

A Descriptive Study to Assess the Impact of Headphone Usage on Hearing Acuity among Students at Dr NGP Institute of Technology, Coimbatore

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Tune in, but don't tune out your hearing!

Abstract

Amid the digital revolution, headphone usage has seamlessly integrated into the daily lives of students. This study was conducted to investigate headphone usage patterns and their impact on hearing acuity at Dr. NGP Institute of Technology, Coimbatore from June to September 2024. A descriptive design was employed to examine headphone usage and its impact on hearing acuity among 205 students at Dr NGP Institute of Technology. Data collection utilised a semi structured questionnaire to assess usage habits and Marcin Masalski's 'The Hearing Test Application' for hearing assessments. The results revealed that 45.4 percent of participants had mild hearing loss in the left ear, and 47.3 percent in the right ear. Factors such as daily headphone use (51.4%), prolonged listening (42.4%), and high-volume levels (61-90 dB) were linked to hearing impairments. Additionally, 51.2 percent of participants experienced ringing sensations, and 27.8 percent reported ear pain. It is concluded that prolonged headphone use among students is linked to significant hearing impairment, with 51.7 percent experiencing hearing loss, highlighting the importance of promoting safe listening habits.

Key words: Headphone usage, Hearing acuity, Auditory health

Hearing loss, particularly due to noise exposure, is a growing public health concern, especially among young adults. The widespread use of personal audio devices, such as headphones and earphones at high volume levels has been linked to noise-induced hearing loss (NIHL). Studies show that sounds above 85 decibels, which is easily reached with many personal listening devices, can cause irreversible damage to the inner ear. This is a serious issue for students, who often use headphones for long periods, whether for studying, entertainment, or socialising.

Headphones, which convert electrical signals into sound, come in various forms like headsets, earphones, and wireless earbuds. While these devices provide convenience, their prolonged use at high volumes raises concerns about hearing impairment. Despite the growing prevalence of hearing loss among headphone users, many remain unaware of the risks of sustained exposure to loud audio levels. This study aims to explore how demographic factors like age, gender, socioeconomic status, and living conditions that affect hearing health and raise awareness about safe listening

habits, and the preventive measures that could help mitigate the risk of hearing damage.

The study by Dillard et al (2022) aimed to determine the prevalence of unsafe listening practices among individuals aged 12-34 years and to estimate the number of young people worldwide who are at risk of hearing loss. A systematic review and meta-analysis of 33 studies found a pooled prevalence estimate of 23.81 percent for exposure to unsafe listening from personal listening devices (PLDs) and 48.20 percent for exposure to loud entertainment venues. The estimated global number of young people at risk ranged from 0.67 to 1.35 billion.

According to the World Health Organization (WHO) (2021), an estimated 700 million people will suffer from debilitating hearing loss by 2050, with 6.3 percent of India's population (63 million) already affected. The report highlights that high-volume headphone use is a significant risk factor for hearing loss, especially among students. Audiologists recommend keeping audio levels below 60 percent of maximum volume, with safe listening levels between 65-85 dB.

The Centers for Disease Control and Prevention (CDC) (2020) stated that noise-induced hearing loss is prevalent among US adults, with 19.2 percent of individuals aged 20-29 and 27.3

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percent of individuals aged 50–59 affected. The condition is more common in men than women and is largely attributed to workplace exposure, loud environments like concerts or sporting events, and headphone use. Hearing damage can occur from exposure to sounds at 85 decibels or higher, equivalent to a lawnmower's noise level. Chronic exposure to noise can also lead to other health problems, including stress, anxiety, high blood pressure, and tinnitus. Experts recommend regular hearing screenings and the use of ear protection to prevent hearing damage.

Need of the study: Amoodi et al (2023) investigated the link between headphone use and hearing problems among Saudi Arabian high school students. Their study of 1703 participants (81.3% female, 18.7% male) found a significant correlation between headphone usage and hearing issues, particularly tinnitus. The research highlights the need for further study to develop interventions and educational strategies promoting safe listening practices among students.

A study by James et al (2020) emphasised that the volume level and duration of headphone usage were critical factors determining the risk for hearing loss. Listening to audio at high volumes (above 85 dB) for more than one hour a day could significantly elevate the risk of hearing damage. These results suggest that awareness campaigns should focus on educating headphone users about safe listening volumes and regular breaks to prevent hearing loss.

Research on headphone usage habits, auditory health, and their association with hearing loss is crucial due to the increasing concerns about potential impacts on individuals' auditory health, especially among younger populations. There is a lack of awareness regarding safe listening levels and practices, necessitating education campaigns.

