

HEADPHONE USE AND HEARING IN MEDICAL STUDENTS AT A PUBLIC UNIVERSITY IN LIMA, PERU

USO DE AURICULARES Y LA AUDICIÓN EN ESTUDIANTES DE MEDICINA DE UNA UNIVERSIDAD PÚBLICA DE LIMA, PERÚ

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ABSTRACT

Introduction: Hearing loss affects millions globally, especially young people who frequently use headphones. **Objective:** To establish the relationship between headphone use and hearing among medical students in Lima, Peru. **Methods:** An observational, analytical, and cross-sectional study was conducted at the Universidad Nacional Federico Villarreal. Participants included 98 medical students (18-32 years) who regularly used headphones. Those with previous hearing pathologies were excluded. Data collection included surveys on headphone use and audiometries performed in a silent booth. Results were analyzed using descriptive and inferential statistics, employing the Spearman's Rho correlation coefficient to assess the relationship between variables. **Results:** 59.2% of the students were women. 39.2% had mild hearing loss at high tones, while 36.2% had normal hearing. 71.4% reported decreased hearing capacity, and 56.1% experienced ear pain. Headphone use showed a positive and significant correlation with hearing ($Rho = 0.298$, $p = 0.003$). Exposure time was also significant ($Rho = 0.260$, $p = 0.010$), but sound intensity was not ($Rho = 0.193$, $p = 0.057$). **Conclusion:** There is a positive relationship between headphone use and hearing loss in medical students. It is recommended to implement awareness programs on safe headphone use and conduct regular hearing evaluations to prevent auditory deterioration.

Keywords: Hearing loss; Hearing aid use; hearing aids; hearing loss; Medical students. (Source: MESH-NLM)

RESUMEN

Introducción: La pérdida auditiva afecta a millones globalmente, especialmente a jóvenes que usan auriculares frecuentemente. **Objetivo:** Establecer la relación entre el uso de auriculares y la audición en estudiantes de medicina en Lima, Perú. **Métodos:** Se realizó un estudio observacional, analítico y transversal en la Universidad Nacional Federico Villarreal. Participaron 98 estudiantes de medicina (18-32 años) que usaban auriculares regularmente. Se excluyeron aquellos con patologías auditivas previas. La recolección de datos incluyó encuestas sobre el uso de auriculares y audiometrías realizadas en una cabina silente. Los resultados se analizaron mediante estadística descriptiva e inferencial, utilizando el coeficiente de correlación de Rho de Spearman para evaluar la relación entre las variables. **Resultados:** El 59,2% de los estudiantes eran mujeres. El 39,2% presentó hipoacusia leve a tonos agudos, mientras que el 36,2% tenía audición normal. El 71,4% reportó disminución de la capacidad auditiva y el 56,1% experimentó otalgia. El uso de auriculares mostró una correlación positiva y significativa con la audición ($Rho = 0,298$, $p = 0,003$). El tiempo de exposición también fue significativo ($Rho = 0,260$, $p = 0,010$), pero la intensidad del sonido no lo fue ($Rho = 0,193$, $p = 0,057$). **Conclusión:** Existe una relación positiva entre el uso de auriculares y la pérdida auditiva en estudiantes de medicina. Se recomienda implementar programas de concienciación sobre el uso seguro de auriculares y realizar evaluaciones auditivas periódicas para prevenir el deterioro auditivo.

Palabras clave: Hipoacusia; Uso de auriculares; Audición; Pérdida auditiva; Estudiante de medicina. (Fuente: DeCS-BIREME)

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INTRODUCTION

Hearing loss is a significant public health problem affecting millions of people worldwide. According to data from the United Nations (UN), half of young people listen to music with headphones at a dangerous volume, and according to the World Health Organization (WHO)⁽¹⁾, more than 1 billion people aged 12 to 35 are at risk of hearing loss due to prolonged and excessive exposure to loud music⁽²⁾. Locally, it is noted that frequent use of headphones not only causes irreversible hearing damage but also stress, anxiety, and nervous system disorders⁽³⁾. These statistics underscore the severity of the problem and the urgent need for preventive and awareness measures, especially among young people who regularly use audio devices.

