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Original Research Article

Assessment of the impact on health associated with earphone usage among medical students: a questionnaire-based cross-sectional study

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ABSTRACT

Background: The use of earphones has become ubiquitous, especially among medical students, due to their utility in academic and recreational activities. However, prolonged and improper usage has raised concerns about auditory and systemic health effects. This study examines earphone usage patterns and their associated health impacts among medical students in Mumbai, India.
Methods: A cross-sectional study was conducted among 747 MBBS students using a structured online questionnaire. Participants provided data on earphone usage patterns, hygiene practices, and health outcomes. Statistical analysis, including logistic regression, was performed to identify risk factors for adverse health effects, with a significance level of $p<0.05$.
Results: All participants reported regular earphone use, with Bluetooth earphones being preferred by 62.7%. Adverse auditory outcomes were reported by 89.3%, including ear pain (48.3%) and tinnitus (43.1%). Systemic effects such as headaches (68%) and blood pressure changes (47.1%) were prevalent, with wired earphone users at higher risk. Psychological impacts included reduced memory recall (30%) and mental fatigue (49.1%). The 58.2% of participants were found to clean their earphones.
Conclusions: Earphone usage among medical students is associated with significant auditory, systemic, and psychological health impacts. Promoting safe listening practices, including limiting usage duration and prioritizing hygiene, is essential. Further longitudinal studies are warranted to establish causation and to develop evidence-based interventions.

Keywords: Earphone usage, Auditory health, Medical students, Noise-induced hearing loss, Health outcomes, Safe listening practices

INTRODUCTION

In today's digital age, earphones have become an indispensable accessory, offering convenience and mobility in audio consumption. Among medical students, earphones have gained widespread popularity, serving as tools for multitasking and enhancing study efficiency. Both wired and wireless (Bluetooth) earphones allow users to listen to music, study, exercise, and attend virtual lectures while on the move.

However, concerns have emerged regarding the potential health impacts of prolonged earphone usage, particularly concerning hearing health. Earphones can produce sound levels ranging from 75 dB to 136 dB, with a mean of 94 dB.[1] Prolonged exposure to levels exceeding 85 dB can potentially cause hearing damage over time.[2]

Noise-induced hearing loss (NIHL) is a significant global public health concern, affecting over 1 billion individuals aged 12-35 years who are at risk due to recreational exposure to high decibel levels (WHO).[3] Exposure to high-decibel noise can lead to NIHL and tinnitus. NIHL results from damage to the cochlea's hair cells due to excessive noise, leading to sensorineural hearing loss.[4] Tinnitus, characterized by phantom auditory perceptions, is often associated with such cochlear damage. In India, excessive earphone usage has been linked to an increasing prevalence of hearing impairment, affecting approximately one in every 12 individuals.[5]

Only a few studies have been done which reported common complaints. Research indicates that prolonged earphone usage leads to symptoms like dizziness, tinnitus, speech comprehension difficulties, and diminished auditory acuity.[6-8] Studies have reported common complaints among students, including headache (41.9%), ear pain (36.1%), itching (27%), and impaired hearing (6.9%).[9] Associations with conditions like tinnitus (22.9%) and anxiety/depressive symptoms (6.5%), and higher sound levels correlating with increased blood pressure highlight broader health implications.[10,11]

Given the pervasive use of earphones among medical students for music, lecture videos, and gaming, there is a critical need to examine their usage patterns and potential health consequences.[12] WHO guidelines recommend limiting earphone use to one hour daily to mitigate risks.[13] Despite the increasing prevalence of earphone usage and associated health concerns, there is limited research focusing specifically on medical students, a group with distinct usage patterns and stress-related vulnerabilities.

Hence, to address these concerns, this study was conducted employing a cross-sectional, questionnaire-based design to gather comprehensive data on earphone usage patterns and health impacts among medical students. This demographic is particularly relevant due to high stress levels, extensive digital device use, and reliance on effective study tools. This study could shed light on the relationship between earphone usage and various health outcomes, contributing to evidence-based public health interventions.

Objectives

Objectives were to assess the prevalence and patterns of earphone usage among medical students. To investigate the association between earphone usage and various health impacts, including auditory system issues, headache, blood pressure abnormalities, and psychological symptoms.

METHODS

Study design

This was a questionnaire-based cross-sectional study conducted among medical students. A convenience sampling method was employed for participant recruitment, as the target population was easily accessible through digital communication platforms.

