

Knowledge, perception, and risk behaviours associated with earbud use among university undergraduates in Ibadan, Nigeria: implications for hearing health promotion

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ABSTRACT

The widespread use of earbuds among young adults presents public health concerns, including noise-induced hearing loss (NIHL), tinnitus, ear infections, and accidents due to reduced environmental awareness. This study assessed the knowledge, perceptions, and risk behaviours related to earbud use among undergraduates at the University of Ibadan, Nigeria, and examined the sociodemographic factors associated with knowledge. A cross-sectional survey was conducted among 416 undergraduates using a pre-tested, semi-structured questionnaire. Data were analysed using descriptive statistics, chi-square tests, and binary logistic regression at $\alpha=0.05$. Respondents' mean age was 21.0 ± 3.0 years, and 51.2% were male. Overall, 59.4% had poor knowledge of the health implications of earbud use. Two thirds (66.3%) could not describe NIHL, and 55.8% did not know the WHO safe listening limit of 80 dB, whereas 85.8% correctly identified sharing earbuds as the main infection risk. Unsafe practices were common: 40.6% used earbuds daily, 20.0% at high volume, and 36.5% while crossing roads. Knowledge was significantly associated with religion ($p=0.018$) and faculty ($p<0.001$). After adjustment, students in Dentistry (AOR=7.93), Veterinary Medicine (AOR=4.04) and Education (AOR=2.79) had higher odds of good knowledge than those in Basic Clinical Sciences, and Muslim students had lower odds than Christian students (AOR=0.56). Knowledge category was not significantly associated with perception category ($p=0.133$), although the continuous scores were weakly correlated ($\rho=0.17$). Education that goes beyond basic facts about NIHL and safe listening limits, and that takes account of differences between faculties, is needed.

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1. Introduction

The proliferation of personal audio devices, especially earbuds, has changed the way young adults interact with academic material, entertainment, and even everyday social talk. However, the convenience of this technology carries public health risks. The World Health Organisation estimates that more than one billion young people worldwide are at risk of hearing loss from unsafe listening habits, such as spending too much time with personal audio devices at high volume (WHO, 2022). In Africa, including Nigeria, the problem is compounded by rapid technology adoption, limited regulation and oversight, and low public health awareness (Haruna et al., 2023).

Earbuds deliver sound directly into the ear canal, and reported listening levels are often between 75 and 105 dB. This range can exceed the 80 dB level that is considered safe for no more than about 40 hours per week (Le et al., 2017). When exposure continues at those intensities, it can harm cochlear hair cells in ways that are difficult to reverse, contributing to noise-induced hearing loss (NIHL), persistent tinnitus, and other hearing problems (Byeon, 2021). Earbud use has other health consequences. It has also been linked with ear infections, partly because the covered ear canal can support bacterial growth. Users also report ear soreness, which may relate to earbud design, and accidents while moving, for example when crossing roads, where awareness of the surroundings matters and earbuds can reduce it (Fasanya & Strong, 2018; Ahamad & Mehta, 2023).

University students are a vulnerable group. They often use earbuds for long periods, for example during online lectures, reading and studying, commuting, or leisure, and much of this happens in noisy places, which may lead users to raise the volume (Gupta et al., 2022). Work from Nigeria points to considerable exposure among young adults. For example, a study in Kwara State found that 43.5% of daily earbud users were at risk of ear infections and canal irritation (Salami et al., 2025). A study of students in Durban, South Africa, reported that about 40% had high-frequency hearing loss around 6000 Hz, linked to recreational noise exposure (Mahomed & Panday, 2024).

Despite this growing evidence, little is known about how much Nigerian students know and think about earbud-related hazards. How knowledge, perception and behaviour relate to one another is also unclear, and existing work points to uneven awareness. Students may notice immediate effects such as ear discomfort but may not recognise slower, less visible harms such as NIHL, or connect their own listening routines to longer-term outcomes (AlOmari et al., 2024).

This study therefore assessed knowledge, perception and risk behaviours related to earbud use among undergraduates at the University of Ibadan, examined the sociodemographic factors associated with knowledge, and examined the relationship between knowledge and perception.

2. Literature Review

This study is guided by the PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational/Environmental Diagnosis and Evaluation) model, which was developed by Green and Kreuter (2005). In general, PRECEDE provides a systematic roadmap for understanding the many levels of influence on health behaviours and helps in designing interventions that address them. The model is well suited for examining earbud use among university students because it covers the relationships among individual drivers, social forces, and the surrounding environment that together shape health practices among young adults (Glanz, Rimer, & Viswanath, 2015).

