

RESEARCH ARTICLE

Knowledge and Practices Regarding Personal Listening Device Use and Associated Health Risks among Medical Students

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ABSTRACT

Introduction: The growing use of personal listening devices (PLDs) among young adults has raised concerns about unsafe listening practices, yet evidence on Indonesian medical students' knowledge remains limited. This study aimed to assess undergraduate medical students' knowledge of hearing-related risks and self-reported PLD listening practices.

Methods: An analytical cross-sectional study was conducted among undergraduate medical students at a university in Yogyakarta, Indonesia, from April to May 2022. A total of 182 students completed a structured self-administered questionnaire adapted from previous studies. The questionnaire covered demographic characteristics, knowledge of hearing-related risks, and safe listening practices. Chi-squared or Fisher's exact tests were used to examine associations between categorical variables, with statistical significance set at $p < 0.05$.

Results: Most respondents (76.4%) had used PLDs for more than five years. Nearly half (49.5%) reported using PLDs for less than one hour per day, and 39.0% preferred a loud listening volume. Most participants recognised possible consequences of prolonged PLD use, including hearing loss (100%) and tinnitus (99.5%). Overall, 61.5% identified less than three hours as the safe limit at normal volume, and 72.0% identified less than one hour at loud volume.

Conclusion: Respondents generally recognised hearing-related risks; however, knowledge of safe-listening recommendations and exposure limits was incomplete, and potentially unsafe listening practices were reported. These findings support hearing-conservation education that emphasises practical safe-listening behaviours among university students.

Keywords: Sound; Music; Noise-Induced Hearing Loss; Medical Students

INTRODUCTION

Earbuds, headphones, headsets, and noise-cancelling earphones—collectively referred to as personal listening devices (PLDs)—are ubiquitous in daily life, particularly among adolescents and young adults. The proliferation of smartphones and digital media has led to a marked increase in recreational listening through PLDs (1), allowing users to listen to music or other audio for extended periods and at high volumes without disturbing others. Despite their convenience and appeal, unsafe listening behaviours, such as listening at high volumes or for prolonged periods, have raised concerns about their potential effects on auditory health (2,3).

Extended exposure to high-intensity recreational noise is a major risk factor for noise-induced hearing loss (NIHL), a permanent and largely preventable disorder caused by damage to the sensory structures of the inner ear. Because NIHL may develop gradually and remain asymptomatic in its early stages, individuals may be unaware of auditory decline until substantial damage has occurred. In addition to hearing loss, hazardous listening habits have been associated with tinnitus, reduced auditory sensitivity, and poorer quality of life, underscoring the need for preventive measures and safe-listening education (4,5).

The increasing prevalence of PLD use has become a major public health concern. Approximately one billion young people aged 12–35 years use personal listening devices and may be at risk of hearing loss (6). The World Health Organization has expressed concern about this issue. Without effective preventive interventions, the number of people living with hearing loss, reported as 466 million, is projected to increase to 630 million by 2030 and approximately 900 million by 2050. More than 1.5 billion people worldwide live with some degree of hearing loss, and approximately 430 million have impairment in the better-hearing ear. Most people with hearing impairment live in low- and middle-income countries, although the burden varies across WHO regions (7). These figures underscore the importance of promoting safe-listening practices, particularly among young people, who are major users of PLDs. Alkahtani et al. reported a marked discrepancy between university students' knowledge, listening habits, and awareness of hearing-related problems (8). Although many students know that long-term exposure to loud noise can damage hearing, this knowledge does not necessarily translate into safe-listening behaviours (9). Moreover, most previous studies were conducted outside Indonesia, and evidence directly concerning Indonesian university students, particularly medical students, remains limited (3,10,11).

Medical students are generally assumed to have higher health literacy (12) and are therefore an important group to study. However, greater awareness of health issues does not necessarily lead to the adoption of appropriate protective measures (13). Assessing medical students' knowledge and listening habits and incorporating hearing-health education into medical curricula may clarify the relationship between health literacy and preventive behaviour (14). Despite increasing global concern about PLD use and hearing health, evidence on Indonesian medical students' self-reported behaviours and knowledge remains limited. This study aimed to assess medical students' knowledge of and adherence to recommended practices for protecting their hearing from the potential risks of PLD use at a university in Yogyakarta, Indonesia. The findings may inform educational programmes for future healthcare professionals (9,15,16).