Setting

The study was conducted in medical colleges across Mumbai, India. Data collection took place over three months, from July 2024 to September 2024, and the study was completed in December 2024. The recruitment process involved circulating an online questionnaire through platforms such as WhatsApp and email.

Participants

The study population consisted of medical students enrolled in the MBBS course.

Inclusion criteria

Medical students currently enrolled in the MBBS program, individuals who had used or were currently using earphones, aged between 18 and 26 years of either sex and willing to provide informed consent were included.

Exclusion criteria

Students with a history of significant hearing impairment unrelated to earphone usage, individuals with a history of ear surgeries, chronic ear infections, or genetic hearing disorders were excluded.

Variables

The primary variables assessed included earphone usage patterns (frequency, duration, and volume levels), demographic information (age, sex and batch), and self-reported health symptoms potentially associated with

earphone use. The outcomes examined were auditory issues, headaches, blood pressure abnormalities, and psychological symptoms.

Data sources and measurement

Data were collected via a Google form questionnaire consisting of 25 structured questions. These included demographic details, specifics of earphone usage, and associated health symptoms. Additionally, the questionnaire assessed participants' awareness of safe earphone practices. The questionnaire was shared with all MBBS batches, from first-year students to interns, ensuring broad coverage.

Bias

Efforts to minimize bias included anonymous data collection to encourage honest responses and the use of a structured questionnaire to standardize data collection. Voluntary participation ensured that only interested and eligible individuals participated.

Sample size

Using the sample size formula for population proportion ($n=Z^2.p.(1-p)/e^2$), with a finite population correction, a sample size of 357 was calculated at a 95% confidence interval. Despite this, a larger study size of 747 students participated enhancing statistical robustness and better capture variability in earphone usage patterns and associated health outcomes.

Quantitative variables

Earphone usage frequency and duration were recorded as continuous variables, while categorical variables included sex, health symptoms (e.g., auditory issues, headache presence), and practices (e.g., safe earphone habits).

Statistical methods

Statistical software used: IBM SPSS Version 23.0 and Microsoft office home and student 2021.

Continuous data has been expressed as mean (Standard deviation). The categorical data is summarized as frequencies and percentages. The continuous variables are analysed using unpaired t test. Unadjusted and adjusted odds ratio with 95% confidence interval is calculated for categorical data using logistic regression. Multiple imputation technique is used to impute missing values in the sex variable. $P<0.05$ are accepted as indicative of statistical significance.

Ethical considerations

Ethical approval for the study was obtained from the institutional ethics committee (IEC). Participation was voluntary, and participants could withdraw at any time without repercussions. The study adhered to ethical principles, including respect for persons, beneficence, and justice.

Informed consent

Participants were presented with an informed consent statement at the beginning of the questionnaire. This outlined the purpose, procedures, potential risks and benefits, and confidentiality assurances. Participants provided consent before completing the form.

RESULTS

Participant flow and recruitment

The study initially identified approximately 800 medical students as potentially eligible based on the inclusion criteria. Of these, 747 participants agreed to participate in this study. All 747 participants completed the questionnaire and were included in the final analysis, resulting in a 100% response rate. There were no exclusions or dropouts during the study. Missing data, particularly for sex, were handled using multiple imputation techniques to ensure robustness in the results.

Participant characteristics

The mean age of participants was 21.9 years (SD=2.3), with a range of 18 to 26 years. The sex distribution included 43.6% males (n=326), 38.4% females (n=287), and 17.9% (n=134) who preferred not to specify their sex. Participants were evenly distributed across the years of the MBBS course: 17.8% in their first year (n=133), 20.9% in their second year (n=156), 23% in their third year (n=172), 23% in their fourth year (n=172), and 15.3% (n=114) were interns.

Prevalence and patterns of earphone usage

All participants reported regular earphone use. Bluetooth earphones were the preferred type for 62.7% of participants (n=468), while 37.3% (n=279) used wired earphones. Noise-cancellation features were used by 46.7% (n=349), and silicon buds were used by 59.3% (n=443).

Patterns of usage of earphones is given in (Table 1). Additionally, 43.4% of participants (n=324) wore earphones without playing any sound.

Students were engaged in using earphones for various purposes, as shown in (Figure 1). These included academic activities such as attending online lectures and listening to educational content, which supported their studies. They also used earphones for recreational purposes like listening to music, exercising, and gaming. Additionally, some students relied on earphones for communication and making phone calls. More than half of the participants (437) were engaged in watching

videos, while playing games was the least common activity (292).

Table 1: Earphone usage patterns among the study participants.