The PRECEDE model proposes that three categories of factors shape health behaviours, and that these should be identified before an intervention is designed:

Predisposing factors are earlier conditions that set the stage for a behaviour before it even happens (Green & Kreuter, 2005). They typically involve knowledge, attitudes, beliefs, values, perceptions, and self-efficacy. For earbud use, predisposing factors include students' understanding of the health implications (for example, understanding noise-

induced hearing loss [NIHL] and knowing what counts as safe volume limits), how strongly they believe they might personally be harmed, how serious they think the outcomes are, and whether they feel able to adopt safe listening habits. Hutchinson et al. (2015) showed that even when about 50% of young adults recognised that earbuds could lead to permanent hearing loss, that knowledge by itself did not reliably translate into safe behaviours, suggesting that predisposing factors need to be weighed alongside other determinants. Gilles et al. (2013) also reported that perceived susceptibility and perceived severity meaningfully shape intentions to use hearing protection. Wells et al. (2018) described optimism bias among young adults, who tend to underestimate their personal risk, and reported that self-efficacy predicted protective actions.

Enabling factors are the conditions that can make behaviour easier or harder to perform, including skills, resources, and barriers that either help or block behaviour change (Green & Kreuter, 2005). When it comes to earbud use, the enabling factors would be access to safe listening technologies, such as volume-limiting devices, the affordability of good earbuds, the availability of health information, and the presence of environmental cues, such as warning labels. Practical skills also matter, such as judging volume accurately and following proper hygiene routines. Some studies from resource-limited settings show that students from lower socioeconomic backgrounds often use low-cost earbuds that lack safety features, which creates a major enabling barrier (Ramya & Geetha, 2022; Wang et al., 2021). In addition, earbud packaging often lacks mandatory health warnings, which removes an environmental cue that could remind users about safe practices (Trimmis et al., 2025). Keppler, Dhooge, and Vinck (2015) emphasised that skills training is essential for turning knowledge into action.

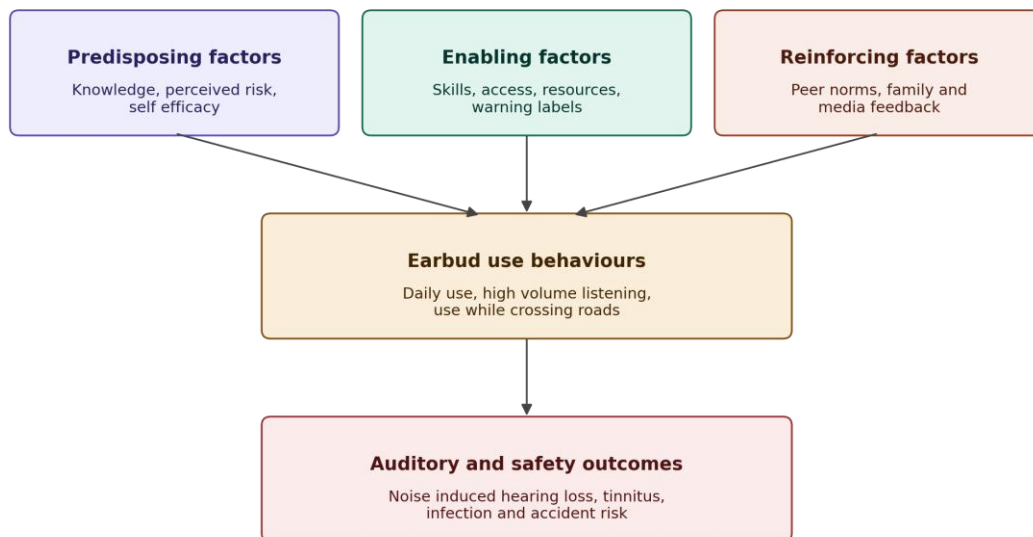
Reinforcing factors are the kinds of feedback and rewards people receive right after a behaviour, which shape whether they keep doing it or stop (Green & Kreuter, 2005). In a university setting, these reinforcing factors can include peer approval or disapproval tied to earbud practices, as well as social expectations or norms about how students listen in general. Feedback from family and authority figures, and observation of what peers and the media do, also act as reinforcing factors. Chinyoka (2022) described how peer norms in Zimbabwean universities reinforced high-volume listening as a status signal, highlighting the power of social reinforcement. Weisskirch (2025) found that adolescents' perceptions of what their peers do with listening are a strong predictor of their own listening behaviour. Holt-Lunstad (2023) showed that social media platforms can amplify certain listening practices, where influencers normalise risky listening. The researcher also noted that the cultural praise of loud music, reinforced through marketing, makes these risky behaviour tendencies even more persistent.