Various studies have investigated the relationship between headphone use and hearing loss in medical students and other educational levels. It has been shown that headphone use is significantly associated with hearing problems among students⁽⁴⁾, as well as the presence of tinnitus and acoustic trauma⁽⁵⁾. International studies have linked the degree of hearing loss in students to the intensity and frequency of audio device use^(6,7). In the Peruvian context, specifically in the north⁽⁸⁾, an association was found between the use of portable players and sensorineural hearing loss in medical students, while in the south of the country, a significant relationship was identified between hearing loss and the use of music headphones in schoolchildren⁽⁹⁾.

Despite various studies exploring the relationship between headphone use and hearing loss in students, several aspects remain under-investigated. Most studies have focused on general populations or specific regions outside Lima, leaving a gap in the literature about the impact on medical students in this city, who exhibit particular habits due to their long study hours and frequent use of electronic devices. Additionally, there has not been sufficient study on how specific preferences for types of headphones, such as ear cups, in-ear, circumaural, and supra-aural, affect users' hearing⁽¹⁰⁾. While some studies mention general symptoms such as tinnitus, few have detailed the

frequency of other symptoms such as otalgia and the perception of hearing loss.

This study is of great importance because it analyzes the relationships between headphone use, exposure time, sound intensity, and hearing loss, providing more precise and detailed data than previous studies. This approach raises awareness among students about the risks associated with improper headphone use and its impact on hearing health. Therefore, the main objective of this study is to establish the relationship between headphone use and hearing in medical students at a public university in Lima, Peru.

METHODS

Study design and area

An observational, analytical, and cross-sectional study was conducted at the Universidad Nacional Federico Villarreal, a public university in Lima, Peru. The research focused on students from the Faculty of Medicine, a key population due to their intense study loads and frequent use of audio devices.

Population and sample

The population consisted of 130 medical students from the Universidad Nacional Federico Villarreal during the 2023-II academic year. Inclusion criteria were: being between 18 and 32 years old, enrolled during the 2023-II academic year, regular headphone use (at least three times a week), and no known history of auditory pathologies. Students with a history of prior auditory pathologies (ear surgery, recurrent otitis media, congenital hearing loss, genetic hearing loss, use of ototoxic medications, etc.) and those who did not consent to participate in the study were excluded. To calculate the sample size, the formula for a finite population with a 95% confidence level and a 5% significance was applied, resulting in a sample of 98 students. The sample was not adjusted for losses as all participants met the specified inclusion and exclusion criteria. The sampling technique used was simple random sampling, without stratification by academic cycle, as all participants shared common characteristics such as age range, regular headphone use, and no





history of auditory pathologies.

Variables and instruments

The independent variable of the study was headphone use, defined as transducers that receive an electrical signal and use speakers placed in the ear region to convert the signals into audible waves. Various models exist, such as circumaural, supra-aural, in-ear, and earbuds⁽¹¹⁻¹³⁾. The dependent variable was hearing, defined as the human ability to perceive sounds, allowing communication through language, and depending on the function of the auditory system and the sociocultural environment in which it develops⁽¹⁴⁻¹⁶⁾.

The instruments for data collection included a questionnaire titled "Survey on the frequency of headphone use directed at secondary school students," consisting of 19 questions related to the variables headphone use and hearing. This questionnaire was adapted from Vera Tapia Cristhian⁽⁹⁾ and validated by expert judgment, showing acceptable reliability (Cronbach's alpha: 0.74). Otoscopy was also performed using a Welch Allyn otoscope to visualize the external auditory canal and tympanic membrane, ruling out alterations such as otitis, perforations, foreign bodies, impacted cerumen, external otitis, exostosis, and ear tumors. Audiometry was conducted in a soundproof audiometric booth using a Sibelmed brand audiometer, model Sibelound, to categorize the students' hearing levels.

Procedure

With the authorization of university authorities and informed consent signed by the participants, data collection was carried out through surveys. Otoscopies and audiometries were performed by an otorhinolaryngology specialist. Tonal audiometry was conducted in a soundproof audiometric booth, designed to block external noises and provide a controlled environment for auditory evaluation. A Sibelmed brand audiometer, model Sibelound, was used to assess the students' hearing ability across different frequencies (250 Hz, 500 Hz, 1,000 Hz, 2,000 Hz, 4,000 Hz, and 8,000 Hz). Audiometry results were categorized into four levels based on auditory

thresholds: normal hearing (auditory threshold between -10 dB and 25 dB), mild hearing loss (auditory threshold between 26 dB and 40 dB), moderate hearing loss (auditory threshold between 41 dB and 55 dB), and severe hearing loss (auditory threshold between 56 dB and 70 dB). Otoscopy findings were categorized according to the presence or absence of alterations in the external auditory canal and tympanic membrane: normal (no visible alterations) and abnormal (presence of otitis, perforations, foreign bodies, impacted cerumen, external otitis, exostosis, or tumors).