Characteristics	N	Percentage (%)
Frequency of use		
Daily	374	50.1
Once a week	140	18.7
2-3 times a week	128	17.1
1-2 times a month	105	14.1
Usage in a day (in hours)		
<1 hour	113	15.1
1-2 hours	151	20.2
2-4 hours	153	20.5
4-6 hours	202	27.0
> 6 hours	128	17.1

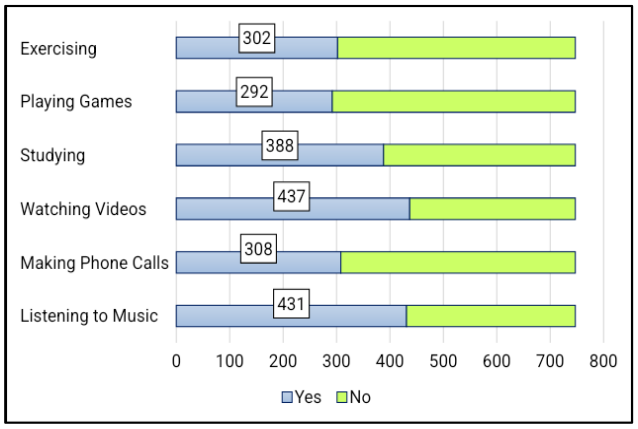

Figure 1: Purpose of using earphones among the study participants.

Table 2: Hygiene during usage of earphones among the participants.

Characteristics	N	Percentage (%)
Earphones shared with friends		
Yes	343	45.9
No	404	54.1
Cleaning of earphones done		
Yes	435	58.2
No	312	41.8
Cotton buds used to clean ears		
Yes	361	48.3
No	386	51.7
Total	747	100

In relation to hygiene related factors, nearly half (45.9%) of the participants reported sharing earphones with friends, potentially facilitating the transmission of pathogens and increasing the risk of infections like otitis externa. While 58.2% of participants cleaned their earphones, a significant 41.8% neglected this practice, highlighting a gap in awareness about its importance.

Additionally, 48.3% of participants used cotton buds for ear cleaning, which, although intended for hygiene, may inadvertently push earwax deeper into the canal, exacerbating wax buildup. These findings, summarized in (Table 2), emphasize the need for targeted educational interventions to promote safer and more hygienic earphone usage practices among medical students.

Health outcomes and associated risk factors

Auditory complaint

Auditory complaints were reported by 89.3% of participants (n=667), as shown in (Table 3). Regarding health impacts related to earphone usage, 48.3% (359 respondents) reported experiencing ear pain, while 46% (342 respondents) mentioned gradual adaptation to high volume. Itching in the ears affected 47.6% (354 respondents), and increased ear wax production was noted by 49.7% (369 respondents).

Changes in hearing ability and tinnitus (ringing in the ears) were each reported by 43.2% (321 respondents) and 43.1% (320 respondents), respectively. Interestingly, 48% (357 respondents) reported no health issues related to earphone usage.

The likelihood of auditory complaints increased with an increase in age in this study. Participants using Bluetooth earphones had lower odds of auditory complaints compared to those using wired earphones. Daily users also had significantly lower odds of auditory complaints than less frequent users.

Participants who did not clean their earphones regularly were at a higher risk of auditory complaints, while sharing earphones increased the likelihood of auditory complaints.

Headache and blood pressure changes

Headaches were reported by 68% of participants (n=508), while 47.1% (n=352) noted changes in blood pressure, with 25.3% (n=189) reporting increased blood pressure as shown in (Table 4). The odds of these symptoms increased with an increase in age.

Bluetooth earphone users had significantly lower odds of headaches and blood pressure changes compared to wired earphone users. Participants using silicon buds were less likely to report these effects. Daily users had reduced odds compared to less frequent users. Regular cleaning of earphones was associated with lower odds, while wearing earphones without sound increased odds of these symptoms.

Psychological and cognitive effects

Among the participants, 190 (25.4%) had decrease in cognitive function, mental fatigue was reported by 49.1%

(n=367), decreased concentration or productivity by 28.5% (n=213), reduced memory or recall by 30% (n=224), and 221 (29.6%) had decreased sleep quality, as shown in (Table 5).

Participants using Bluetooth earphones and participants using silicon buds had significantly lower odds of these effects. Cleaning ears with cotton buds was also associated with a lower likelihood of these outcomes.

Other analyses

Subgroup analyses highlighted significant differences between groups. Bluetooth earphone users consistently showed lower odds of adverse effects compared to wired earphone users across auditory, psychological, and cognitive domains. Participants using silicon buds also demonstrated reduced odds of these outcomes.

