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ORIGINAL ARTICLE

Effects of using personal headphones on hearing: Example of faculty of health sciences students

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ABSTRACT

Objectives: This study aims to screen the hearing thresholds of university students, determine their daily personal headphone usage durations, and evaluate their speech perception performance in noise.

Patients and Methods: Between January 2022 and january 2023, a total of 90 university students (20 males, 70 females; mean age: 22.13±2.50 years; range, 18 to 32 years) were enrolled in this study. Participants were divided into two groups based on their daily personal headphone usage duration: Group 1 (< 3 h/day, n = 43) and Group 2 (> 3 h/day, n = 47). Routine pure-tone (125-8000 Hz) and speech audiometry, high-frequency audiometry (9-20 kHz), and immittance measurements were performed. Speech-in-noise perception performance was also assessed. ANCOVA was used to control for age and sex, and Bonferroni correction was applied for multiple comparisons.

Results: No significant differences were found between the groups in routine hearing thresholds or speech-in-noise performance ($p > 0.05$). Regarding extended high-frequency thresholds, although Group 2 tended to have higher thresholds at 14, 16, and 18 kHz compared to Group 1, these differences did not reach statistical significance after adjusting for age, sex, and multiple comparisons ($p > 0.05$).

Conclusion: The findings indicate that while prolonged headphone use shows a clinical trend toward elevated high-frequency thresholds, the results remain statistically non-significant in the adjusted models. Raising awareness about safe listening habits among young adults remains crucial for the long-term preservation of auditory health.

Keywords: High-frequency hearing loss, understanding speech in noise, use of headphones.

The use of personal headphones for activities such as listening to music and mobile communication is ubiquitous in the modern era; this trend has seen a particularly sharp increase among adolescents and young adults, including high school and university students, compared to previous years.[1,2] This frequency and duration of personal headphone use cause young people to be exposed to noise and, therefore, the risk of hearing loss.[3] According to the World Health Organization (WHO), 43 million people between the ages of 12 and 35 have hearing loss, and half of these are caused by the use of headphones.[4] Many studies on personal headphone use have shown that almost half of surveyed teenagers and young adults are at risk of constant exposure to loud noise during personal headphone use, while only a few have safe listening habits or attitudes.[5,6] Additionally, the WHO estimates that more than 1.5 billion people worldwide are at risk of some form of hearing loss due to listening at unsafe volumes.[7]

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Various studies have shown that prolonged exposure to high sound levels caused by music or noise can lead to auditory symptoms such as temporary hearing loss, threshold shifts, and permanent hearing loss.[4,8,9] Noise exposure is associated with damage to sensory cells in the inner ear (cochlea), usually in outer hair cells. The formation of oxidative stress and the occurrence of synaptic excitotoxicity are the main causes of cochlear damage.[10,11] The functional consequences of noise-induced cochlear damage include a permanent hearing threshold shift as well as impaired speech discrimination in noise. In humans, the early symptom of noise-induced hearing loss (NIHL) is the presence of an audiometric notch at frequencies of 4-6 kHz as well as a decrease in high-frequency hearing thresholds. Hearing threshold shifts due to intense noise exposure are sometimes temporary in their early stages and manifest themselves as temporary threshold shifts. However, repeated chronic exposure or a single intense acoustic event can lead to lasting impairment, clinically recognized as a permanent or persistent threshold shift. In addition, hearing loss due to noise exposure may predispose to the development of tinnitus as a result of changes in central auditory signaling.[12,13]

Today, hearing loss is a public health problem seen not only in adults but also in adolescents.[14] One of the main causes of acquired hearing loss in adolescents is noise exposure.[15] Lifestyle changes among today's adolescents, including increasing use of electronic media such as mobile phones, tablets, computers/laptops, online games, and portable music devices, increase these rates.[16]

The primary aim of this study was to investigate the effects of daily personal headphone use on the auditory system of students at Ankara University Faculty of Health Sciences. The secondary goal was to raise awareness about limiting this habit, which is harmful to hearing and therefore to public health.