METHODS

Study Design and Setting

This analytical cross-sectional study evaluated knowledge, self-reported practices, and perceptions of PLD use and associated health risks. A cross-sectional design can identify associations between variables at a single point in time but cannot establish temporal relationships or causality. All health-related findings should therefore be interpreted as participants' self-reported perceptions rather than clinically confirmed health outcomes. The study was conducted among undergraduate medical students at a university in Yogyakarta, Indonesia, between April and May 2022.

Participants and Sampling

The study population comprised 4,367 undergraduate medical students enrolled at the university during the study period. The minimum sample size was calculated using the Lemeshow formula with finite-population correction, assuming a 95% confidence level ($Z = 1.96$), an estimated proportion (p) of 0.25, a precision level (d) of 10%, and a population size of 4,367 students. Based on these assumptions, the minimum sample size required was 139 participants. To improve statistical precision and allow for potentially incomplete responses, data collection continued until 182 complete questionnaires had been obtained.

Participants were recruited using non-probability purposive sampling. The online questionnaire was distributed through Google Forms via official student communication channels and class representatives. Participation was voluntary and was restricted to students who met the inclusion criteria and provided informed consent. Because the survey link could be shared among eligible students, the exact response rate could not be determined.

Inclusion and Exclusion Criteria

Eligible participants were undergraduate medical students aged 18 years or older who were enrolled during the study period and provided electronic informed consent before completing the questionnaire.

Students who submitted incomplete questionnaires were excluded from the final analysis. Students with previously diagnosed hearing disorders were also excluded to minimise potential confounding when assessing knowledge and self-reported practices related to PLD use.

Questionnaire Development and Validation

Data were collected using a structured, self-administered questionnaire adapted from previous studies on PLD use among medical students. The questionnaire was adapted for the study purpose and the Indonesian context. The final instrument comprised 18 items covering four domains: demographic characteristics, knowledge of the health risks of long-term PLD use, perceived health risks, and PLD-use practices.

The knowledge domain comprised seven items assessing participants' knowledge of health risks associated with prolonged PLD use, including hearing loss, tinnitus, headache, insomnia, hypertension, recommended listening duration, and safe listening volume. The practice domain comprised five items assessing participants' self-reported PLD use while walking, crossing the street, cycling, riding a motorcycle, and travelling in a car.

Before data collection, the questionnaire was assessed for content relevance and clarity. Internal consistency was evaluated separately for each questionnaire domain using Cronbach's alpha. The practice domain demonstrated acceptable internal consistency (Cronbach's alpha = 0.725), whereas the knowledge domain had lower internal consistency (Cronbach's alpha = 0.327). This relatively low value was expected because the knowledge items assessed several independent factual concepts related to PLD use rather than a single underlying construct. Cronbach's alpha was therefore interpreted cautiously and was not considered the sole indicator of the questionnaire's adequacy for assessing the knowledge domain.

Data were analysed using the Statistical Package for the Social Sciences (SPSS), version 25. Descriptive statistics were used to summarise participant characteristics and questionnaire responses. Associations between categorical variables were analysed using the chi-squared test. Fisher's exact test was used when the assumptions of the chi-squared test were not met. Correlation coefficients were calculated for continuous variables, where applicable. Statistical significance was set at $p < 0.05$.

Ethical Considerations

The study was approved by the Research Ethics Committee (approval no. 096/EC-KEPK FKIK UMY/III/2022). Participation was voluntary, and all participants provided electronic informed consent before completing the questionnaire. The data were anonymised and used solely for scientific research.

RESULTS

Respondent Characteristics and Patterns of Personal Listening Device Use

A total of 182 undergraduate medical students completed the online questionnaire and were included in the final analysis. Of these, 67 (36.8%) were male and 115 (63.2%) were female. Most respondents (139; 76.4%) had used PLDs for more than five years, whereas 31 (17.0%) had used them for 2–5 years and 12 (6.6%) for less than two years. Regarding frequency of use, 111 respondents (61.0%) reported using PLDs on 0–3 days per week, whereas 71 (39.0%) used them on more than three days per week. Almost half of the respondents (90; 49.5%) reported using PLDs for less than one hour per day, followed by 66 (36.3%) who reported using them for 2–3 hours per day and 26 (14.3%) who reported using them for more than four hours per day.