Participants' self-assessment of their overall well-being highlights the multifaceted impact of earphone usage, extending beyond physical health to mental well-being. A concerning trend is evident, as only a small fraction of participants reported no adverse effects, while a significant proportion indicated they were considering reducing their earphone usage.

This suggests a growing awareness of the potential risks associated with prolonged and improper use.

These findings, as illustrated in (Figure 2), underscore the urgent need for targeted awareness campaigns to promote safe usage practices and mitigate the associated health outcomes.

Out of the participants, only 31 (4.1%) participants did not report any health issue and 450 (60.2%) considered reducing usage of earphones.

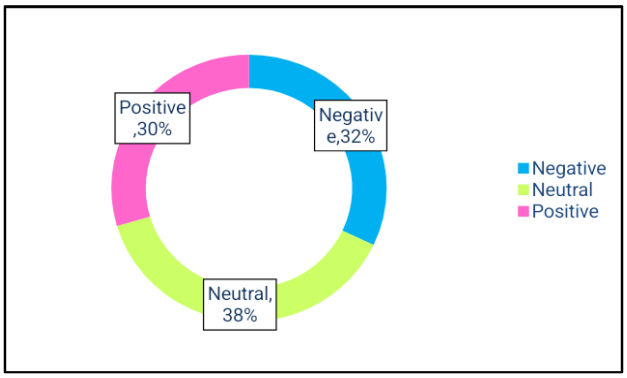

Figure 2: Overall rating of the participants on general wellbeing.

Table 3: Risk factors for auditory complaints among the participants.

Risk factor	Participants with auditory complaints	Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Age (Mean (SD))	22 (2.4) vs 20.8 (1.3)	p<0.0005*	1.24 (1.1-1.398)*
Sex^ [n (%)]			
M	353 (88.3)	1.252 (0.777-2.051)	1.198 (0.717-2.003)
F	314 (90.4)		
Type of earphone			
Wired	264 (94.6)	0.352 (0.197-0.631)*	0.525 (0.281-0.982)*
Bluetooth	403 (86.1)		
Earphones with noise cancelation			
No	352 (88.4)	1.211 (0.758-1.934)	1.427 (0.856-2.377)
Yes	315 (90.3)		
Silicon buds in earphones			
No	283 (93.1)	0.483 (0.287-0.813)*	0.58 (0.331-1.015)*
Yes	384 (86.7)		
Frequency of use			
Less frequent	357 (95.7)	0.217 (0.123-0.383)*	0.284 (0.157-0.514)*
Daily	310 (82.9)		
Duration of use per day			
≤6 hours	548 (88.5)	1.713 (0.833-3.524)	1.501 (0.698-3.227)
>6 hours	119 (93)		
Cleans earphones			
No	292 (93.6)	0.428 (0.252-0.726)*	0.561 (0.32-0.982)*
Yes	375 (86.2)		
Cleans ears with cotton buds			
No	348 (90.2)	0.829 (0.521-1.320)	0.888 (0.543-1.45)
Yes	319 (88.4)		
Shares earphones with friends			
No	352 (87.1)	1.662 (1.024-2.696)*	1.718 (1.03-2.865)*
Yes	315 (91.8)		

Continued.

Risk factor	Participants with auditory complaints	Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Wears earphones without sound			
No	370 (87.5)	1.576 (0.967-2.567)	1.359 (0.806-2.293)
Yes	297 (91.7)		

^Multiple imputation done for missing values. Hence, includes all the cases. *Significant at 0.05 level.

Table 4: Risk factors for health effects (including headache and/or increase in blood pressure) among the participants.

