



Research Article

Tinnitus: The Hidden Cost of Earbuds

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Abstract

Background: In the era of modern technology, young adults, in particular, extensively use earbuds as a social trend. Prolonged use can lead to noise exposure and potentially cause tinnitus. **Objectives:** To investigate the frequency of earbud use, subjective tinnitus among the students, and the relationship between the pattern of use and the development of tinnitus. **Methods:** It is a descriptive cross-sectional study. 275 young adults, aged 18 to 24, of both sexes, were recruited through voluntary response sampling. Participants were evaluated by clinical examination, tympanometry, a self-administered questionnaire, and the Tinnitus Handicap Inventory (THI). **Results:** Of the 275 participants, 184 were earbud users (66.9%), and 35 (19.0%) of them reported tinnitus. Tinnitus was more common among those using earbuds over 4 hours daily (32%) and those always listening at high volume (39.4%). There was a strong association between poor hearing habits and the development of tinnitus. **Conclusions:** The higher frequency of tinnitus in earbud users suggests a possible link between earbud use and tinnitus. The rates of tinnitus were higher among individuals who used earbuds for more than 4 hours/day (32%) and those who always listened at high volumes (39.4%), with a significant association between tinnitus and hours of earbud usage per day. These findings highlight a clear correlation between unsafe earbud use and early auditory dysfunction.

Keywords: Cochlear insult, Earbuds, NIT, Noise, Tinnitus.

طنين الأذن: التكلفة الخفية لساعات الأذن

الخلاصة

الخلفية: في عصر التكنولوجيا الحديثة، يستخدم الشباب بشكل خاص سماعات الأذن بشكل واسع كاتجاه اجتماعي. الاستخدام المطول قد يؤدي إلى التعرض للضوضاء وقد يسبب طنين الأذن. **الأهداف:** دراسة تكرار استخدام سماعات الأذن، وطينن الذاتي بين الطلاب، والعلاقة بين نمط الاستخدام وتطور الطنين. **الطرق:** هي دراسة مقطعية وصفية. تم تجنيد 275 شاباً، تتراوح أعمارهم بين 18 و24 عاماً، من كلا الجنسين، من خلال أخذ عينات استجابية طوعية. تم تقييم المشاركين من خلال الفحص السريري، وقياس طيب الأذن، واستبيان ذاتي الجرد، وقائمة إعاقات الطنين (THI). **النتائج:** من بين 275 مشاركاً، كان 184 مستخدماً لساعات الأذن (66.9%)، و35 منهم (19.0%) أبلغوا عن طنين الأذن. كان الطنين أكثر شيوعاً بين من يستخدمون سماعات الأذن لأكثر من 4 ساعات يومياً (32%) وأولئك الذين يستمعون دائماً بصوت عالٍ (39.4%). كان هناك ارتباط قوي بين سوء عادات السمع وتطور طنين الأذن. **الاستنتاجات:** يشير التكرار الأعلى للطنين لدى مستخدمي السماعات إلى وجود علاقة محتملة بين استخدام السماعات والطنين. كانت معدلات الطنين أعلى بين الأفراد الذين استخدموا سماعات الأذن لأكثر من 4 ساعات يومياً (32%) وأولئك الذين كانوا يستمعون دائماً بصوت مرتفع (39.4%)، مع ارتباط كبير بين الطنين وساعات استخدامها يومياً. تسلط هذه النتائج الضوء على ارتباط واضح بين استخدام السماعات غير الآمن وضعف السمع الميكرو.

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INTRODUCTION

The rapid and revolutionary advancement of audio technology has played a crucial role in transforming the design and functionality of personal listening devices. This progress has led to the development of diverse types, and each one is engineered with distinct features and sound output capabilities to enhance the listening experience [1]. Their use has become an integral part of daily life, particularly among young adults and students [2] trying to focus on audio content in noisy environments, prompting users to increase the volume to overcome background noise. This behavior can lead to prolonged exposure to high-intensity sound levels

[3,4]. According to the CDC, five in ten young people listen to music or other audio too loudly [5]. In a review and meta-analysis by Dillard *et al.*, the frequency of unsafe listening practices was 23.81% among adolescents and young adults [6]. Tinnitus is defined as the perception of sound in the absence of an identifiable external auditory stimulus. It occurs in about 10–20% of the adult population, with significant negative impacts on their quality of life, including sleep disturbances, concentration difficulties, anxiety, and depression [7]. Its pathophysiology remains poorly understood [7,8] The current treatment options are largely limited to symptomatic management, with responses varying widely among individuals, with

some experiencing partial relief while others report no benefit [7]. Studies have established a strong link between recreational noise exposure and the development of tinnitus. Noise-induced tinnitus (NIT) can present as either acute, which is typically short-lived, lasting from a few seconds to several days, and follows immediate exposure to loud noise, or chronic tinnitus that persists for months or even years and is often associated with cochlear damage [9]. The presence of Temporary noise-induced tinnitus after exposure to loud music, even in the absence of hearing loss, is possibly accompanied by cochlear and/or neural damage. This damage may pass unnoticed by the individual and may not be detectable through conventional audiometric evaluation [10]. The aims of this study are to determine the frequency of the use of earbuds and subjective tinnitus among the students, as well as the relationship between the pattern of use of earbuds and the development of tinnitus in these students.