PATIENTS AND METHODS

Study design and participants

This cross-sectional observational study was conducted at Ankara University, Faculty of Health Sciences Department of Audiology between January 2022 and january 2023. A total of 90 university students (20 males, 70 females; mean age: 22.13±2.50 years; range, 18 to 32 years) were enrolled and divided into two groups based on their daily personal headphone usage duration: Group 1 (11 males, 32 females; mean age: 23.07±4.35 years; range, 18 to 32 years) who used headphones for less than 3 h per day, and Group 2 (9 males, 38 females; mean age: 21.28±1.66 years; range, 18 to 26 years) who used headphones for 3 h or more per day. The participants of the study were the students of Ankara University Faculty of Health Sciences. The inclusion criteria required participants to be between 18 and 35 years of age, with no prior diagnosis of hearing loss, no history of using hearing aids or implants, and no previous ear surgery for any reason; conversely, individuals not meeting these criteria were excluded from the study. All participants filled out a standardized demographic information form to determine their daily personal headphone usage duration, listening volume (low, medium, or high), and primary usage purposes, such as listening to music, playing games, or watching movies. Subsequently, a comprehensive hearing assessment was performed, including high-frequency audiometry (HFA) and speech discrimination in noise tests. The study protocol was approved by Ankara University Human Research Ethical Committee (Date: 11.02.2020, Approval No.: İ2-103-21) and was conducted in accordance with the ethical standards of the Declaration of Helsinki, with written informed consent obtained from all participants prior to the start of the study. The audiometry and tympanometry devices required for the study were purchased with the support of Ankara University University Scientific Research Projects Unit (Project No: 21B0242001).

Hearing assessment

Air conduction thresholds were tested with supra-aural headphones in the 125-8000 Hz frequency range. Using a bone vibrator, bone-conduction thresholds were evaluated at frequencies between 500 and 4000 Hz. The pure tone average threshold was calculated as the average threshold across the four frequencies (500-1000-2000-4000 Hz) for each ear. Speech recognition threshold (SRT) and speech discrimination score (SDS) were tested. High-frequency audiometry was performed for all participants using the same audiometric device and high-frequency earphones at 9, 10, 12.5, 14, 16, 18, and 20 kHz. Pure-tone and high-frequency audiometric measurements were conducted using a calibrated clinical audiometer (AC40, Interacoustics A/S, Assens, Denmark). Standard air-conduction thresholds were obtained using supra-aural headphones (TDH-39, Telephonics, USA), while extended high-frequency thresholds were measured using high-frequency circumaural earphones (HDA-200, Sennheiser electronic SE & Co. KG, Wedemark, Germany). Bone-conduction

Table 1. Demographic characteristics of participants

Headphone usage time	n	Mean±SD
Group 1 (under 3 h)		
Males	11	23.07±4.35
Females	32	
Group 2 (3 h and above)		
Males	9	21.28±1.66
Females	38	
Total		
Males	20	22.13±2.50
Females	70	

SD, standard deviation.

thresholds were assessed using a bone vibrator (B71, Radioear Corporation, Pennsylvania, USA). All equipment was annually calibrated prior to data collection in accordance with the ANSI S3.6 and ISO 389 standards.

All audiological assessments were conducted in a sound-treated audiometric booth meeting international standards for permissible ambient noise levels. Tests were administered by a certified audiologist with experience in clinical and research audiometry. Appropriate masking was applied when necessary in accordance with standard clinical audiological protocols to prevent cross-hearing.

Speech discrimination in noise

Monosyllabic word lists were presented with 3 different signal-to-noise ratios (SNR) (+5 decibel [dB], 0 dB, and -5 dB), and speech discrimination in noise performances were evaluated. As in SDS, each correct answer was multiplied by 4 to obtain the speech discrimination in noise score, and is shown as a percentage.

Statistical analysis

Statistical analysis was performed using IBM SPSS version 26.0 software (IBM Corp.; Armonk, NY, USA). Sample size was determined using G*Power version 3.1 software (Heinrich Heine University Düsseldorf, Düsseldorf Germany) (parameters: correlation of interest $\rho H1 = 0.5$, α error rate = 0.05, power = 0.85). Percentage values for categorical variables were used for descriptive statistics. Mean and standard deviation values were used in the descriptive

Table 2. Hearing data by groups

	Group 1 Mean±SD	Group 2 Mean±SD	F	*p*
Pure tone average (dB)				
Right	4.93±3.38	6.26±2.88		0.51
Left	4.70±3.60	5.36±2.37		0.301
Speech recognition threshold (dB)				
Right	3.84±3.59	3.62±3.41		0.766
Left	3.49±3.86	4.04±3.85		0.498
Speech discrimination (%)				
Right	97.12±3.41	97.02±3.06		0.890
Left	97.12±3.18	96.85±3.11		0.691
Speech discrimination in noise –5 dB SNR (%)				
Right	94.79±4.90	94.38±4.22	0.502	0.481
Left	95.07±4.68	93.28±5.47	1.665	0.200
Speech discrimination in noise 0 dB SNR (%)				
Right	95.81±4.27	96.43±3.65	0.154	0.696
Left	95.91±4.74	96.43±3.93	0.642	0.581
Speech discrimination in noise +5 dB SNR (%)				
Right	97.58±3.61	97.87±2.87	2.465	0.325
Left	97.12±3.85	96.85±3.00	0.234	0.536

