aligns with the findings of this study (17). In a study conducted by *Hülya et al.*, it was reported that listening to music with headphones resulted in worse pure tone and high-frequency thresholds in the study

group in comparison to the control group but the thresholds were within normal hearing limit (18).

Sensorineural hearing loss can occur due to prolonged exposure to loud noises resulting in irreversible hearing damage. Earphones exacerbate direct noise exposure and thus increase the risk of serious hearing impairment (19). In this study, sensorineural hearing loss was found in 13.3% of Intense earphone users (earphone usage > 1 hour daily). Similar results were reported in a study in which 13.8% of subjects who used earphones more than 1 hour daily had sensorineural hearing loss (20). The characteristic dip of SNHL was observed at 4000Hz. The study identified a higher prevalence of associated symptoms such as headache (35.9% vs. 16%), fatigue (47.2% vs. 17.6%), otalgia (46.5% vs. 22.4%), and tinnitus (34.5% vs. 17.6%) in Intense users as compared to mild users. The odds ratios for these symptoms were 2.94 for headache, 4.18 for fatigue, 3.00 for otalgia, and 2.47 for tinnitus, with the highest being for fatigue. These findings align with recent literature, as in a study, *Ceepa et al*. reported symptoms such as fatigue and tinnitus having a higher incidence in Intense users, with odds ratios of 1.99 and 1.65 respectively.1 In another study, *Ramya et al.* reported headache (41.9%), as the most common symptom associated with headphone use, with otalgia (36.1%) being the second most common symptom (21). A study by *Abdullah et. al.* reported itching (28%) as the most common symptom, with other symptoms being otalgia (23%), headache (19.4%) and tinnitus (16.5%) (22). this higher prevalence in Intense users highlights a significant correlation between prolonged headphone use and the onset of auditory-related symptoms. It suggests that intense earphone use may not only impact auditory thresholds but also overall well-being, indicating a holistic impact on health that needs further exploration.

The analysis of hearing habits revealed that a majority of participants preferred Bluetooth devices (52.4%). Previous studies have reported that relatively a smaller number of participants use Bluetooth hands-free (21). Saba et al. reported that Bluetooth handsfree was used by only 14% of the participants with insert-type earphones (73.8%) being the most common. This indicated that wireless earphones have become the most common choice of youth recently.11 Smartphone is the most common source used by 224 (83.9%) participants. This finding is supported by previous studies (23). The volume level usage results show that 61 participants (22.8%) listen at or below 60% volume, which is considered safe. In contrast, 120 participants (44.9%) listen at volumes between 60% and 80%, and 86 participants (32.2%) exceed 80% volume, indicating a higher risk of hearing damage. This volume preference aligns with previous studies.15 Overall, a total of 206 participants (77.2%) are using potentially harmful volume levels, emphasizing the need for awareness and education about safe listening practices. In terms of the purpose of usage, the majority of participants used PLDs primarily use headphones for listening to music for entertainment (44.9%) and studying or working (42.3%). As far as the type of content is concerned, the participants primarily used PLDs for music (44.9%) and video content (51.3%). This preference reflects a broader trend among young adults who increasingly rely on mobile technology for entertainment and education (13, 24).

82.8% of participants in the study were aware of the risks associated with headphone use yet a significant gap existed between awareness and action. 94.4% recognized that headphones could lead to hearing issues but many of them still engage in risky behaviours such as sharing earphones with others (62.5%) and not implementing preventive measures (51.7%). This proportion of students who share earphones is even higher than reported in similar studies by *Ramya et al.* (33.8%) and Sachdeva et al (49%).21, 25 16.5% of the participants were familiar with the "WHO 60/60 rule" a guideline which emphasizes safe listening practices. This lack of knowledge is concerning because it indicates that young adults acknowledge the potential risks but most of them are uninformed about the strategies to mitigate these risks. Educational initiatives regarding safe listening practices are urgently needed, as they can play a crucial role in preventing hearing loss among the vulnerable population.