2.1 Theoretical Framework

The PRECEDE model guides this study. The model provides a systematic way of understanding the multiple levels of influence that shape health behaviours. Constructs described under other health behaviour theories, such as perceived susceptibility and self-efficacy, are treated here as part of the predisposing domain, and peer influence as part of the reinforcing domain (Green & Kreuter, 2005).

Figure 1

Theoretical framework of the study, based on the PRECEDE model (Green and Kreuter, 2005). Hearing outcomes are shown to complete the framework .



2.2 Operationalisation of the framework

The PRECEDE model organises the determinants of earbud-related health behaviour into predisposing, enabling and reinforcing factors, which together shape whether students engage in safe or unsafe listening practices. In this study, predisposing factors were measured through the knowledge score and the perception score, which included personal risk, discomfort, the vulnerability of young people and intention to continue use. Enabling factors were assessed only indirectly, through knowledge of volume-limiting features, response to health warnings on packaging and the listening environment. Reinforcing factors were assessed through one item on peer influence. Earbud use behaviours (frequency, duration, volume, noise masking, use while crossing roads and accident history) were treated as the behaviours that these factors influence. Self-efficacy, access to safe listening technology, and family and media influences were not measured, and hearing outcomes such as NIHL and tinnitus were not assessed.

3. Methods

3.1 Study Design and Setting

This cross-sectional study was conducted at the University of Ibadan, located in Oyo State, South-West Nigeria. The university comprises 16 faculties with approximately 16,462 undergraduate students across diverse disciplines.

3.2 Study Population and Sampling

The study population included all registered undergraduate students. Inclusion criteria were: currently enrolled undergraduate status, willingness to participate, and availability during data collection. Exclusion criteria were refusal to participate.

Sample size was calculated using the Kish (1965) formula, based on a 43.5% prevalence of earbud-related risks from a previous Nigerian study (Salami et al., 2025):

$$n = Z^2pq/d^2$$

Where $Z=1.96$ (95% CI), $p=0.435$, $q=0.565$, $d=0.05$, yielding 378 participants. Adding 10% to account for non-response yielded a final sample of 416. The formula assumes simple random sampling and was not adjusted for the multi-stage design.

A multi-stage sampling technique was used. In Stage 1, eight of the 16 faculties were selected by systematic sampling. The faculties were listed alphabetically, giving a sampling interval of 2, and a random starting point of 1 was chosen by balloting. In Stage 2, the sample of 416 was allocated to the selected faculties in proportion to their undergraduate enrolment. In Stage 3, students within each selected faculty were chosen by simple random sampling. The sampling frame was the class register obtained from the course representatives. Each student on the list was assigned a serial number, and the required number of participants for the faculty was drawn using a table of random numbers. Selected students were then approached in person and invited to take part. Where a selected student could not be reached or declined, the next number on the random list was used as a replacement.

3.3 Data Collection Instrument

A semi-structured, self-administered questionnaire was developed based on a literature review and validated instruments. It comprised four sections:

Section A: Sociodemographic characteristics (sex, age, religion, ethnicity, faculty, department, academic level).

Section B: Knowledge of health implications (11 questions, four open ended and seven multiple choice, on NIHL, tinnitus, safe volume limits, infection risks and preventive practices). For the three open ended questions on conditions, preventive practices and effects of sharing, each correct answer scored 1 up to a maximum of 2. The question asking respondents to describe NIHL scored 2 if correct, and each multiple-choice question scored 1 if correct. Total scores ranged from 0 to 15, with higher scores indicating better knowledge. A threshold of 60% of the maximum score (9 of 15) was set in advance and applied to all respondents, in line with Islam et al. (2024). Scores of 9 or more were categorised as good knowledge and scores below 9 as poor knowledge

Section C: Perception of health implications (9 statements rated on a 4-point scale from strongly agree to strongly disagree). Strongly disagree and disagree were scored 0, agree 1 and strongly agree 2. Two statements (young people are less vulnerable to hearing damage, and would continue using earbuds despite long-term harm) were reverse-scored, so that higher scores indicate greater perceived risk and more support for protective measures. Total scores ranged from 0 to 18. Scores of 10 or more were categorised as higher perceived risk and scores below 10 as lower perceived risk (Abassi, 2024).