Risk factor	Participants with health effects	Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Age [mean (SD)]	22.1 (2.4) vs 21.2 (1.8)	p<0.0005*	1.148 (1.059-1.245)*
Sex^ [n (%)]			
M	280 (70.7)	0.794 (0.574-1.097)	1.171 (0.796-1.724)
F	263 (75.1)		
Type of earphone			
Wired	239 (85.7)	0.313 (0.213-0.460)*	0.415 (0.274-0.629)*
Bluetooth	305 (65.2)		
Earphones with noise cancelation			
No	288 (72.4)	1.051 (0.761-1.453)	1.249 (0.867-1.8)
Yes	256 (73.4)		
Silicon buds in earphones			
No	248 (81.6)	0.455 (0.320-0.646)*	0.536 (0.365-0.786)*
Yes	296 (66.8)		
Frequency of use			
Less frequent	316 (84.7)	0.282 (0.198-0.400)*	0.364 (0.251-0.528)*
Daily	228 (61)		
Duration of use per day			
≤6 hours	439 (70.9)	1.872 (1.154-3.035)*	1.647 (0.97-2.798)
>6 hours	105 (82)		
Cleans earphones			
No	252 (80.8)	0.486 (0.344-0.687)*	0.62 (0.426-0.904)*
Yes	292 (67.1)		
Cleans ears with cotton buds			
No	291 (75.4)	0.765 (0.554-1.056)	0.768 (0.538-1.098)
Yes	253 (70.1)		
Shares earphones with friends			
No	286 (70.8)	1.252 (0.904-1.734)	1.293 (0.903-1.85)
Yes	258 (75.2)		
Wears earphones without sound			
No	290 (68.6)	1.664 (1.191-2.326)*	1.552 (1.074-2.241)*
Yes	254 (78.4)		

^Multiple imputation done for missing values. Hence, includes all the cases. *Significant at 0.05 level.

Table 5: Risk factors for psychological and cognitive effects (including negative impact on cognition, decreased concentration/productivity, decreases memory/recall, mental fatigue and/ or decreased sleep quality) among the participants.

Risk factor	Participants with health effects	Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Age [mean (SD)]	21.9 (2.4) vs 21.5 (1.9)	p=0.02*	1.044 (0.955-1.142)
Sex^, n (%)			
M	327 (82.6)	0.930 (0.622-1.391)	0.884 (0.57-1.37)
F	286 (81.7)		
Type of earphone			
Wired	254 (91)	0.328 (0.206-0.522)*	0.385 (0.237-0.624)*
Bluetooth	360 (76.9)		

Continued.

Risk factor	Participants with health effects	Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Earphones with noise cancelation			
No	333 (83.7)	0.807 (0.554-1.174)	0.894 (0.601-1.331)
Yes	281 (80.5)		
Silicon buds in earphones			
No	270 (88.8)	0.438 (0.287-0.667)*	0.518 (0.334 - 0.801)*
Yes	344 (77.7)		
Frequency of use			
Less frequent	322 (86.3)	0.564 (0.384-0.828)*	0.725 (0.482-1.09)*
Daily	292 (78.1)		
Duration of use per day			
≤6 hours	504 (81.4)	1.394 (0.814-2.338)	1.26 (0.717-2.215)
>6 hours	110 (85.9)		
Cleans earphones			
No	267 (85.6)	0.665 (0.449-0.985)*	0.831 (0.549-1.257)
Yes	347 (79.8)		
Cleans ears with cotton buds			
No	330 (85.5)	0.626 (0.428-0.914)*	0.629 (0.424-0.933)*
Yes	284 (78.7)		
Shares earphones with friends			
No	324 (80.2)	1.351 (0.922-1.979)	1.403 (0.944-2.085)
Yes	290 (84.5)		
Wears earphones without sound			
No	345 (81.6)	1.106 (0.756-1.617)	1.052 (0.705-1.57)
Yes	269 (83)		

^Multiple imputation done for missing values. Hence, includes all the cases. *Significant at 0.05 level.

DISCUSSION

The study revealed significant findings in alignment with its objectives. The prevalence of regular earphone use among medical students was universal, with Bluetooth earphones being more favored than wired ones. Auditory complaints were common, reported by 89.3% of participants, with factors like wired earphone use, infrequent cleaning, and sharing earphones contributing to higher odds. Headaches and blood pressure changes affected 68% and 47.1% of participants, respectively, with an increase in age and wired earphone use being significant risk factors. Psychological and cognitive effects, including mental fatigue (49.1%) and reduced memory recall (30%), were notable, with wired earphone users and those neglecting hygiene practices demonstrating higher susceptibility. With almost all participants using earphones, the study underscores the growing reliance on earphones for academic, recreational, and communication purposes.

A significant 89.3% of participants reported auditory complaints, including tinnitus (43.1%), ear pain (48.3%), and impaired hearing (43.2%). These findings are consistent with previous studies where tinnitus was reported in 23-36% of earphone users by Ramya et al, Velaro et al and Tyagi et al and hearing problems were noted in 63.1% of users by Aljuaid et al raising concerns about the long-term implications of prolonged and improper earphone use.[9,10,14,15] Notably, among Bluetooth, non-Bluetooth, and combined user groups, tinnitus prevalence was 29.2%, 36.4%, and 28.6%, respectively, along with vertigo complaints in 25%, 36.4%, and 42.9% of these groups, as reported by Hareedy.[18] This emphasizes the widespread nature of auditory symptoms across different types of earphones.