Understanding the relation between headphone use and hearing loss can lead to preventive measures and public health implications, addressing a significant research gap in bridging behaviours and patterns of headphone usage with hearing acuity for targeted intervention strategies. By elucidating the complex dynamics between headphone exposure and auditory function, this research contributes to advancing our knowledge of the potential risks associated with modern audio practices, thereby fostering informed decision-making and proactive measures to protect and preserve hearing well-being.

Objectives

This study aims :

- To assess the headphone usage habits among students.

- To investigate the hearing acuity of students.
- To find out the association between level of hearing acuity with their demographic variables and headphone usage habits

Review of Literature

Related to Headphone Usage and Its Impact on Hearing Acuity

You et al (2020) analysed the use of personal listening devices (PLDs) among 1009 college students in Korea, focusing on their knowledge of hearing loss and attitudes towards hearing conservation. The researchers used a specially adapted questionnaire with 78 items across 9 categories to assess the students' understanding of hearing loss prevention and their usage habits. Despite most students being aware of how to protect their hearing and recognising the signs of hearing loss, many still used PLDs at high volumes in noisy environments without recognising the risks to their hearing. The study revealed that students' self-reported hearing difficulties were more closely linked to high volume levels rather than the frequency of PLD use. A positive attitude toward hearing conservation was found, particularly among those with more knowledge about hearing loss. The authors suggest that increasing awareness about hearing loss among PLD users could help prevent further hearing damage by encouraging responsible listening practices.

Osmanoğlu et al (2021) investigated the impact of headphone use on hearing thresholds among young adults. The study involved 88 participants aged 18–25, with 44 individuals who used headphones and 44 who did not. The results showed that those who listened to music through headphones had significantly worse hearing thresholds at certain frequencies (4000 Hz, 6000 Hz, 14,000 Hz, 16,000 Hz, and 18,000 Hz) compared to the control group. While both groups had hearing thresholds within the normal range, the study emphasised that prolonged exposure to loud music through headphones could lead to deteriorating hearing over time. The authors concluded that raising awareness about the risks of high-volume headphone use is crucial, especially among young people.

A study by Yash Shrimal & Aparna Nandurkar (2021) examined headphone usage among 341 Indian college students (aged 17–23). It found that 78 percent used headphones for less than 3 hours/day, and 22 percent for more. While 77 percent were aware of the risks of loud sounds, 54.83 percent were unaware of safe listening hours. The study also found a weak positive correlation ($r=0.2304$) between self-reported hearing difficulty and poor high-frequency hearing thresholds, highlighting the need for better awareness and counselling to prevent noise-induced hearing loss.

A study by Asghar Mohammadpoorasl (2018) at Qazvin University of Medical Sciences found that 60.2 percent of 890 students reported hearing loss, with 86.4 percent using earphones. Most listened to music on cell phones (81.7%) and used headphones (89.6%). Earbud-style earphones were most common (51.3%). Frequent earphone use was linked to higher hearing loss scores, indicating a need for awareness and intervention.

Literature Related to Mobile Applications for Hearing Assessment

A study conducted by M. Masalski (2024) explored the Hearing Test app for Android devices, highlighting its distinctive features for pure-tone audiometry. Released over a decade ago, the app has undergone systematic improvements addressing common issues in mobile hearing testing. Masalski discusses mobile device calibration techniques, testing procedures differing from traditional audiometry, bone conduction testing potential, and interpretation considerations including test duration and background noise. The study provides valuable insights for the app's hundreds of thousands of active users worldwide and users of other hearing test apps, emphasising clinically relevant aspects requiring special attention during testing and result interpretation.

A study by Swanepoel et al (2019) explores the use of mobile applications for detecting hearing loss, highlighting both clinical and consumer apps. Clinical apps, which are used in community screening programmes, offer affordable, mobile alternatives to traditional audiometers.

Consumer apps, such as those using pure-tone audiometry or speech-in-noise tests, can assess hearing ability, though their accuracy varies based on device and headphone type. The article discusses the potential of these apps to improve access to hearing care, especially in low-income regions, but also notes challenges like data security and the need for standardisation.

Methodology

This study utilised a quantitative research design to evaluate headphone usage patterns and their potential impact on hearing acuity among students at Dr NGP Institute of Technology, Coimbatore where this study was conducted; it is a private engineering institution in Tamil Nadu, India, providing a suitable environment for evaluating the hearing acuity of young adults.