Section D: Patterns of earbud use (frequency, duration, volume, listening contexts, and accident history). Accident history was assessed by asking whether respondents had experienced an accident while using earbuds when walking or crossing a major road, and what type of accident it was. Public health experts reviewed the instrument for content validity, and it was pre-tested among 50 students at Obafemi Awolowo University, Ile-Ife, before data collection. Cronbach's alpha in the pre-test was 0.882. In the main sample, internal consistency was modest (Cronbach's alpha 0.68 for the 11 knowledge questions and 0.67 for the 9 perception items).

3.4 Data Collection Procedure

Five research assistants were trained on ethical procedures and questionnaire administration. Data were collected over six weeks. Questionnaires were distributed during lecture breaks and in common areas. Completed questionnaires were reviewed immediately for completeness. Participation was voluntary and anonymous.

3.5 Data Analysis

Data were entered into SPSS version 27. Descriptive statistics (frequencies, percentages, means and standard deviations) were calculated. Associations between categorical variables were examined with Pearson's chi-square test, or with Fisher's exact test where more than 20% of cells had expected counts below 5 (religion). The relationship between knowledge and perception was examined with a chi-square test on the categorised scores and with Spearman's rank correlation on the continuous scores. Variables associated with knowledge at $p < 0.05$ in bivariate analysis (religion and faculty) were entered together in a binary logistic regression using the enter method. Christianity, the largest religious group, was used as the reference category for religion. Basic Clinical Sciences, the first faculty in the coding order, was used as the reference category for faculty. Crude and adjusted odds ratios with 95% confidence intervals are reported. Multicollinearity was checked with variance inflation factors (all below 3.5). Model fit was assessed with the omnibus test of model coefficients and Nagelkerke R^2 , and discrimination with the area under the receiver operating characteristic curve. Statistical significance was set at $p < 0.05$.

4. Results

4.1 Sociodemographic Characteristics

A total of 416 undergraduates participated. Table 1 presents the sociodemographic profile. Respondents' mean age was 21.0 ± 3.0 years (range 16 to 32), with the largest group (43.5%) aged 20 to 23 years. Males constituted 51.2% of the sample. Most were Christian (72.4%) and of Yoruba ethnicity (83.7%). Respondents were in 100 to 600 level, mostly in 100 to 300 level (80.8%), and came from eight faculties: Education (26.9%), Science (26.4%), Clinical Sciences (16.3%), Social Sciences (11.3%), Basic Clinical Sciences (7.5%), Veterinary Medicine (5.3%), Public Health (4.3%), and Dentistry (1.9%).

Table 1

Sociodemographic Characteristics of Respondents (N=416)

Characteristic	Frequency	Percentage
Sex		
Male	213	51.2
Female	203	48.8
Age group (years)		
16 to 19	157	37.7
20 to 23	181	43.5
24 to 27	61	14.7
28 and above	17	4.1
Religion		

Christianity	301	72.4
Islam	108	26.0
Traditionalist	7	1.7

Ethnicity

Yoruba	348	83.7
Hausa	11	2.6
Igbo	27	6.5
Others	30	7.2

Academic Level

100	110	26.4
200	111	26.7
300	115	27.6
400	71	17.1
500	4	1.0
600	5	1.2

Faculty

Education	112	26.9
Science	110	26.4
Clinical Sciences	68	16.3
Social Sciences	47	11.3
Basic Clinical Sciences	31	7.5
Veterinary Medicine	22	5.3
Public Health	18	4.3

4.2 Knowledge of Health Implications

Overall, 59.4% (n=247) of respondents had poor knowledge of the health implications of earbud use (mean score 7.65 ± 3.08 out of 15). Table 2 summarises key knowledge findings for the open ended and multiple choice questions. When asked to name two conditions that can result from unsafe earbud use, 54.3% named partial or total deafness and 29.8% named ear infection, whereas few named tinnitus (5.3%) or ear irritation (3.1%). In the multiple choice question on tinnitus, 46.9% chose the correct description. Two thirds (66.3%) answered "I don't know" when asked to describe NIHL, and 27.2% gave a correct description. For the WHO safe listening limit, 17.3% chose the correct value of 80 dB, 26.9% chose an incorrect value and 55.8% answered "I don't know". However, 76.9% correctly identified "halfway or lower" as a safe volume level, and 80.5% understood that volume-limiting features reduce the risk of hearing damage. Knowledge of infection risk was higher: 85.8% correctly identified sharing earbuds as the main infection risk, and 56.3% named infection as an effect of sharing earbuds when asked to list effects.