Conclusion

This study has concluded that there is a significant link between prolonged earphone use and the emergence of hearing loss among medical students in South Punjab. The results indicate that students who used personal listening devices (PLDs) for more than one hour per day had notably higher hearing thresholds, especially at higher frequencies, compared to those who used headphones less frequently. Mild sensorineural hearing loss, particularly at 4000 Hz, was the most common form of impairment. Health. Considering the young age of the participants, it should be kept in mind that the hearing thresholds may worsen in the future. Furthermore, the prevalence of symptoms associated with earphone use such as headache, fatigue, otalgia, and tinnitus, was higher in intense users, with the severity of these symptoms being strongly correlated with both the duration of use and the volume levels. Despite being aware of the risks associated with hearing loss, many students did not follow the recommended guidelines, highlighting the need for greater awareness and preventive action.

The cross-sectional design of the study limits the ability to conclude causality between earphone use and hearing loss, as data was collected at only one point in time. Furthermore, the reliance on self-reported information may introduce some degree of recall bias or inaccuracies, although this is unlikely to have a major impact on the results. The sample was taken from a single institution, which may restrict the broader applicability of the findings, but the medical students' demographic details suggest that they belong to various regions in South Punjab and it still offers relevant insights. While potential confounding factors, such as ear infections and environmental noise, were considered and excluded to the best of the researchers' knowledge, other variables like genetic predisposition or occasional exposure to loud sounds were not fully addressed. Despite these limitations, the study provides valuable preliminary data on the potential risks of earphone use about hearing health.

This study may be helpful to educate the youth and raise awareness among them by demonstrating this fact with test results that usage of earphones continuously for the prolonged duration at high volume levels causes permanent damage to their hearing thresholds. To reduce the risk of noise-induced hearing loss (NIHL), it is

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essential to promote safe listening habits, such as adhering to the "Rule of 60" and taking regular breaks during listening sessions. In addition, launching comprehensive public health campaigns aimed at educating young people, particularly students could help control the long-term auditory damage caused by excessive earphone use.