The target population for the study consisted of undergraduate students who were regular users of headphones. The study aimed to assess students' headphone usage patterns and hearing health.

Sample size and sampling technique: A total of

205 participants were selected for the study using a randomisation technique under a probability sampling approach to ensure a representative sample of the student population. This technique helped minimise selection bias and provided a balanced representation of students from various demographic backgrounds.

Inclusion and Exclusion Criteria

Inclusion criteria: Participants were required to have used headphones for a minimum of six months to ensure familiarity with the risks associated with prolonged headphone usage. Only those who used headphones regularly were included to assess the correlation between usage patterns and hearing acuity.

Exclusion criteria: Participants with any known hearing loss were excluded to avoid confounding variables and ensure that the study specifically examined the effects of headphone usage on hearing acuity.

Data Collection Tools

A semi structured questionnaire was used to collect data on the participants' headphone usage patterns, including frequency, duration, and volume levels. Additionally, demographic information such as age, gender, parents' occupations, and socioeconomic status were collected. The questionnaire also assessed participants' living conditions (e.g., accommodation type, area of residency) and auditory experiences, including symptoms like discomfort, tinnitus (ringing sensations), and any difficulties in hearing or understanding sounds.

Hearing test application: Hearing acuity was assessed using a Hearing Test Application designed to measure auditory thresholds at various frequencies (e.g., 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, etc.). The reliability and validity of this application have been previously established through calibration against standard audiometric tools in research settings

Reliability and validity: The questionnaire was validated through a pilot study conducted among a smaller sample of 30 students, ensuring its clarity, relevance, and ability to capture the intended data on headphone usage and hearing health.

The Hearing Test Application was chosen based on its previous validation in research, with reliable calibration against standard audiometric tools. The app has been shown to accurately measure hearing thresholds in a variety of populations, including students, and is a reliable tool for field-based hearing assessments.

Ethical clearance: Ethical approval for this study was obtained. Participants were informed about the study's objectives, procedures, and

written informed consent was obtained from all participants. Participation was voluntary, and students had the right to withdraw from the study at any time without consequence. All personal data was kept confidential and securely stored, ensuring anonymity.

Data Analysis

Descriptive statistics were used to summarise demographic data and headphone usage patterns. Descriptive statistics was used to analysis the frequency, percentage of demographic variables, headphone usage patterns. The chi-square was used to associate the selected demographic variable with headphone usage on hearing acuity.

Results

Demographics characteristics (Fig 1): The study comprised 205 students with a mean age of 19 years, evenly split between genders (52.19% male, 47.8% female). Most participants (59%) were day scholars, while others resided in campus hostels (10.2%), private hostels (14.6%), or paying guest accommodations (1.46%). Geographically, 54 percent came from urban areas, 10.7 percent from suburban areas, and 35 percent from rural areas.

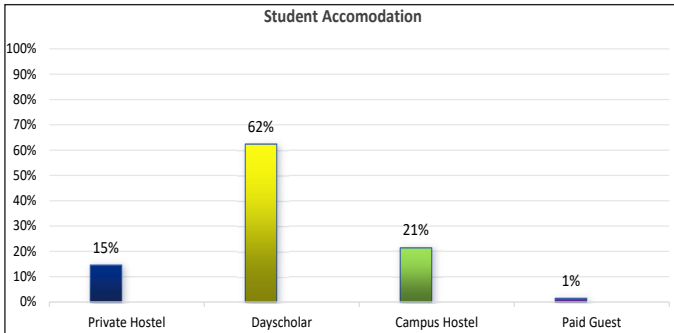


Figure 1: Percentage distribution of student accommodation.

Headphone Usage Patterns

Headphone usage patterns revealed 51.4 percent used headphones daily, with 42.4 percent listening for 1-2 hours at volumes exceeding 61-90 dB (Fig 2&3). Notably, 27.8 percent experienced ear pain,

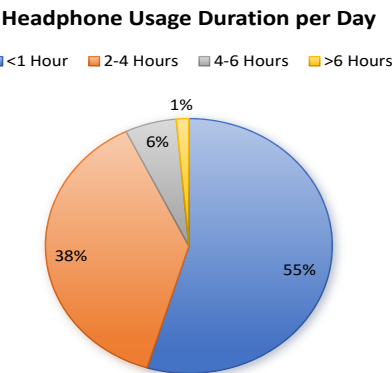


Figure 2: Percentage distribution of headphone usage duration per day.