Table 2

Key Knowledge Indicators (N=416)

Knowledge Item	n (%)
Open ended questions (respondents could name up to two answers)	
Named partial or total deafness as a condition	226 (54.3)
Named ear infection as a condition	124 (29.8)
Named tinnitus as a condition	22 (5.3)
Named ear irritation or discomfort as a condition	13 (3.1)
Answered "I don't know" when asked to name conditions	90 (21.6)
Named infection as an effect of sharing earbuds	234 (56.3)
Described NIHL correctly	113 (27.2)
Answered "I don't know" when asked to describe NIHL	276 (66.3)
Multiple choice questions	
Identified tinnitus correctly	195 (46.9)
Chose 80 dB as the WHO safe limit	72 (17.3)
Chose an incorrect value for the WHO safe limit	112 (26.9)
Answered "I don't know" for the WHO safe limit	232 (55.8)

Identified sharing earbuds as the main infection risk	357 (85.8)
Identified permanent hearing damage as a consequence of prolonged high volume	216 (51.9)
Understood that volume-limiting features reduce hearing damage	335 (80.5)
Identified "halfway or lower" as a safe volume	320 (76.9)
Chose breaks every 60 minutes	92 (22.1)

4.3 Perception of Health Implications

The mean perception score was 9.54 ± 3.16 (possible range 0 to 18, with higher scores indicating greater perceived risk). Overall, 51.2% (n=213) had lower perceived risk (score below 10) and 48.8% (n=203) had higher perceived risk. Table 3 presents responses to the individual statements.

Agreement was high for institutional responsibility and prevention: 58.9% strongly agreed that universities should provide education on earbud risks, and 54.1% strongly agreed that risks are preventable through safe listening guidelines. Personal risk perception was lower: 18.0% strongly agreed and 36.5% agreed that they were personally at risk (54.6% combined), and 48.8% agreed or strongly agreed that young people are less vulnerable to hearing damage.

Stated intentions and behaviour did not match: 62.7% disagreed or strongly disagreed that they would continue using earbuds if they knew of the long-term harm, yet risky use was common. Peer influence was acknowledged as a barrier by 55.5% who agreed or strongly agreed that it makes healthy practices difficult, and 76.7% agreed or strongly agreed that health warnings on earbud packaging would make them reconsider how they use earbuds.

Table 3

Perception of Health Implications (N=416)

Statement	SA n(%)	A n(%)	D n(%)	SD n(%)
Universities should provide education	245(58.9)	156(37.5)	11(2.6)	4(1.0)
Risks are preventable through guidelines	225(54.1)	180(43.3)	6(1.4)	5(1.2)
Discomfort affects well-being or mood	131(31.5)	184(44.2)	87(20.9)	14(3.4)
Young people are less vulnerable (reverse scored)	82(19.7)	121(29.1)	138(33.2)	75(18.0)
I am personally at risk	75(18.0)	152(36.5)	108(26.0)	81(19.5)
Infections from unclean or shared earbuds can be serious	173(41.6)	193(46.4)	32(7.7)	18(4.3)
Would continue even if aware of harm (reverse scored)	55(13.2)	100(24.0)	145(34.9)	116(27.9)

Peer influence hinders safe practices	66(15.9)	165(39.7)	127(30.5)	58(13.9)
Health warnings on packaging would make me reconsider	123(29.6)	196(47.1)	74(17.8)	23(5.5)

SA=Strongly Agree, A=Agree, D=Disagree, SD=Strongly Disagree Statements on the vulnerability of young people and on continuing use despite harm were reverse scored.

4.4 Patterns of Earbud Use and Risk Behaviours

Table 4 summarises usage patterns. Daily earbud use was reported by 40.6%, with 28.4% using earbuds 1 to 2 days per week, 19.0% 3 to 4 days per week, and 12.0% 5 to 6 days per week. Average daily duration was 1 to 2 hours (31.3%), 3 to 4 hours (26.4%), and more than 6 hours (9.6%). The longest continuous use without a break was more than 2 hours for 19.5%.