METHODS

Study design and setting

This was a descriptive cross-sectional study. The study was carried out in the Otolaryngology and Audiology Unit at the College of Medicine, Mustansiriyah University, Baghdad, Iraq, over three months from the 30th of October 2024 to the 30th of January 2025. A total of 275 volunteer students were recruited through voluntary response sampling. Announcements were made through classroom visits and digital platforms, inviting students who met the eligibility criteria to participate in the study. The recruitment was open to all eligible students, regardless of their academic year or personal beliefs about earbuds.

Inclusion criteria

Participants included young adults of both sexes aged 18–24 years of both non-users and users who had used earbuds for over an hour per day for at least six months and had type A tympanometry performed using an 85 dB SPL 226 Hz probe tone Otowave Tympanometer (Amplivox LTD, UK).

Exclusion criteria

All individuals with known self-reported, pre-existing hearing loss, on ototoxic drugs, and who had ear infections were excluded from the study in order to isolate the potential impact of earbud usage on tinnitus without confounding factors.

Outcome measurements

All participants underwent clinical evaluations and responded to a self-administered questionnaire regarding demographic information, earbud usage patterns, listening habits, the presence of tinnitus, and its duration. Those who reported tinnitus proceeded to

answer THI. The THI consists of 25 questions that assess the impact of tinnitus on daily life, with responses scored as Yes (4 points), Sometimes (2 points), or No (0 points). Total scores range from 0 to 100. (0-16) no handicap, (18-36) mild handicap, (38-56) moderate handicap, (58-76) severe handicap, (78-100) catastrophic handicap. An average score was calculated for each participant.

Ethical considerations

The local Institutional Scientific Committee of the College of Medicine at Mustansiriyah University approved the study protocol. All participants provided informed consent and were thoroughly informed about the purpose, procedure, and potential benefits of the research.

Statistical analysis

Statistical analyses were carried out using the IBM SPSS version 25.00 (IBM Corp., Armonk, NY, USA). Categorical variables are presented as percentages. The analysis was performed using the Chi-square test (χ^2 test). A p-value less than 0.05 was considered significant.

RESULTS

A total of 275 participants were included in the study. 184 (66.9%) were earbud users, and the other 91 (34.1%) were non-users. The age range was 18-24 years, with a mean age of the earbud users of 21.84 ± 1.15 years versus 21.86 ± 1.04 for non-users. Regarding sex, there were 80 males (43.5%) vs. 104 females (56.5%) in earbud users, while there were 31 males (34.1%) vs. 60 females (65.9%) in non-users, and there was no evidence of a significant difference (P-value ≥ 0.05) between the two groups in terms of age and sex (Table 1). Of the 184 earbud users, 163 (88.6%) used earbuds for over 2 years. 75 users (40.8%) used earbuds for more than 4 hours daily, and 161 (87.5%) used them 5–7 days per week. Fewer than half of the users, 75 participants (40.8%), frequently listened at high volume. 100 (54.3%) people used noise-isolating earbuds. Over half of the users, 108 (58.7%), reported taking breaks every hour or less.

Table 1: Demographic characteristics of the study participants

Characteristics	Study groups		p-value
	Earbud users (n= 184)	Non-users (n= 91)	
Mean age (year)	21.84±1.15	21.86±1.04	0.108
Sex			
Female	104(56.5)	60(65.9)	0.134
Male	80(43.5)	31(34.1)	

Data are presented as mean \pm SD or frequency and percentage.

Concerning tinnitus and related symptoms, 35 (19%) users experienced ringing, buzzing, or noise; of them, 17 (48.6%) experienced symptoms rarely, and 15 (42.9%) noticed symptoms after a year (Table 2). Of the 184 earbud users, 35 participants had tinnitus,

resulting in a frequency of 19%. In contrast, 8 non-users reported tinnitus, with a frequency of 8.8%.