10.7 percent reported headaches, and 51.2 percent had ringing sensations in their ears. Additionally, 93.6 percent primarily used smartphones with headphones, split between earphones (28.2%) and wireless headphones (56%).

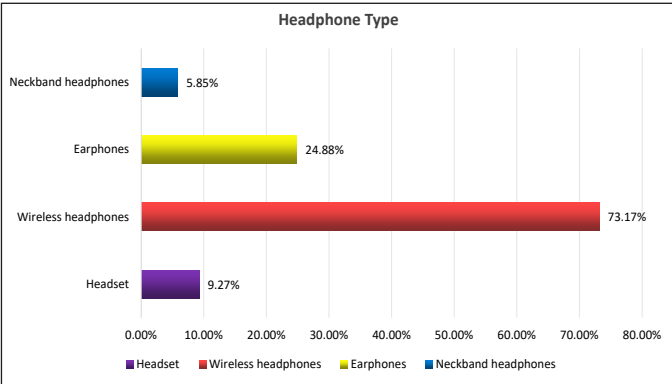


Figure 3: Percentage distribution of type of headphone used by students.

Hearing Test Results

The analysis of hearing acuity revealed significant differences between the right and left ears. In the right ear, 30 percent had normal hearing, 47 percent had mild hearing loss, 19 percent had moderate loss, and 3 percent had severe hearing loss (Table 1, Fig 4). In comparison, the left ear showed 35 percent with normal hearing, 45 percent with mild loss, 18 percent with moderate loss, and only 1 percent with severe loss. Mild hearing loss was more prevalent in both ears, with a slightly higher occurrence in the right ear. These findings underscore the need for attention to hearing health, as mild to moderate hearing loss was widespread among the participants.

Table 1: Assessment of hearing acuity among students (N=205)

S.No.	Normal hearing	Mild hearing loss	Moderate hearing loss	Severe hearing loss
Left ear	73 (35.6%)	93 (45.4%)	36 (17.6%)	3 (1.5%)
Right ear	62 (30.2%)	97 (47.3%)	39 (19.0%)	7 (3.4%)

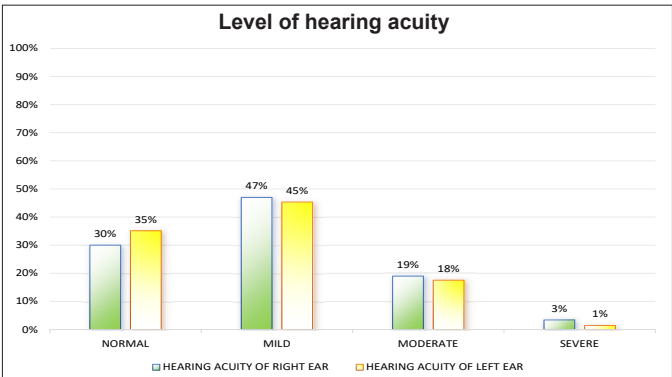


Figure 4: Percentage distribution of hearing acuity levels.

Table 2: Association between the level of hearing acuity with their demographic variables and headphone usage patterns (N=205)

Demographic variable & headphone usage habits	Left ear chi-square value (CV)	Right ear chi-square value (CV)	Degrees of freedom (Df)	Table value Level of significance, 0.05
Year of study	21.55*	17.5*	9	16.919
Age	8.7	19.3*	9	16.919
Gender	3.35	5.83	3	7.815
Student accommodation	9.86	17.5*	9	16.919
Area of residency	7.16	4.91	6	12.592
Type of headphone device used	12.5	14.6*	9	16.919
Frequency of headphone Use	5.29	11.7	9	16.919
Frequency of taking breaks from headphones	11.55	14.3	9	16.919
Hours of headphone use per day	22.53*	14.3	9	16.919
Preferred volume level when using headphones	13.8	11.4	9	16.919
Use of headphones to fall asleep or relax	9.85	9.85	9	16.919
Sharing headphones with others	13.15	21*	9	16.919
Ringing sensation in ears after using headphones	8.36	19.9*	9	16.919
Ear discharge after using headphones	22.1*	31.2*	9	16.919

Discussion

Headphone Usage Habits

Descriptive statistics revealed that 51.4 percent of students used headphones daily, with 42.4 percent listening for 1-2 hours at volumes exceeding 61-90 dB. Common issues reported included ear pain (27.8%), headaches (10.7%), and ringing sensations (51.2%). A significant majority (93.6%) primarily used smartphones with headphones, preferring wireless headphones (56%) over earphones (28.2%). These findings underscore the prevalent and potentially risky headphone usage patterns among students (Table 2).

