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Relationship Between Personal Audio System Use and Tinnitus Among Medical Students

Lina Marlina^{1)*}, Tiroy Sari B. Simanjuntak²⁾, Monika Maria Bate Adur³⁾

¹⁾ Department of Ear Nose and Throat, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia

²⁾ Department of Internal Medicine, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia

³⁾ Medical Student, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia

*Corresponding Author: Lina Marlina

Email : lina.marlina@uki.ac.id

Abstract

Personal Audio Systems (PAS) have become increasingly prevalent, particularly among younger populations, due to their affordability and ease of use—reaching a usage prevalence of up to 95% in some groups. Despite their popularity, concerns have arisen regarding the potential risks associated with prolonged and improper use, including extended duration, high frequency, and excessive volume levels. Chronic exposure to such conditions may lead to reduced hearing sensitivity and the onset of tinnitus. This study aimed to examine the usage patterns of PAS and their association with tinnitus occurrence and severity among pre-clinical medical students at the Faculty of Medicine, Christian University of Indonesia, Classes of 2023–2024. A cross-sectional analytical observational design was employed. Data were collected via a self-administered questionnaire distributed through Google Forms, using consecutive sampling. Inclusion criteria included active pre-clinical students using PAS without a history of diabetes mellitus, hypertension, ear infections, or tumours, and who consented to participate. Two instruments were used: the PAS Usage Pattern Questionnaire (PPPAS) and the Tinnitus Handicap Inventory (THI) to assess tinnitus severity. Statistical analyses included the Chi-square test, normality testing, and Spearman correlation using IBM SPSS Statistics 26. Among 200 respondents, 58.5% demonstrated risky PAS usage patterns. According to THI results, 71% reported no handicap, while 29% experienced varying levels of tinnitus severity, which is 10,5% reported mild handicap, 7% moderate handicap, 6,5% severe handicap, dan 5% catastrophic handicap. A significant relationship was found between PAS usage patterns and the presence of tinnitus symptoms ($p = 0.025$). The findings suggest that risky use of Personal Audio Systems is associated with an increased risk of tinnitus among medical students.

Keywords: *Personal Audio System, Tinnitus, Hearing Loss, Medical Students, Tinnitus Handicap Inventory.*

INTRODUCTION

The rapid advancement of technology has led to the creation of various innovations aimed at improving human convenience, one of which is the Personal Audio System (PAS) as a means of entertainment. PAS refers to personal music players or hearing devices used to listen to audio privately without disturbing others. These systems include content sources such as MP3 players or mobile phones connected to transducers such as earphones or headphones (World Health Organization, 2021). In recent years, PAS usage has become increasingly common and an integral part of daily life, particularly among adolescents and young adults. The popularity of PAS is attributed to its affordability and portability, with prevalence reaching up to 95% in some populations (Smith et al., 2020). Studies show that 90% of PAS users aged 16–69 years are at risk of Noise-Induced Hearing Loss (NIHL) due to average exposure levels exceeding 70 dB, with PAS identified as the main source of noise exposure for 88% of individuals (Johnson & Lee, 2019).

The World Health Organization (2021) recommends maintaining daily sound exposure below 85 dB for a maximum of eight hours, whereas excessive and prolonged PAS use is often reported among users who listen for more than one hour per day at volumes exceeding 50% over one year (Harrison et al., 2022). Chronic exposure to high-intensity sounds can decrease auditory sensitivity and lead to tinnitus, a condition characterized by the perception of sound such as

ringing or buzzing in the absence of an external stimulus (Roberts et al., 2020). Tinnitus may be objective—heard by both the patient and examiner—or subjective, perceived only by the patient and considered the most common form (Henry, 2016). Global prevalence of tinnitus ranges between 11.9% and 30.3% (Davis, 2018), and studies have shown prevalence among adolescents reaching 36.8% (Park et al., 2019). In Indonesia, although national statistics are limited, research by Velaro (2021) found that 35.1% of individuals with risky earphone use experienced tinnitus, and similar findings were reported by Sasidharan (2020), where 33% of medical students using PAS developed tinnitus symptoms.