The hygiene practices associated with earphone usage were also concerning. Nearly half of the participants (45.9%) shared earphones, while 41.8% did not clean them regularly, a pattern supported by findings from Magare et al that half of the students in other studies neglected audio device cleaning.[19] Poor hygiene was significantly associated with an increased prevalence of auditory issues, as reported by Thomas et al who found that bacterial growth contributed to conditions like otitis externa in 56-92% of earphone users.[20] These findings underline the importance of educating users about the hygienic practices necessary to mitigate health risks.

Headaches were reported by 68% of participants, which aligns with the prevalence rates of 19.4-41.9% found in studies by Alarfaj et al, Ramya et al and Thomas et al.[7,9,20] Additionally, 26% of participants in one study experienced headaches, and 30% reported ear pain, highlighting the systemic impacts of prolonged earphone use, as observed by Harshitha et al.[21] Such symptoms were notably higher among wired earphone users, while Bluetooth earphone users demonstrated a lower prevalence of both auditory and systemic symptoms, as reported by Aljuaid et al and Hareedy.[15,18] Also, in this study, 25.3% of earphone users reported increased blood

pressure, which is consistent with findings from a study by Okojie et al.[22]

Cognitive and psychological effects, such as decreased concentration (28.5%), mental fatigue (49.1%), and reduced memory recall (30%), were prominent. These findings are consistent with other studies where 11% of participants reported attention and concentration problems, and 43.2% experienced academic performance issues due to earphone use, as noted by Ramya et al and Harshitha et al.[9,21] Furthermore, 89.4% of students reported poor sleep quality, reinforcing the systemic effects of excessive earphone usage, as observed by Ramya et al and Fasanya et al.[9,16] These effects suggest that earphone usage may not only affect physical health but also influence mental well-being and academic performance, critical areas for medical students.

A noteworthy observation was the reduced risk associated with safer practices. Daily usage demonstrated an odds ratio of 0.785, indicating a protective effect compared to irregular use, as reported by Aljuaid et al.[15]

Interestingly, certain factors, such as the use of Bluetooth earphones and silicone buds, were associated with a reduced likelihood of adverse outcomes, which is also supported by previous studies indicating the potential for safer usage practices to mitigate risks, as shown by Aljuaid et al and Hareedy.[15,18]

The study also observed behavioral responses to awareness of earphone-related risks. Among participants, 13% were unlikely to continue using earphones after learning about their potential harm, while 53% remained neutral, indicating a gap in awareness and the need for targeted interventions, as highlighted by Harshitha et al.[21]

Though this study provides a comprehensive assessment of earphone usage patterns and their associated health impacts among medical students, with several key findings aligning with existing literature, it has certain limitations that warrant consideration. First, the use of a convenience sampling method and reliance on self-reported data may introduce selection bias and reporting inaccuracies. Participants might have underreported or exaggerated their symptoms or earphone usage habits due to recall bias or social desirability bias, potentially affecting the validity of the results. The cross-sectional design limits the ability to establish causality between earphone usage and observed health outcomes, as temporal relationships cannot be confirmed. The associations observed between earphone usage patterns and health outcomes provide valuable clues but should be interpreted cautiously, as reverse causation or confounding variables cannot be ruled out. Additionally, the inclusion of medical students from a specific geographic region may limit the generalizability of findings to broader populations with differing usage patterns and health profiles. While efforts were made to minimize bias, such as using anonymous surveys, the potential for misclassification bias in categorizing earphone types, cleaning practices, or health complaints remains. These factors could have influenced the magnitude and direction of observed associations, potentially underestimating or overestimating certain risks.

Despite these limitations, the study's robust sample size and detailed analysis of usage patterns and health impacts contribute significantly to the growing body of literature in this area. These results underscore the multidimensional health impact of earphone usage, fulfilling the study's aim to explore usage patterns and associated health outcomes among medical students.

CONCLUSION

In conclusion, this study underscores the multidimensional health risks associated with earphone use among medical students, emphasizing the critical need for awareness campaigns and formulating the development of public health interventions promoting safe listening practices. By adopting strategies like limiting usage duration, maintaining hygiene, and prioritizing safer earphone types, users can significantly reduce adverse outcomes. While the results are compelling, further research using longitudinal designs and objective measures is necessary to substantiate these findings and explore the underlying mechanisms.

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