Volume practices were concerning: 20.0% reported using high volume, and 68.8% sometimes increased the volume to block surrounding noise (the response options were never, rarely and sometimes). Risky contexts included using earbuds while crossing roads (36.5%) and falling asleep while listening (38.9%). In all, 7.5% (n=31) reported an accident related to earbud use while walking or crossing a major road. Twelve respondents described the accident, and the descriptions included a car accident, near misses with a tricycle, a speeding bike and a car, bumping into people, and falling into a pit.

Table 4

Patterns of Earbud Use and Risk Behaviours (N=416)

Variable	Category	n (%)
Frequency of use	Every day	169 (40.6)
	1 to 2 days/week	118 (28.4)
	3 to 4 days/week	79 (19.0)
	5 to 6 days/week	50 (12.0)
Average daily duration	<1 hour	92 (22.1)
	1 to 2 hours	130 (31.3)
	3 to 4 hours	110 (26.4)
	5 to 6 hours	44 (10.6)
	>6 hours	40 (9.6)
Volume level	Low	52 (12.5)
	Intermediate	281 (67.5)

	High	83 (20.0)
Increase volume to block noise.	Never	31 (7.5)
	Rarely	99 (23.8)
	Sometimes	286 (68.8)
Use while crossing roads.	Yes	152 (36.5)
	No	264 (63.5)
Fall asleep while listening.	Yes	162 (38.9)
	No	254 (61.1)
Experienced accident	Yes	31 (7.5)
	No	385 (92.5)

4.5 Factors Associated with Knowledge

Chi-square analysis (Table 5) showed significant associations between knowledge and religion ($\chi^2=8.06$, $p=0.018$; exact $p=0.014$) and faculty ($\chi^2=26.23$, $p<0.001$). Sex, ethnicity, academic level and age group showed no significant associations.

In binary logistic regression (Table 6), faculty and religion were entered together. Compared with students in Basic Clinical Sciences, students in Dentistry (AOR=7.93, 95% CI: 1.32 to 47.55, $p=0.024$), Veterinary Medicine (AOR=4.04, 95% CI: 1.26 to 13.01, $p=0.019$) and Education (AOR=2.79, 95% CI: 1.18 to 6.62, $p=0.020$) had higher odds of good knowledge. Muslim students had lower odds of good knowledge than Christian students (AOR=0.56, 95% CI: 0.34 to 0.92, $p=0.021$). The model was significant overall ($\chi^2=32.14$, $df=9$, $p<0.001$; Nagelkerke $R^2=0.10$), discrimination was modest (area under the curve 0.65), and variance inflation factors were below 3.5. The estimates for Dentistry ($n=8$) and for Traditionalist respondents ($n=7$) are imprecise, as their wide confidence intervals show.

Table 5

Association Between Sociodemographics and Knowledge (N=416)

Variable	Poor Knowledge n(%)	Good Knowledge n(%)	χ^2	p-value
Religion			8.063	0.018*
Christianity	166(55.1)	135(44.9)		
Islam	76(70.4)	32(29.6)		
Traditionalist	5(71.4)	2(28.6)		

Faculty			26.226	<0.001*
Basic Clinical Sciences	22(71.0)	9(29.0)		
Clinical Sciences	50(73.5)	18(26.5)		
Dentistry	2(25.0)	6(75.0)		
Education	53(47.3)	59(52.7)		
Public Health	14(77.8)	4(22.2)		
Science	70(63.6)	40(36.4)		
Social Sciences	28(59.6)	19(40.4)		
Veterinary Medicine	8(36.4)	14(63.6)		

*Statistically significant at p<0.05

Table 6

Crude and Adjusted Odds Ratios for Good Knowledge

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value (adjusted)
Faculty (ref: Basic Clinical Sciences)			
Clinical Sciences	0.88 (0.34 to 2.26)	0.91 (0.35 to 2.36)	0.849
Dentistry	7.33 (1.24 to 43.41)	7.93 (1.32 to 47.55)	0.024*
Education	2.72 (1.15 to 6.43)	2.79 (1.18 to 6.62)	0.020*
Public Health	0.70 (0.18 to 2.71)	0.81 (0.21 to 3.20)	0.767
Science	1.40 (0.59 to 3.33)	1.64 (0.68 to 3.96)	0.272
Social Sciences	1.66 (0.63 to 4.38)	1.77 (0.67 to 4.71)	0.250
Veterinary Medicine	4.28 (1.34 to 13.71)	4.04 (1.26 to 13.01)	0.019*
Religion (ref: Christianity)			
Islam	0.52 (0.32 to 0.83)	0.56 (0.34 to 0.92)	0.021*

Traditionalist	0.49 (0.09 to 2.58)	0.63 (0.12 to 3.39)	0.591
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*p<0.05. OR=odds ratio; AOR=adjusted odds ratio, adjusted for the other variable in the table.