Regarding preferred listening volume, the largest proportion of respondents preferred a loud volume (39.0%), followed by a somewhat loud volume (29.1%) and a medium or low volume (30.2%). Only three respondents (1.6%) reported preferring a very loud volume. No statistically significant differences were observed between male and female respondents in the duration of PLD use, frequency of use, daily listening duration, or preferred listening volume (all $p > 0.05$) (Table 1).

Table 1. Characteristics of personal listening device use among medical students

Variable	Male (n = 67) n (%)	Female (n = 115) n (%)	p	Total n (%)
Duration (years)				
<2	6 (50%)	6 (50.0%)	0.307	12 (6.6%)
2–5	14 (45.2%)	17 (54.8%)		31 (17.0%)
>5	47 (33.8%)	92 (66.2%)		139 (76.4%)
Use per week (days)				
0–3	36 (32.4%)	75 (67.5%)	0.085	111 (61.0%)
>3	31 (43.7%)	40 (56.3%)		71 (39.0%)

Variable	Male (n = 67) n (%)	Female (n = 115) n (%)	p	Total n (%)
Use per day (hours)				
<1	31 (34.4%)	59 (65.6%)	0.080	90 (49.5%)
2–3	26 (39.4%)	40 (60.6%)		66 (36.3%)
>4	10 (38.5%)	16 (61.5%)		26 (14.3%)
Preferred listening volume				
Very loud	3 (100%)	0 (0.0%)	0.142	3 (1.6%)
Somewhat loud	20 (37.7%)	33 (62.3%)		53 (29.1%)
Loud	24 (36.4%)	47 (66.2%)		71 (39.0%)
Medium or low	20 (36.4%)	35 (63.6%)		55 (30.2%)

Knowledge of Health Risks Associated with Personal Listening Device Use

Table 2 presents students' knowledge of the potential health risks associated with prolonged PLD use. All respondents recognised hearing loss as a potential consequence of prolonged PLD use (100.0%), and 181 (99.5%) recognised tinnitus as a potential consequence. Knowledge of other potential health risks varied. Overall, 129 respondents (70.9%) recognised insomnia as a possible consequence, 179 (98.4%) recognised headache, and 87 (47.8%) identified hypertension as a potential health risk associated with prolonged PLD use.

Regarding safe-listening practices, 112 respondents (61.5%) identified less than three hours as the recommended safe listening duration when using PLDs at normal volume. For listening at loud volume, 131 respondents (72.0%) considered less than one hour to be the safe limit. No statistically significant differences between male and female respondents were observed in knowledge of tinnitus, insomnia, hypertension, recommended listening duration, or safe listening limits (all $p > 0.05$). A statistically significant difference between male and female respondents was observed only for knowledge of headache ($p = 0.048$) (Table 2).

Table 2. Knowledge of potential health risks and safe-listening practices related to personal listening device use among medical students

Variable	Male (n = 67) n (%)	Female (n = 115) n (%)	p	Total n (%)
Knowledge of hearing loss as a potential consequence of prolonged PLD use				
Possible	67 (36.8%)	115 (63.2%)	NA*	182 (100%)
Unlikely	0 (0%)	0 (0%)		
Knowledge of tinnitus as a potential consequence of prolonged PLD use				
Possible	67 (37.0%)	114 (63%)	0.632	181 (99.5%)
Unlikely	0 (0%)	1 (100%)		
Knowledge of insomnia as a potential consequence of prolonged PLD use				
Possible	46 (35.7%)	83 (64.3%)	0.367	129 (70.9%)
Unlikely	21 (39.6%)	32 (60.4%)		
Knowledge of headache as a potential consequence of prolonged PLD use				
Possible	64 (35.8%)	115 (64.2%)	0.048	179 (98.4%)
Unlikely	3 (100%)	0 (0.0%)		
Knowledge of hypertension as a potential consequence of prolonged PLD use				
Possible	38 (43.7%)	49 (56.3%)	0.139	87 (47.8%)
Unlikely	29 (30.5%)	66 (69.5%)		
Knowledge of the safe listening duration at normal volume				
<3 h	38 (33.9%)	74 (66.2%)	0.769	112 (61.5%)
4–5 h	12 (42.9%)	16 (57.1%)		28 (15.4%)
No specific limit	6 (42.9%)	8 (57.1%)		14 (7.7%)
Don't know	11 (39.3%)	17 (60.7%)		28 (15.4%)
Knowledge of the safe listening duration at loud volume				
<1 h	47 (35.9%)	84 (64.1%)	0.700	131 (72.0%)
2-3 h	7 (43.8%)	9 (56.3%)		16 (8.8%)
4–5 h	1 (100%)	0 (0%)		1 (0.5%)
No specific limit	6 (33.3%)	12 (66.7%)		18 (9.9%)
Don't know	6 (37.5%)	10 (62.5%)		16 (8.8%)