Declarations

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References

1. Thomas CA, Ebenezer R, Joice YS. Prevalence of sensorineural hearing loss among medical students who are chronic mobile phone and earphone users in Trivandrum, South Kerala, India. Indian Journal of Forensic and Community Medicine. 2019 Apr; 6(2):81-5.
2. Kurabi A, Keithley EM, Housley GD, Ryan AF, Wong AC. Cellular mechanisms of noise-induced hearing loss. Hearing research. 2017 Jun 1; 349:129-37.
3. Feldman E. The Effect of Personal Listening Devices on Subjective Hearing Status.
4. Haruna K, Salisu AD, Labaran SA, Fufore MB. Prevalence and pattern of hearing loss among young adults in tertiary institutions with habitual headphone/earphone usage in Kaduna metropolis. Journal of West African College of Surgeons. 2023 Oct 1; 13(4):98-105.
5. Le TN, Straatman LV, Lea J, Westerberg B. Current insights in noise-induced hearing loss: a literature review of the underlying mechanism, pathophysiology, asymmetry, and management options. Journal of otolaryngology-head & neck surgery. 2017 Jan; 46(1):41.
6. Sulaiman AH, Husain R, Seluakumaran K. Hearing Risk among Young Personal Listening Device Users: Effects at High-Frequency and Extended High-Frequency Audiogram Thresholds. Journal of International Advanced Otology. 2015 Aug 1; 11(2).
7. Moustafapour SP, Lahargone K, Gate GA. Noise-induced hearing loss in young adults: The role of personal listening devices and other sources of leisure noise. Laryngoscope 1998; 108:1832-9.
8. Jiang W, Zhao F, Guderley N, Manchaiah V. Daily music exposure dose and hearing problems using personal listening devices in adolescents and young adults: A systematic review. International Journal of Audiology. 2016 Apr 2; 55(4):197-205.
9. Akilarooran A, Lakshmanan G. Survey on usage of Personal listening devices and its effect on hearing health among college students. Drug Invention Today. 2019; 11(6):351-1353.
10. WHO. Hearing Loss Due to Recreational Exposure to Loud Sound: A Review. Geneva: World Health Organization; 2015
11. Asghar S, Khan H, Parveen S, Rafi T. Acoustic trauma inducing 'low frequency sensorineural hearing loss; A cross-sectional study among medical students using Pure Tone Audiometry. Authorea Preprints. 2022 Mar 30.
12. Gilliver M, Nguyen J, Beach EF, Barr C. Personal listening devices in Australia: Patterns of use and levels of risk. InSeminars in hearing 2017 Nov (Vol. 38, No. 04, pp. 282-297). Thieme Medical Publishers.
13. Fageeh YA, Basurrah MA, Almutairi RA, Altalhi WA, Alharthi NS, Alhossaini ZA, Altalhi HH, Alsharif SK. The prevalence and awareness of personal listening device use and hearing loss among medical students in Saudi Arabia. Med Sci. 2022; 26.
14. Degeest S, Clays E, Corthals P, Keppler H. Epidemiology and risk factors for leisure noise-induced hearing damage in Flemish young adults. Noise and Health. 2017 Jan 1; 19(86):10-9.
15. Sadaf Z, Mehboob AJ, Mohammed B, Tooba F, Fateema L, Lubna T, et al. Noise-induced hearing loss related to personal music players—Awareness level among the young users in a developing country. J Dow Uni Health Sci 2004; 8:11-5.
16. Haruna K, Salisu AD, Labaran SA, Fufore MB. Correlation between Hearing Thresholds and Habitual Use of Headphones/Earphones among Students of Tertiary Institutions in Northwestern Nigeria. Research Journal of Health Sciences. 2024 Feb 12; 12(1):22-33.
17. Sulaiman AH, Seluakumaran K, Husain R. Hearing risk associated with the usage of personal listening devices among urban high school students in Malaysia. Public Health. 2013 Aug 1; 127(8):710-5.
18. Osmanoğlu H, Dizdar HT, Koçyiğit AA. The effects of music listening time with headphones on hearing thresholds among the young population. The Egyptian Journal of Otolaryngology. 2024 Jan 24; 40(1):13.

19. Umar RH, Mokhtar S, Arifuddin AT, Pratama AA. Pengaruh Kebiasaan Penggunaan Headset terhadap Gangguan Telinga. Fakumi Medical Journal: Jurnal Mahasiswa Kedokteran. 2023; 3(10):781-7.
20. Rahman NC, Sanna A AT, Lantara AMHD, Sulaiman AB, Pratama AA. The Relationship between the Habit of Listening to Music using Earphones with the Incidence of Hearing Loss in Students of SMA Negeri 8 Luwu Timur 2023. FJST [Internet]. 2024 May 29 [cited 2024 Dec. 1]; 3(5):955-62.
21. Ramya MR, Geetha M. Headphone/earphone usage practices and its health effects among college going students: a cross-sectional study from south India.
22. Alarfaj AA, AlAhmmed LM, Ali SI. Perception of earbuds side effects among teenager and adults in Eastern Province of Saudi Arabia: A cross-sectional study. Clinical Epidemiology and Global Health. 2021 Oct 1;12:100784
23. Mahmood S, Naz S, Asghar E, Maratab S, Yousuf SK. Auditory Threshold Shift Associated With Prolong Use Of Personal Listening Devices For Music Listening Among University Students In Pakistan. Webology. 2022 Apr 1; 19(2).
24. Srihari A, Shanmukananda P, Kumar LS, John S. Analysis of the potential risk of hearing loss among students using personal audio devices. National Journal of Physiology, Pharmacy and Pharmacology. 2021; 11(5):462-5.
25. Sachdeva S, Kumar M. Study on health impacts of ear and headphones among students lives in Chandigarh. Int J Res Appl Sci Eng Technol. 2018; 6(3):3527-1.
26. Humes LE. The World Health Organization's hearing-impairment grading system: an evaluation for unaided communication in age-related hearing loss. International journal of audiology. 2019 Jan 2; 58(1):12-20..

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