4.6 Knowledge-Perception Relationship

Knowledge category was not significantly associated with perception category ($\chi^2=2.26$, $p=0.133$). Among respondents with poor knowledge, 54.3% had lower perceived risk, compared with 46.7% of those with good knowledge. However, knowledge and perception scores were weakly and positively correlated (Spearman's $\rho=0.17$, $p<0.001$), so higher knowledge was associated with somewhat higher perceived risk. Perceived risk did not differ significantly by sex ($p=0.85$), religion ($p=0.66$), ethnicity ($p=0.79$), faculty ($p=0.068$) or age group ($p=0.055$).

5. Discussion

This study examined what undergraduates at the University of Ibadan know and perceive about the health implications of earbud use, and the risk behaviours they report. Most respondents had some basic awareness of earbud-related hazards but limited detailed knowledge. Perceptions of risk were not clearly related to safer habits, and risky use was common. The finding that 59.4% had poor knowledge, with major gaps in understanding NIHL and safe listening limits, is in line with earlier work on young adults (Hutchinson et al., 2015; Mina et al., 2023)). Two thirds could not describe NIHL, which is the most serious irreversible harm associated with unsafe listening. Hutchinson Marron et al. (2015) similarly reported that young adults may recognise that earbuds can contribute to hearing damage without understanding the mechanism or the thresholds involved. Only 17.3% identified the 80 dB limit, and more than half answered "I don't know", which shows how little is known about safe listening levels.

Some areas of knowledge were stronger. Most respondents identified sharing earbuds as the main infection risk (85.8%), understood the purpose of volume-limiting features (80.5%) and knew that a volume of halfway or lower is safe (76.9%). Knowledge of infection risks appeared better than knowledge of gradual, less visible harms such as NIHL, a pattern that has been described in other low-resource settings, where health education tends to focus on acute rather than chronic threats (Ramya & Geetha, 2022). Knowledge differed by faculty. Students in Dentistry, Veterinary Medicine and Education had higher odds of good knowledge than those in Basic Clinical Sciences. Curriculum content was not measured, so we cannot say whether this reflects exposure to biomedical or health education material, and the Dentistry estimate rests on only eight respondents. Knowledge was lowest in descriptive terms among Public Health students (22.2% with good knowledge, $n=18$) and Clinical Sciences students (26.5%), but these groups did not differ significantly from Basic Clinical Sciences after adjustment, so no conclusion about professional training can be drawn from these data.

Muslim students had lower odds of good knowledge than Christian students. Religion may stand in for factors that were not measured, such as sources of health information, so this association should be interpreted with caution and examined in further studies. Knowledge and perception were not significantly associated when categorised ($p=0.133$), although the continuous scores showed a weak positive correlation ($\rho=0.17$). Higher knowledge was therefore related, at most, weakly to higher perceived risk, which suggests that knowledge alone is unlikely to produce concern about personal risk. Within the PRECEDE framework, knowledge is one predisposing factor, and beliefs about susceptibility and severity and confidence in changing one's behaviour are further predisposing factors that may determine whether knowledge leads to action (Green & Kreuter, 2005). Personal risk perception was modest: 18.0% strongly agreed that they were personally at risk, and 48.8% agreed that young people are less vulnerable to hearing damage. This pattern is consistent with optimism bias, in which young people expect to be less vulnerable than others (Holt-Lunsta, 2024; Wang et al., 2021; Brown & Bidelman, 2022), although optimism bias was not measured directly.