Note:

*NA, not applicable. The chi-squared test was not performed because all respondents selected the same response category ('Possible'), resulting in no variation between groups.

Overall, respondents demonstrated high awareness of hearing loss and tinnitus as potential consequences of prolonged PLD use. However, knowledge of hypertension and recommended safe listening limits was comparatively lower.

DISCUSSION

This study investigated knowledge and practices related to PLD use among undergraduate medical students in Indonesia. Three principal findings emerged. First, most respondents had used PLDs for more than five years, indicating longer-term recreational listening. Second, although most respondents were aware of potential hearing-related risks associated with prolonged PLD use, a substantial proportion reported behaviours that might increase recreational noise exposure, including prolonged listening and a preference for loud volumes. Third, no statistically significant differences between male and female respondents were observed for most listening practices and knowledge variables, except knowledge of headache.

The widespread, long-term use of PLDs observed in this study is consistent with global trends among adolescents and young adults. More than 75% of participants reported using PLDs for more than five years, reflecting the growing presence of smartphones and portable audio devices in daily life. Similar long-term PLD use has been reported among medical students in India and health-sciences students in South Africa (16,17). A recent systematic review estimated that 0.67–1.35 billion adolescents and young adults worldwide engage in unsafe listening practices, emphasising that recreational noise exposure is a major public health concern (9). Although long-term use alone does not necessarily indicate hazardous listening, cumulative exposure may increase when prolonged listening is combined with excessive volume.

Almost half of the participants reported using PLDs for less than one hour per day, whereas more than one-third reported listening for 2–3 hours per day. Furthermore, approximately 40% preferred a loud listening volume. This finding is concerning because repeated exposure to amplified music has been associated with temporary and permanent auditory changes, particularly among young adults (18). Levey et al. reported that many university students exceeded recommended recreational sound-exposure levels (15), and Seedat et al. found frequent and prolonged PLD use among health-sciences students (16). Similarly, Mourad Abd El-Mawgoud reported that frequent and prolonged use of personal audio devices was common among young adults and might increase cumulative noise exposure (11). However, because the present study relied exclusively on self-reported listening behaviours and did not objectively measure sound-pressure levels or listening intensity, the findings should be interpreted as reported listening practices rather than direct estimates of hazardous noise exposure.

A key finding was the apparent discrepancy between knowledge and listening behaviour (19). Nearly all respondents recognised hearing loss and tinnitus as possible consequences of prolonged PLD use, and most identified the stated safe listening limits. Nevertheless, many respondents reported habits that might increase recreational noise exposure, including prolonged daily use and a preference for loud listening. This discrepancy suggests that awareness of risk alone may be insufficient to encourage safe-listening habits. You et al. similarly found that university students had general knowledge of hearing conservation, but this knowledge did not necessarily translate into safer listening behaviours (2). Basu et al. also found that medical students knew about the potentially harmful effects of PLD use but continued to engage in potentially unsafe listening behaviours (17). Collectively, these findings indicate a persistent knowledge–practice gap and suggest that hearing-conservation interventions should emphasise behavioural change as well as awareness.

No statistically significant differences between male and female students were found for most PLD-use characteristics or knowledge variables. Listening duration, frequency of use, preferred listening volume, and knowledge of recommended listening limits were generally comparable between the two groups. Only the headache knowledge item showed a statistically significant difference. Because the study was not specifically designed to investigate differences between male and female students and only one variable reached statistical significance, this isolated finding should be interpreted cautiously and confirmed in larger, more representative samples.