SD, standard deviation; SNR, signal-to-noise ratio.

statistics of headphone use hours, age, and hearing threshold variables. Whether the data conformed to normal distribution was evaluated with histogram curves and bell curves. A paired samples t-test was used to compare normally distributed data. A student's t-test or Mann-Whitney U test was used for two-group comparisons. A *p*-value under 0.05 was considered statistically significant. To evaluate the independent effect of headphone usage duration on high-frequency hearing thresholds and speech discrimination in noise recognition scores, multivariable regression models (ANCOVA) were performed. In these models, headphone usage (Group 1 and Group 2) was included as the fixed factor, while age and sex were entered as covariates to adjust for potential confounding effects.

To control for the inflation of type 1 error due to multiple frequency comparisons, the Bonferroni correction was applied for all pairwise comparisons. Descriptive statistics were presented as adjusted means and standard errors. A *p*-value of < 0.05 was considered statistically significant.

RESULTS

Age and sex distributions by groups are shown in Table 1. Pure tone average, SRT, SDS, and speech discrimination in noise scores according to groups are listed in Table 2. No statistically significant difference was found between the groups ($p > 0.05$).

High-frequency hearing thresholds were compared between the two groups. Although Group 2 showed higher thresholds (worse hearing) at 14, 16, and 18 kHz compared to Group 1, these differences did not reach statistical significance after adjusting for age and sex and applying Bonferroni correction ($p > 0.05$), as shown in Table 3.

DISCUSSION

It is well known that exposure to excessive noise for a long time can cause NIHL.[17] Most studies have focused on the occupational noise exposure outcome of NIHL, ignoring personal headphones. There

Table 3. High-frequency thresholds by groups

	Group 1	Group 2		
Frequency	Mean±SD	Mean±SD	F	*p*
9 kHz				
Right	3.14±11.54	3.30±15.15	0.028	0.866
Left	3.26±9.69	2.34±7.65	0.039	0.60
10 kHz				
Right	9.53±9.31	9.36±7.34	0.229	0.633
Left	8.72±8.93	8.30±8.22	0.278	0.783
12.5 kHz				
Right	13.57±6.62	14.25±1.46	0.035	0.851
Left	7.09±10.53	10.19±1.48	0.132	0.107
14 kHz				
Right	15.93±17.12	10.11±1.47	2.560	0.113
Left	12.56±16.16	16.95±10.95	3.041	0.056
16 kHz				
Right	21.27±2.49	23.72±2.29	2.117	0.149
Left	10.08±12.81	24.19±18.28	2.712	0.141
18 kHz				
Right	6.81±11.90	12.67±15.97	0.343	0.560
Left	5.85±14.26	12.91±12.21	2.74	0.068
20 kHz				
Right	–2.02±8.54	–0.47±7.54	1.537	0.219
Left	–1.16±7.30	–1.49±8.46	0.126	0.642

SD, standard deviation; kHz, KiloHertz.

are a few studies on the potential damage caused by non-occupational noise exposure.[18,19] Studies investigating the potential effects of headphone use suggest that it may be associated with an increased risk of hearing impairment.[5,20] The use of personal headphones, particularly during activities such as computer gaming, has been associated with an increased risk of hearing-related changes, especially when used at high volumes and for prolonged durations.[21-23]

Some of the many reasons that cause hearing loss are genetic and environmental factors, such as noise, increasing age, and ototoxicity. Studies conducted on the young population show that the prevalence of hearing impairment due to personal headphone use is significantly high. The negative effect of personal headphone use on hearing is determined by factors such as daily use time, sound level during use, and the type of personal headphone used. In studies investigating the effects of personal headphone use, it has been shown that there are increased hearing threshold levels in the high-frequency region (8 kHz - 20 kHz frequency range).[23,24]

There are approximately 2.5-3 million individuals with hearing loss in Türkiye. According to the Turkish Statistical Institute (2015)[25] data, approximately 480,000 people between the ages of 15-44 have hearing loss, and this rate constitutes 0.6% of the total population. It is known that this age range is also the age range where personal headphone use is most intense. In this study, the average daily headphone use of individuals in a similar age range was questioned, and the hearing thresholds of two groups that used personal headphones for less than 3 h and more than 3 h per day were compared. In the present study, a trend toward poorer high-frequency hearing thresholds was observed in Group 2, who used headphones for more than 3 h per day; however, these differences did not reach statistical significance after adjustment for age and sex.