Peer influence was acknowledged by 55.5% of respondents as making unhealthy use hard to avoid. This was measured with a single item, and observational learning and the perceived benefits of listening were not assessed,

so the mechanisms behind this finding cannot be examined here. Within PRECEDE, peer norms are reinforcing factors that may help to explain why risky use persists (Green & Kreuter, 2005). Risk behaviours were common: 40.6% used earbuds daily, 20.0% listened at high volume, and 36.5% used earbuds while crossing roads. These practices may increase the risk of both hearing damage and injury, although neither was measured directly. In total, 7.5% reported an accident while using earbuds when walking or crossing a major road, which is in line with evidence that distracted pedestrians are at greater risk of injury (Nasar & Troyer, 2013). In addition, 68.8% sometimes increased the volume to block out surrounding noise. In a city such as Ibadan, where traffic and markets are noisy, this may lead to high listening levels, but sound levels and hearing were not measured.

Applied to these findings, the PRECEDE model points to gaps in each domain. Predisposing gaps are indicated by the 59.4% with poor knowledge and the 66.3% who could not describe NIHL. Reinforcing influences are indicated by the 55.5% who agreed that peer influence makes unhealthy use hard to avoid. Enabling factors were measured only indirectly, through the 76.7% who said that health warnings on packaging would make them reconsider their use. Using earbuds while crossing roads (36.5%) and raising the volume to block noise (68.8%) are behaviours that these factors may influence, rather than enabling factors in themselves.

5.1 Implications and Future Directions

These findings suggest that interventions should address knowledge, perceptions and the wider environment. For individuals, education should go beyond facts and figures and address beliefs about personal risk and confidence in adopting safe listening habits. Socially, peer-led activities, for example using student ambassadors, may help to shift what students regard as normal. At the environmental level, 76.7% of respondents agreed that health warnings on earbud packaging would make them reconsider how they use earbuds, which suggests that warning labels merit consideration, together with the inclusion of hearing health in university health education.

The differences across faculties suggest that one approach may not suit all students. For health professional students, the topic could be built into clinical training, while for other students social media and student wellness programmes may be options. Perceived risk did not differ significantly across the demographic groups examined, so broad awareness campaigns may suit all students, with additional activities targeting the knowledge gaps identified here.

5.2 Limitations

This study has several limitations. The cross-sectional design allows associations to be identified but not causal relationships. The data were self-reported, so recall error and social desirability bias are possible. The study was conducted at one university, and the findings may not apply to other Nigerian institutions or regions. Questionnaires were handed out during lecture breaks and in common areas, so respondents may not fully represent the sampled students. Some estimates, notably for Dentistry (n=8) and Traditionalist respondents (n=7), are imprecise. The perception scale combined disagree and strongly disagree into a single score, and the question on increasing volume had no option above "sometimes". An item on whether an accident had been fatal could not be interpreted and was not analysed. No objective audiological measurements were made, and these should be included in future studies.

6. Conclusion

In this cross-sectional survey of 416 University of Ibadan undergraduates, 59.4% had poor knowledge of the health implications of earbud use, two thirds (66.3%) could not describe noise-induced hearing loss, and only 17.3% correctly identified the WHO recommended 80 dB limit. Knowledge differed by faculty and religion. Risky listening practices were common: 40.6% used earbuds daily, 20.0% reported high volume, 68.8% sometimes raised the volume to mask surrounding noise, 36.5% used earbuds while crossing roads, and 7.5% reported an accident. Although 54.6% agreed or strongly agreed that they were personally at risk, perception was only weakly related to knowledge, and 55.5% acknowledged peer influence as a barrier to safe use. These findings are associations from self-reported data at a single university and cannot establish causes. Within the PRECEDE framework, they point to the value of education that goes beyond facts about noise-induced hearing loss and safe listening limits, strategies that engage

peer norms, and attention to environmental cues such as health warnings, which 76.7% said would make them reconsider their use. Objective audiological assessment and multi-institution samples are needed to confirm and extend these findings.

Declarations

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Competing Interests

The authors declare no conflicts of interest.

Ethical Approval

Ethical approval was obtained from the University of Ibadan/University College Hospital Ethics Review Committee (UI/EC/25/0536). Written informed consent was obtained from all participants. Confidentiality was assured, and participants could withdraw at any time without consequences.

Author Contributions

Author¹: Conceptualisation, Data curation, Methodology, Formal analysis, Writing – original draft, Writing – review and editing, Resources, and Software

Author²: Supervision, Investigation, Methodology, Writing – review and editing, Validation, Visualisation, and Resources.

Data availability

The identified transcripts and analytic materials are available from the corresponding author on reasonable request, subject to ethical and privacy constraints.

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