Pathophysiologically, tinnitus arises from peripheral dysfunction involving the degeneration or loss of outer and inner hair cells, which play essential roles in sound amplification and mechano-electrical transduction. The resulting deafferentation increases auditory neuron sensitivity, producing hyperactivity and the “phantom sound” phenomenon in the absence of actual auditory input (Eggermont & Roberts, 2015). This condition is associated with neurotransmitter imbalance, characterized by elevated glutamate and decreased inhibitory neurotransmitters such as gamma-aminobutyric acid (GABA) and glycine, leading to abnormal excitation within the auditory pathway (Møller, 2019).

Considering the increasing prevalence of PAS use and the potential risk of tinnitus among young adults, particularly medical students who are at an age group of high exposure to personal listening devices, this study aims to analyze the relationship between PAS usage patterns and the occurrence of tinnitus among pre-clinical medical students at the Faculty of Medicine, Christian University of Indonesia, Classes of 2023–2024.

RESEARCH METHODS

This study employed an analytical observational design with a cross-sectional approach to examine the relationship between Personal Audio System (PAS) usage patterns and the occurrence of tinnitus among pre-clinical medical students at the Faculty of Medicine, Christian University of Indonesia, Classes of 2023–2024. The research was conducted in April 2025 at the Faculty of Medicine, Christian University of Indonesia, Jakarta. The study population consisted of medical students from the 2023 and 2024 cohorts. The sample was obtained using a non-probability consecutive sampling technique according to predetermined inclusion and exclusion criteria. The minimum sample size was calculated using the Slovin formula with a 5% margin of error, resulting in 186 respondents.

Inclusion criteria included active pre-clinical students who used Personal Audio Systems, had no history of diabetes mellitus, hypertension, ear infection, or ear tumour, and agreed to participate voluntarily. Exclusion criteria were students on academic leave, exposed to prolonged noise environments, incomplete questionnaire responses, or withdrawal from participation.

The independent variable in this study was the pattern of Personal Audio System use, while the dependent variable was the presence of tinnitus symptoms. Data were collected using two validated instruments: the Personal Audio System Usage Pattern Questionnaire (PPPAS) to assess risk behaviour in device usage, and the Tinnitus Handicap Inventory (THI) to measure tinnitus severity. The PPPAS questionnaire evaluated frequency, duration, volume, and type of device and transducer, whereas THI consisted of 25 items with three response options (“yes,” “sometimes,” and “no”), producing global scores ranging from 0 to 100, categorized into no, mild, moderate, severe, and catastrophic handicap levels.

Data collection was conducted online through Google Forms after obtaining informed consent. Respondents completed both questionnaires voluntarily. Collected data were then screened based on inclusion and exclusion criteria, organized, and processed using IBM SPSS Statistics 26 and Microsoft Excel. Univariate analysis was performed to describe the frequency distribution and percentage of each variable. Bivariate analysis was conducted using the Chi-square test to determine associations between PAS usage patterns and tinnitus occurrence. For inferential analysis, the Pearson correlation test was applied to normally distributed data and the Spearman correlation test for non-normal data distributions. A significance level of $p < 0.05$ was used to determine statistical significance.

The research procedures followed ethical standards for human studies, ensuring respondent confidentiality, voluntary participation, and data anonymity. The analytical framework of this study provides a quantitative assessment of the relationship between PAS use behaviour and tinnitus symptoms among medical students.

RESULTS AND DISCUSSION

This study involved 200 pre-clinical medical students from the Faculty of Medicine, Christian University of Indonesia, Classes of 2023–2024, who met the inclusion criteria and completed both questionnaires. Data collection was carried out using an online survey through Google Form during April–May 2025. Respondents were asked to fill out the Personal Audio System Usage Pattern Questionnaire (PPPAS) and, for those reporting tinnitus symptoms, to complete the Tinnitus Handicap Inventory (THI) validated in Indonesian.