Mohammadpoorasl et al.[26] evaluated the relationship between students' headphone use and hearing loss and stated that NIHL was common among students. It has been reported that 86.4% of 60.2% of students with a history of hearing loss use headphones for a long time. A similar study emphasized that daily listening time affects hearing thresholds regardless of headphone type, and that an average of three hours of music exposure causes an average of 10-15 decibels of hearing level (dB HL) hearing loss at high-frequency hearing thresholds. It has been reported that this situation means that they experience the first symptoms of permanent hearing damage. Although previous studies have reported statistically significant high-frequency hearing threshold shifts associated with prolonged headphone use, our findings demonstrated a similar directional trend, albeit without statistical significance after covariate adjustment and correction for multiple comparisons. Prolonged and loud headphone use, regardless of the headphone type, is associated with various auditory symptoms such as temporary or permanent hearing loss, tinnitus, and noise sensitivity, and these may eventually increase the risk of developing permanent hearing loss.[24] Due to the increased use of headphones, younger generations are more exposed to noise, and the prevalence of NIHL is increasing among young people. However, the most common type of preventable hearing loss is NIHL. Increasing awareness of hearing loss and its relationship to personal listening devices is critical to reducing rates of NIHL. To this end, it is recommended that preventive strategies be used for young adults, including the promotion of 'safe listening' and safe listening devices.

Taken together, the findings of the present study indicate a potential early effect of prolonged headphone use on high-frequency hearing; however, the absence of statistically significant differences after adjustment for age and sex suggests that these changes should be interpreted with caution. This highlights the importance of considering extended HFA as a sensitive tool for detecting early auditory changes, particularly in young adults with prolonged personal headphone use.

Several limitations of this study should be considered when interpreting the findings. First, data on headphone use duration and listening volume were based on self-reported questionnaires, which are inherently susceptible to recall bias and subjective judgment. Second, although participants reported their typical listening volume using categorical descriptors (low, medium, high), objective measurements of sound pressure levels or cumulative noise exposure were not available. Furthermore, detailed information regarding headphone characteristics, including in-ear, over-ear, and noise-canceling types, was not collected, nor was data regarding years of use, cumulative lifetime exposure, or exposure to other recreational and occupational noise sources. These factors may have influenced the observed hearing outcomes. Third, the study sample consisted of students from a single faculty and university, which may limit the generalizability of the results to other populations or age groups. Finally, given the cross-sectional nature of the study, causal relationships between headphone use and hearing outcomes cannot be established. Future longitudinal studies incorporating objective exposure measurements are warranted.

In conclusion, early diagnosis and intervention in cases of hearing loss are crucial for an individual's communication, academic achievement, and social life. While hearing screening programs are widely implemented for this purpose, they often focus on standard frequencies. Our study contributes to this perspective by identifying a trend toward higher hearing thresholds in students with prolonged headphone usage, although the results were not statistically significant after adjusting for age and sex. These findings highlight the potential risk of high-frequency hearing impairment associated with unsafe listening habits and emphasize the need for larger, longitudinal studies to establish definitive causal relationships.