Statistical analysis

The results were analyzed using descriptive and inferential statistics with SPSS version 26 software. Descriptive analysis utilized frequencies and percentages to summarize sample characteristics. For bivariate analysis, Spearman's Rho correlation coefficient was used to assess the linear relationship between headphone use and hearing, given that the variables did not follow a normal distribution. A significance level of 0.01 was considered.

Ethical aspects

The research was approved by the ethics committee of the Faculty of Medicine at the Universidad Nacional Federico Villarreal. The study adhered to the four principles of biomedical research ethics: respect for persons, beneficence, non-maleficence, and justice. Students participated voluntarily, signed informed consent, and the information obtained was used exclusively for the study purposes, preserving data confidentiality.

RESULTS

Table 1 shows that the majority of medical students are female (59.2%) and that the preferred type of headphone is the ear cup (62.2%). Regarding audiometry, 39.2% have mild high-tone hearing loss, while 36.2% have normal hearing. In terms of hearing loss symptoms, 71.4% report a decrease in hearing capacity, and 56.1% experience otalgia. In terms of use, 30.6% use headphones for 1 to 2 hours without a break per day, and 54.1% prefer a medium volume.

Table 1. Characteristics of headphone use in medical students at a public university in Lima, Peru.

Category	Frequency	Percentage
Sex		
Female	77	59.2%
Male	53	40.8%
Audiometry		
Mild high-tone hearing loss	51	39.2%
Normal hearing	47	36.2%
Others	32	24.6%
Headphone type preference		
Ear cup	61	62.2%
In-ear	21	21.4%
Circumaural	15	15.3%
Supra-aural	1	1.0%
Symptoms of hearing loss		
Tinnitus	46	46.9%
Sensation of hearing loss	41	41.8%
Otalgia	56	56.1%
Decreased hearing capacity	71	71.4%
Continuous usage time per day		
1 to 2 hours	30	30.6%
30 minutes to 1 hour	28	28.6%
15 to 30 minutes	25	25.5%
2 hours or more	15	15.3%
Exposure time per week		
3 to 4 days	43	43.9%
5 days or more	39	39.8%
1 to 2 days	16	16.3%
Sound intensity		
High volume	28	28.6%
Medium volume	53	54.1%
Low volume	17	17.4%

In Table 2, it can be observed that headphone use (Spearman's $Rho = 0.298$, $p = 0.003$) and exposure time (Spearman's $Rho = 0.260$, $p = 0.010$) show statistically significant correlations with hearing in medical

students, while sound intensity does not present a significant correlation (Spearman's $Rho = 0.193$, $p = 0.057$).



Table 2. Factors correlated with hearing in medical students at a public university.

Factor	Spearman's Rho Correlation Coefficient	p-value
Headphone use	0.298	0.003
Exposure time	0.260	0.010
Sound intensity	0.193	0.057

DISCUSSION

Of the total students evaluated, the majority presented mild hearing loss at high tones or frequencies. This finding is similar to the study conducted by Guíñez et al.⁽⁵⁾, who found that a high percentage of their participants (42.5%) presented acoustic trauma due to prolonged exposure to loud sounds. Hearing loss and acoustic trauma are related, as both can result from exposure to high noise levels. Additionally, acoustic trauma is a form of auditory injury that can lead to hearing loss, especially at high frequencies⁽¹⁷⁾. The prevalence of hearing loss in our study could be due to prolonged use and high volume of headphones during the COVID-19 pandemic when virtuality significantly increased the use of these devices^(18,19).

Regarding the exposure time to headphone use, most students used them between one and two continuous hours without breaks, and between three to four days per week. This suggests that prolonged headphone use, defined in similar studies as use for more than one continuous hour per day and more than five days per week, can cause auditory alterations, agreeing with Dávila⁽²⁰⁾, who mentioned that prolonged and high-volume headphone use can generate symptoms of hearing loss. The consequences of this prolonged use include the possibility of developing sensorineural hearing loss, which can negatively affect the academic and social performance of students.