The findings of this study bear similarities to the study by Fassanya (2019), who surveyed 280 college students to understand their headphone usage habits and the associated health and academic impacts. It found significant patterns,

such as 84 percent being daily users and 79 percent listening at high volumes for over an hour. These findings align with our first objective of assessing the headphone usage habits among students.

Hearing Acuity

The hearing test results indicated significant differences in hearing acuity between the right and left ears. In the right ear, 30 percent of students had normal hearing, 47 percent had mild hearing loss, 19 percent had moderate loss, and 3 percent had severe hearing loss. For the left ear, 35 percent had normal hearing, 45 percent had mild loss, 18 percent had moderate loss, and 1 percent had severe loss. These results highlight the widespread occurrence of mild to moderate hearing loss, emphasising the need for routine hearing assessments and preventive measures.

The findings of this study bear similarities to the study by Haruna et al (2024) examined the hearing thresholds among undergraduate students using headphones or earphones and found that prolonged use at higher volumes led to poorer hearing acuity. This supports our second objective of investigating the hearing acuity of students.

Demographic Associations

The analysis revealed significant associations between headphone usage patterns and hearing acuity, aligning with the study's third objective. Male students (52.19%) and day scholars (59%) showed higher instances of prolonged headphone use. The type of device (56% wireless headphones, 28.2% earphones), listening duration (42.4% for 1-2 hours), and volume levels (61-90 dB) influenced hearing acuity. Urban students (54%) used headphones more extensively, leading to higher hearing issues.

The findings of the study, which identified significant associations between headphone usage patterns and various demographic variables, bear similarities to the study by Goman & Lin (2016) on recreational noise exposure and hearing function in young adults. Both studies recognised factors such as age, gender, and type of device used as influential in the context of noise exposure and its adverse effects on hearing acuity. The approach taken in the referenced study, utilising audiological tests and statistical analysis, mirrors the methodology used in the current study. This alignment highlights the need for long-term assessments and targeted interventions to reduce the risks of hearing loss among young adults, underscoring the importance of demographic considerations in developing preventive strategies.

Recommendations

Neurological impact study: Investigate effects of headphone usage on cognitive function, memory, and mental health.

Long-term effects investigation: Conduct longitudinal study on prolonged headphone usage impact on hearing acuity.

Technological innovations analysis: Evaluate effectiveness of AI-powered hearing protection, smart headphones, and noise-cancellation technology.

Comparative study on hearing protection strategies: Compare effectiveness of earplugs, volume limits, and other hearing protection measures.

Sleep quality investigation: Investigate impact of headphone usage on sleep quality, duration, and overall well-being.

Interdisciplinary research collaboration: Foster partnerships between audiologists, psychologists, educators, and technologists.

Headphone usage and nutrition study: Investigate the relationship between headphone usage and eating habits, nutrition, and appetite regulation.

Sedentary behaviour analysis: Examine the impact of headphone usage on sedentary behaviour, physical activity levels, and exercise habits.

Sleep pattern disruption study: Investigate the effects of headphone usage before bedtime on sleep quality, duration, and circadian rhythm.

Study Implications

The study highlights the need for increased awareness of safe listening practices among students. Educational interventions focusing on the risks associated with high-volume headphone use could be beneficial.

Limitations: The study's reliance on self-reported data may introduce bias.

Conclusion

This study underscores the alarming impact of headphone usage on hearing acuity among students, highlighting a critical public health concern. The findings reveal that nearly half of the participants (47% in the right ear and 45% in the left ear) exhibit mild hearing loss, with a significant proportion (19% in the right ear and 18% in the left ear) experiencing moderate hearing loss. The prevalence of hearing impairment is particularly concerning given the young age of the participants (mean age 19 years).

The study identifies key risk factors associated with hearing loss, including living conditions, using headphones in wet conditions, sharing headphones, ear discharge presence, and age-related differences. Notably, the analysis reveals significant correlations between these factors and hearing acuity, emphasising the complex interplay between environmental, behavioural, and demographic factors influencing auditory health. As nurses, we must prioritise education and prevention, promoting

healthy listening habits and responsible headphone use. Key strategies include:

1. Hearing health education and screenings.
2. Encouraging volume limits and regular breaks.
3. Collaborating on guidelines for safe headphone use.

“By acting now, we can protect the auditory health and well-being of our young adults.”

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