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REFERENCES

1. Sharma Y, Mishra G, Mahida DA. Effect on Hearing due to Amplified Music Exposure. AIJOC 2022;14: 22-5.
2. Paping DE, Vroegop JL, Koenraads SPC, le Clercq CMP, Goedegebure A, Baatenburg de Jong RJ, et al. A smartphone application to objectively monitor music listening habits in adolescents : Personal listening device usage and the accuracy of self-reported listening habits. J Otolaryngol Head Neck Surg 2021;50:11. doi: 10.1186/s40463-020-00488-5.
3. Widén SE, Möller C, Kähäri K. Headphone listening habits, hearing thresholds and listening levels in Swedish adolescents with severe to profound HL and adolescents with normal hearing. Int J Audiol 2018;57:730-6. doi: 10.1080/14992027.2018.1461938.
4. Ding T, Yan A, Liu K. What is noise-induced hearing loss? Br J Hosp Med (Lond) 2019;80:525-9. doi: 10.12968/hmed.2019.80.9.525.
5. Kim MG, Hong SM, Shim HJ, Kim YD, Cha CI, Yeo SG. Hearing threshold of Korean adolescents associated with the use of personal music players. Yonsei Med J 2009;50:771-6. doi: 10.3349/ymj.2009.50.6.771.
6. Kumar A, Mathew K, Alexander SA, Kiran C. Output sound pressure levels of personal music systems and their effect on hearing. Noise Health 2009;11:132-40. doi: 10.4103/1463-1741.53357.
7. Haile LM, Bärnighausen T, Jonas JB. Hearing loss prevalence and years lived with disability, 1990-2019: Findings from the Global Burden of Disease Study 2019. Lancet 2021;397:996-1009. doi: 10.1016/S0140-6736(21)00516-X.
8. Alshuaib WB, Al-Kandari JM, Hasan SM. Classification of hearing loss. In: Update on Hearing Loss. Rijeka: InTechOpen; 2015. p. 7-18.
9. Tan WJT, Song L. Role of mitochondrial dysfunction and oxidative stress in sensorineural hearing loss. Hear Res 2023;434:108783. doi: 10.1016/j.heares.2023.108783.
10. Talaska AE, Schacht J. Mechanisms of noise damage to the cochlea. Audiol Med 2007;5: 3-9.
11. Fetoni AR, Paciello F, Rolesi R, Paludetti G, Troiani D. Targeting dysregulation of redox homeostasis in noise-induced hearing loss: Oxidative stress and ROS signaling. Free Radic Biol Med 2019;135:46-59. doi: 10.1016/j.freeradbiomed.2019.02.022.
12. Ryan AF, Kujawa SG, Hammill T, Le Prell C, Kil J. Temporary and permanent noise-induced threshold shifts: A review of basic and clinical observations. Otol Neurotol 2016;37:e271-5. doi: 10.1097/MAO.0000000000001071.
13. Finneran JJ. Noise-induced hearing loss in marine mammals: A review of temporary threshold shift studies from 1996 to 2015. J Acoust Soc Am 2015;138:1702-26. doi: 10.1121/1.4927418.
14. Gilles A, Paul Vde H. Effectiveness of a preventive campaign for noise-induced hearing damage in adolescents. Int J Pediatr Otorhinolaryngol 2014;78:604-9. doi: 10.1016/j.ijporl.2014.01.009.
15. Śliwińska-Kowalska M, Zaborowski K. WHO Environmental Noise Guidelines for the European Region: A systematic review on environmental noise and permanent hearing loss and tinnitus. Int J Environ Res Public Health 2017;14:1139. doi: 10.3390/ijerph14101139.
16. Yusni Y, Ikbal I, Meutia F. Prevalence and population at risk for noise induced hearing loss (NIHL) in Adolescent Students. Folia Med Indones 2021;57:214-19.

17. Dehankar SS, Gaurkar SS. Impact on hearing due to prolonged use of audio devices: A literature review. Cureus 2022;14:e31425. doi: 10.7759/cureus.31425.
18. Niskar AS, Kieszak SM, Holmes AE, Esteban E, Rubin C, Brody DJ. Estimated prevalence of noise-induced hearing threshold shifts among children 6 to 19 years of age: The Third National Health and Nutrition Examination Survey, 1988-1994, United States. Pediatrics 2001;108:40-3. doi: 10.1542/peds.108.1.40.
19. Båsjö S, Möller C, Widén S, Jutengren G, Kähäri K. Hearing thresholds, tinnitus, and headphone listening habits in nine-year-old children. Int J Audiol 2016;55:587-96. doi: 10.1080/14992027.2016.1190871.
20. Dobrucki A, Maurycy K, Bartłomiej K. Preliminary study on the influence of headphones for listening music on hearing loss of young people. Arch Acoust 2013;38:383-7.
21. Widen SE, Båsjö S, Möller C, Kähäri K. Headphone listening habits and hearing thresholds in Swedish adolescents. Noise Health 2017;19:125-32. doi: 10.4103/nah.NAH_65_16.
22. Tandon PS, Zhou C, Johnson AM, Gonzalez ES, Kroshus E. Association of children's physical activity and screen time with mental health during the COVID-19 pandemic. JAMA Netw Open 2021;4:e2127892. doi: 10.1001/jamanetworkopen.2021.27892.
23. Ansari H, Mohammadpoorasl A, Rostami F, Maleki A, Sahebihagh MH, Naieni KH. Pattern of use of earphone and music player devices among Iranian adolescents. Int J Prev Med 2014;5:776-81.
24. Sulaiman AH, Husain R, Seluakumaran K. Evaluation of early hearing damage in personal listening device users using extended high-frequency audiometry and otoacoustic emissions. Eur Arch Otorhinolaryngol 2014;271:1463-70. doi: 10.1007/s00405-013-2612-z.
25. Turkish Statistical Institute (TURKSTAT). Statistics on Persons with Disabilities, Ankara: TURKSTAT; 2015.
26. Mohammadpoorasl A, Hajizadeh M, Marin S, Heydari P, Ghalenoei M. Prevalence and pattern of using headphones and its relationship with hearing loss among students. Health Scope 2019;8:e68151.