Table 2: Distribution of earbud users based on their responses to questions about earbud usage, hearing experiences, and related habits (n=184)

Variables	n(%)
<i>Duration of earbud usage (year)</i>	
< 1	8(4.4)
1 – 2	13(7)
> 2	163(88.6)
<i>Hours of earbud usage/day</i>	
1 – 2	57(31)
3 – 4	52(28.2)
> 4	75(40.8)
<i>Days of earbud usage/week</i>	
3 – 4	23(22.5)
5 – 7	161(87.5)
<i>Listening at high volume</i>	
Always	33(17.9)
Often	75(40.8)
Sometimes	71(38.5)
Rarely	5(2.7)
<i>Using noise-isolating earbuds</i>	
Yes	100(54.3)
No	54(29.3)
Sometimes	30(16.4)
<i>Taking breaks from using earbuds</i>	
Every hour or less	108(58.7)
Every 2 – 3 hours	46(25)
Every 4 – 5 hours	16(8.7)
Less frequently	8(4.3)
No	6(3.3)
<i>Experience ringing, buzzing, or noise</i>	
Yes	35(19)
No	125(67.9)
Not sure	24(13.1)
<i>Frequency of tinnitus (n=35)</i>	
Rarely	17(48.6)
Occasionally	11(31.4)
Frequently	7(20)
<i>When to notice tinnitus symptoms (n= 35)</i>	
After a few months	7(20)
After one year	13(37.1)
After more than one year	15(42.9)

Values are expressed as numbers and percentages.

A statistically significant difference was noticed in the prevalence of tinnitus between the two groups ($p=0.027$). Regarding handicap degrees, 6 (17.1%) of users had no handicap, 19 (54.3%) had a mild handicap, and 10 (28.6%) had a moderate handicap. Of the 8 non-users, 3 (37.5%) reported no handicap, 4 (50%) reported mild handicap, and only one participant reported moderate handicap. There was no significant association between earbud usage and the degree of handicap ($p=0.374$) (Table 3).

Table 3: Distribution of the study groups according to tinnitus and handicap degree

Variable	Earbud users (n=184)	Non-users (n=91)	Total (n=275)	p-value
<i>Tinnitus</i>				
Yes	35(19)	8(8.8)	43 (15.6)	0.027
No	149(81)	83(91.2)	232 (84.4)	
<i>Handicap</i>				
	n= 35	n= 8	n=43	
No	6(17.1)	3(37.5)	9(23.7)	0.374
Mild	19(54.3)	4 (50)	23(57.9)	
Moderate	10(28.6)	1(12.5)	11(18.4)	

Values were expressed as frequency and percentage. $p < 0.05$ is considered statistically significant.

This study found that the rates of tinnitus were higher among individuals who used earbuds for more than 4 hours per day (32%) and those who always (39.4%) listened at high volume, with a statistically significant association ($p < 0.05$) between tinnitus and hours of earbud usage per day and listening at high volume. At the same time, no significant association was detected regarding the duration of earbud usage and days of usage per week (Table 4).

DISCUSSION

The growing use of earbuds, especially by students, has increased the risk of adverse effects, especially when used for extended periods and at high volumes. The current study suggests the presence of early auditory changes associated with unsafe listening practices, which is a significant public health concern that is increasingly examined in both peer-reviewed research and popular literature [11,12]. After analyzing the results, it can be noticed that 184 young people of both sexes use earbuds, and there was no evidence of a significant difference between the two groups in terms of sex. Although females outnumbered males in both users and non-users, this pattern is consistent with findings in a previous study [13]. While other studies suggest a higher percentage of males using their listening devices [14,15]. This discrepancy in results is attributed to sample characteristics and the study design itself. The study revealed a high frequency of use of personal listening devices among the participants, with about 69% of them using them for more than one hour per day, a result that is not different from students in India, Korea, Egypt, and Australia [16] However, another study in India conducted by Saurav et al. found that most participants used their personal listening devices (PLDs) for less than 1 hour/day, reflecting a high level of awareness about the risk of PLD use [17]. A study by Torre P 3rd in 2008 found that 66.7% of college students used iPods in the USA [18]. A study conducted on medical students in Nigeria found a prevalence of earphone use of 95.6%, which was high [19]. While a community-based survey for ages 18-24 in Nottingham, UK, found a lower prevalence rate of earphone usage of 43.6%, while it was higher, 86.1%, in the younger age group [20]. These discrepancies in results may reflect the cultural and lifestyle differences, as well as the level of awareness and education in every sample studied. In the current study, 19% of users reported having tinnitus compared to 8.8% of non-users, showing a statistically significant difference between the groups. Comparable prevalence rates have been documented in previous research, including 20.6% in Nigeria [19], 22% in Parana, Brazil [21]. These findings collectively suggest that the association between device use and tinnitus is consistent across different populations and geographic regions, underscoring its potential clinical significance. Regarding handicap, the study showed no significant association between earbud usage and the degree of handicap.