The intensity of the sound used by the students is also a critical factor, as in our study most used it at medium-high volume. Previous studies, such as that of Figueroa and González⁽¹³⁾, found that 58.5% of students used headphones at medium volume and 33.7% at high volume. Repeated exposure to loud sounds can damage the hair cells of the inner ear, leading to progressive hearing loss that is, in many cases, irreversible. Additionally, using headphones at high volumes can

increase susceptibility to developing tinnitus and otalgia, affecting the quality of life and general well-being of students. Analyzing the symptoms of hearing loss associated with headphone use, we found that a significant proportion of students presented tinnitus, a sensation of hearing loss, otalgia, and a perception of decreased hearing capacity. These results are consistent with the study by Figueroa and González⁽¹⁵⁾, who reported tinnitus in 61.5%, decreased hearing in 53.2%, and otalgia in 47.3% of cases. Similarly, Escobar et al.⁽¹⁶⁾ also found that the most frequent symptom among headphone users was tinnitus (72%). These symptoms can affect students' quality of life, interfering with their daily activities and concentration ability.

Tinnitus is commonly reported because prolonged exposure to loud sounds damages the hair cells of the inner ear, which then send erroneous signals to the brain perceived as ringing. The sensation of hearing loss is due to the gradual damage that continuous noise causes to the inner ear, permanently affecting hearing capacity, while otalgia may result from prolonged headphone use that exerts pressure on the ear canal or infections caused by unhygienic devices.

Our study found a significant correlation between headphone use and hearing. This positive correlation suggests that headphone use is directly related to the onset of hearing loss. This aligns with Vera's research⁽⁹⁾, which also found a significant relationship between hearing loss and headphone use. The interpretation of this finding suggests that headphone use practices should be monitored and regulated to prevent auditory damage among students, and there is a need for audio device manufacturers to consider including volume limiters and warnings about safe use in their products. It also highlights the importance of conducting periodic hearing

evaluations in young people who frequently use headphones, to early detect any signs of auditory deterioration and take appropriate preventive measures.

A significant correlation was also observed between exposure time to headphone use and hearing. This finding is similar to that of Escobar et al.⁽¹⁶⁾, who suggested the presence of hearing loss associated with prolonged noise exposure in medical students in Paraguay. This indicates that not only the sound intensity but also the duration of headphone use plays a crucial role in students' auditory health. Although a positive correlation was found between sound intensity at headphone use and hearing, this relationship was not as strong as that observed with exposure time. However, studies such as that of Figueroa and González⁽¹⁵⁾ also suggest that people tend to suffer more severe hearing loss risks concerning prolonged exposure time and high volume.

Our study has some limitations. The sample was limited to students from a single university, which may not be representative of the entire student population. Additionally, the cross-sectional nature of the study does not allow establishing causality. Self-reporting of symptoms can also introduce information bias, as participants may not accurately recall their headphone use habits or the severity of their symptoms. Other potentially influential factors, such as the type of music listened to, the environment in which headphones are used (noisy or quiet), and other habits that could affect hearing, such as exposure to loud noises in leisure places, were not evaluated. Despite these limitations, the study is one of the few that specifically addresses

the relationship between headphone use and hearing in medical students in Lima, providing valuable data on a key population. Additionally, the use of validated auditory evaluation methods and the application of robust statistical analyses as employed reinforce the reliability of the findings. These results could serve as a basis for future research and the implementation of preventive measures in the educational field.

CONCLUSION

The study concludes that there is a direct and positive relationship between headphone use and hearing in medical students at the Universidad Nacional Federico Villarreal. Additionally, there is a direct and positive relationship between exposure time and sound intensity at headphone use and hearing in these students, although not statistically significant. Moreover, an association was found between prolonged high-volume exposure with headphone use and hearing loss symptoms.

Based on these findings, it is recommended that educational institutions implement awareness programs about the safe use of headphones, emphasizing the risks of prolonged and high-volume exposure. It is also essential to conduct periodic hearing evaluations in students who frequently use headphones to early detect any signs of auditory deterioration and take appropriate preventive measures. Lastly, future research should consider expanding the sample to multiple universities and employing a longitudinal design to explore causality and use more diverse and complementary auditory evaluation methods.

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