Table 1.
Distribution of Personal Audio System Usage Patterns

Usage Criteria		<i>f</i>	%
Type of Personal Audio System Device	Handphone	75	37,5%
	Komputer/laptop	3	1,5%
	CD player	0	0%
	MP3 player	2	1%
	Handphone and Komputer/laptop	104	52%
	Handphone and MP3	6	3%
	Komputer/laptop and CD player	2	1%
	Handphone, Komputer/laptop and MP3 player	6	3%
	Handphone, Komputer/laptop, and CD player	0	0%
	Handphone, Komputer/laptop, MP3 player dan CD player	2	1%
Type of Personal Audio System Transducer	Earphone	88	44%
	Headphone	4	2%
	Speaker	7	3,5%
	Earphone and Headphone	32	16%
	Earphone and Speaker	23	11,5%
	Headphone and Speaker	10	5%
	Earphone, Headphone and Speaker	36	18%
<3 years		48	24%

Duration of Personal Audio System Use	>3 years	152	76%
	<1 hour	56	28%
Duration of Personal Audio System Use	1-3 hours	88	44%
	>3 hours	56	28%
	1-2 days	50	25%
Frequency of Personal Audio System Use	3-4 days	52	26%
	5-6 days	39	19,5%
	Every Day	59	29,5%
	<60% (<10 clicks from volume 0%)	93	46,5%
Volume Level of Personal Audio System Use	60%-80% (10-13 clicks from volume 0%)	81	40,5%
	>80% (>13 clicks from volume 0%)	26	13%
Pattern of Personal Audio System Use	Non Risk	83	41,5%
	Risk	117	58,5%
Total		200	100%

Table 2.
THI Score Results

Derajat	f	%
No Handicap	142	71%
Mild Handicap	21	10,5%
Moderate Handicap	14	7%
Severe Handicap	13	6,5%
Catasrophic Handicap	10	5 %
Total	200	100%

Table 3.
Relationship between PPPAS and THI

Tinnitus Handicap Inventory

PPPAS

No Handicap

Mild Handicap

Moderate Handicap

Severe Handicap

Catastro-phic Handicap

p-value

	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Non Risk	62	74,7%	5	6%	8	9,6%	8	9,6%	0	0%
Risk	80	68,4%	16	13,7%	6	5,1%	5	4,3%	10	8,5%
Total	142	71%	21	10,5%	14	7%	13	6,5%	10	5%

0,009

Table 4.
Normalitas Uji

Variable	Mean	SD	Median	Min	Max	<i>p-value</i>
Pattern of Personal Audio System Use	9,96	2,105	10,00	6	14	0.000
THI	15,05	23,785	0,00	0	88	0.000

Table 5.
Results of Spearman's Rank Correlation Test

Variable	<i>r</i>	<i>p-value</i>
Pattern of Personal Audio System Use	0,158	0,025
THI		

CONCLUSION

This study concludes that there is a meaningful relationship between the pattern of Personal Audio System (PAS) use and the occurrence as well as the severity of tinnitus among pre-clinical

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medical students of the Faculty of Medicine, Christian University of Indonesia, Classes of 2023–2024. The findings indicate that students with risky listening habits—such as prolonged daily use, high listening frequency, and elevated volume levels—tend to experience higher tinnitus severity. Earphones and smartphones were the most commonly used devices, and many respondents had been using them for more than three years, often exceeding the safe listening duration recommended by the World Health Organization. These results suggest that unsafe listening behaviors have become part of daily routines among young adults, potentially contributing to early auditory dysfunction. Therefore, preventive education emphasizing safe listening practices, hearing health awareness, and early detection of auditory symptoms is essential to minimize the long-term risk of hearing loss and tinnitus in student populations.

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