The health-related variables require careful interpretation. Hearing loss, tinnitus, insomnia, headache, and hypertension were assessed as respondents' perceptions of possible consequences of prolonged PLD use rather than as clinically confirmed conditions. The findings should therefore not be interpreted as the prevalence of these disorders among respondents. Although substantial evidence indicates that long-term exposure to excessive recreational noise can cause NIHL through irreversible damage to cochlear hair cells (3,5), the cross-sectional design and self-reported data do not permit causal inferences about PLD use and hearing-related outcomes. Similarly, previous epidemiological studies have reported associations between recreational noise exposure, tinnitus, and hearing problems (20–23), but these associations cannot be inferred directly from the present findings.

The relatively high awareness of hearing loss and tinnitus is noteworthy when compared with the more variable knowledge of safe listening duration and limits. Although almost all students identified hearing loss as a potential consequence of unsafe PLD use, fewer respondents identified the stated recommended listening durations at normal and loud volumes. This finding suggests that respondents may understand the general health consequences of excessive noise exposure but have less precise knowledge of preventive listening behaviours. Similar findings have been reported in studies of hearing-conservation awareness among university students and the general population (2,16,22,24). Future educational programmes should therefore not only increase awareness of hearing-related risks

but also promote practical safe-listening recommendations, including limiting listening duration, reducing listening volume, and following internationally recommended hearing-conservation practices.

These findings have implications for medical education and campus health promotion. Medical students are future healthcare professionals who are expected to educate patients and communities about disease prevention and healthy behaviours. Promoting safe-listening practices among medical students may therefore have benefits beyond individual hearing health by strengthening future public health education. Incorporating hearing-conservation initiatives into university health-promotion programmes may help bridge the knowledge–behaviour gap identified in this study.

This study also contributes to the limited evidence on PLD use among medical students in Indonesia. Previous studies of listening practices and hearing-conservation knowledge have been conducted in Korea (2), South Africa (16), India (14), and Saudi Arabia (25). By examining both listening behaviour and knowledge among Indonesian medical students, this study provides preliminary evidence from an under-represented setting and highlights the gap between awareness and preventive behaviour. These findings may provide baseline information for developing hearing-conservation interventions in Indonesian universities and designing future multicentre studies with more robust methods (21,22,26).

CONCLUSION

This study provides preliminary evidence of widespread PLD use among undergraduate medical students in Indonesia. Although respondents generally recognised hearing loss and tinnitus as potential consequences of prolonged PLD use, knowledge of recommended safe listening duration and exposure limits was less consistent, and potentially unsafe listening behaviours remained common. These findings highlight a potential gap between awareness and safe-listening practices.

The findings support the inclusion of hearing-conservation education in university health-promotion programmes, particularly practical recommendations on safe listening duration, volume, and the reduction of recreational noise exposure. Given the cross-sectional design, purposive sampling, and self-reported data from a single institution, the findings should be considered descriptive rather than causal. Future multicentre longitudinal studies using validated instruments, objective measures of listening exposure, and audiometric assessments are needed to strengthen the evidence on PLD use and hearing health among university students.

This study has several limitations. First, purposive sampling and recruitment from a single university limit the representativeness of the sample and the generalizability of the findings to other university students in Indonesia. Second, all data were self-reported and were therefore susceptible to recall and social-desirability biases, particularly for listening behaviours and knowledge of safe-listening practices. Third, the cross-sectional design does not permit causal or temporal inferences between PLD use and perceived health risks. Fourth, no objective assessments of listening exposure, such as sound intensity, device-recorded listening duration, or audiometric examination, were performed; therefore, the study could not determine actual noise exposure or clinically confirmed hearing impairment. Finally, the relatively low internal consistency of the knowledge domain (Cronbach's $\alpha = 0.327$) suggests that the items assessed multiple aspects of hearing-related knowledge rather than a single construct; the knowledge findings should therefore be interpreted cautiously. Future studies should use validated instruments, probability-based multicentre sampling, objective exposure measurements, audiometric assessments, and longitudinal designs to provide more robust evidence on PLD use and hearing health among university students.

DECLARATIONS

Author contributions: Conceptualisation: R.F. and A.W.; Methodology: R.F., A.W., and D.Y.; Formal analysis: R.F.; Investigation: R.F.; Data curation: R.F.; Writing—original draft: R.F.; Writing—review and editing: A.W. and D.Y.; Supervision: A.W. and D.Y. All authors have read and approved the final version of the manuscript.

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