Table 4: Distribution of the study group according to tinnitus and earbuds usage

Variable	Tinnitus		Total (n=184)	p-value
	Yes (n=35)	No (n=149)		
<i>Age (year)</i>				
19 – 21	31 (21.4)	114(78.6)	145(78.8)	0.116
22 – 24	4 (10.3)	35(89.7)	39(21.2)	
<i>Sex</i>				
Male	14(17.5)	66(82.5)	80(43.5)	0.644
Female	21(20.2)	83(79.8)	104(56.5)	
<i>Duration of earbud usage (years)</i>				
< 1	3(37.5)	5(62.5)	8(4.3)	0.192
1 – 2	4(30.8)	9(69.2)	13(7.1)	
> 2	28(17.2)	135(82.8)	163(88.6)	
<i>Hours of earbud usage/day</i>				
1 – 2	6(10.5)	51(89.5)	57(31)	0.001
3 – 4	5(9.6)	47(90.4)	52(28.3)	
> 4	24(32)	51(68)	75(40.8)	
<i>Days of earbud usage/week</i>				
3 – 4	6(26.1)	17(73.9)	23(12.5)	0.356
5 – 7	29(18)	132(82)	161(87.5)	
<i>Listening at high volume</i>				
Always	13(39.4)	20(60.6)	33(17.9)	0.003
Often	13(17.3)	62(82.7)	75(40.8)	
Sometimes/rarely	9(11.8)	67(88.2)	76(41.3)	
<i>Using noise-isolating earbuds</i>				
Yes	21(21)	79(79)	100(54.3)	0.386
No	7(13)	47(87)	54(29.3)	
Sometimes	7(23.3)	23(76.7)	30(16.3)	
<i>Taking breaks from using earbuds</i>				
Every hour or less	16(14.8)	92(85.2)	108(58.7)	0.671
Every 2-3 hours	9(19.6)	37(80.4)	46(25)	
Every 4-5 hours	6(37.5)	10(62.5)	16(8.7)	
Less frequently	2(25)	6(75)	8(4.3)	
No	2(33.3)	4(66.7)	6(3.3)	

Values were expressed as frequency and percentage. $p < 0.05$ is considered statistically significant.

The results of the THI of users were 17.1% had no handicap, 54.3% had a mild handicap, and 28.6% had a moderate handicap. These results were inconsistent with the previous result obtained by Al-Swiahb *et al.* [22], which reported the distribution of very mild (13.75%), mild (32.5%), and moderate (37.5%) handicaps. This discrepancy in results may be attributed to the fact that THI is a subjective test, and participants may exaggerate or understate their answers. Significant association was discovered between tinnitus and the use of earbuds > 4 hours per day and listening to high volume. On the contrary, no such relation was discovered with the duration of earbud usage and days of usage/week. Fitri Sakinah found that 77.3% of participants used earbuds with dangerously high volumes [1]. These results were also supported by Levey *et al.* [23] in the study by Davies *et al.*, a significant correlation was found between preferred listening volumes of PLDs and reported subjective tinnitus [24]. The fact that users prefer to listen at a high volume to avoid social interaction and customize their listening environment may help to explain this [25]. According to a study by Shah *et al.*, users of earphones spend an average of more than 4 hours per day using them [26]. Similarly, a systematic review by Jiang and colleagues showed that more than half of the participants exceeded their daily noise limit [27]. Moreover, many earbud users wear them for long durations without intervals [28]. These results suggest that unsafe listening practices may contribute to early cochlear damage, which may manifest as tinnitus [3].

Study limitations

The cross-sectional design of the study restricts the ability to establish causality between earbud use and tinnitus. Furthermore, the study was conducted on

college students of a certain age limit in a single university, which may not reflect the broader population. The reliance on self-administered questionnaires may have introduced inaccuracy, as participants might underreport or overestimate their earbud usage habits or tinnitus symptoms. Also, the study did not account for potential confounders such as Ménière’s disease, thyroid disorders, neurological conditions, and psychological factors, including anxiety and depression, which may have had some influence on the observed auditory findings.

Conclusion

This study highlights a significant association between unsafe earbud usage and the development of subjective tinnitus among young adults. With 19% of tinnitus among earbud users, more than double that of non-users (8.8%). Individuals who used earbuds for more than 4 hours per day or consistently listened at high volumes showed a significantly higher frequency of tinnitus. Although no significant association was found between tinnitus and the total duration (in years) or frequency (days/week) of earbud use, the intensity and daily exposure time were critical contributing factors. Public health awareness programs are essential to educate young people about the potential auditory hazards of prolonged earbud use and to promote safe listening behaviors to prevent noise-induced tinnitus.

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Conflict of interests

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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