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RELATIONSHIP BETWEEN POOR CLASSROOM ACOUSTICS AND HEARING FATIGUE AMONG NIGERIAN UNDERGRADUATES: A HYBRID REVIEW

BY

Barnabas Bem Vangerwua: Department of Audiology, Federal University of Health Sciences, Ila-Orangun, Nigeria

Ajibola Abdulrahman. Ishola: Department of Audiology, Federal University of Health Sciences, Ila-Orangun, Nigeria

&

Ibraheem Abiodun Salako: Department of Audiology, Federal University of Health Sciences, Ila-Orangun, Nigeria; E-mail: ajibola.ishola@fuhsi.edu.ng

Abstract

This hybrid scoping and systematic review investigates the relationship between poor classroom acoustics and hearing fatigue among Nigerian undergraduates. Following PRISMA-ScR and PRISMA 2020 guidelines, we searched PubMed, AJOL, Scopus, and Web of Science for studies up to May 2024. The scoping phase mapped noise exposure across six geopolitical zones, revealing ambient levels consistently exceeding 70 dBA due to power generators and vehicular traffic. The systematic phase synthesized evidence linking these acoustic conditions to health outcomes using the ROBINS-E tool for quality assessment. Results indicate a significant correlation between chronic noise exposure, often exceeding 85 dBA, and physical fatigue, headaches, and impaired cognitive performance. While high noise levels are objectively detrimental, perceived listening difficulty emerges as a stronger predictor of fatigue than measured decibel levels. Furthermore, the cultural normalization of noise masks long term risks of burnout. The review concludes that substandard classroom acoustics represent a critical environmental determinant of academic burnout. We recommend institutional policies prioritizing acoustic interventions and salutogenic design frameworks to mitigate cognitive strain and preserve student mental health.

Keywords: Classroom acoustics, Noise pollution, Hearing fatigue, Listening effort, Academic burnout, Higher education and Cognitive load

Introduction

The quality of the acoustic environment is a fundamental determinant of pedagogical efficacy and cognitive performance. In optimal learning conditions, the acoustic environment acts as an invisible facilitator, supporting the seamless transmission of information between lecturer and student. International bodies, such as the World Health Organization (WHO), recommend ambient noise levels not exceeding 35 dB for classrooms to ensure speech intelligibility (WHO, 2018). However, in many developing educational landscapes, specifically within Nigeria, this ideal is systematically compromised by a convergence of infrastructural deficits, rapid urbanization, and environmental stressors. In the context of Nigerian tertiary institutions, the acoustic reality stands in stark contrast to these recommended standards. The learning environment is frequently characterized by a cacophony of sounds, ranging from the intrusive hum of diesel power generators, a necessity due to the national power grid instability, to the relentless noise of vehicular traffic and overcrowded social interactions within lecture halls (Roberts et al., 2025; Alademomi et al., 2020). Recent assessments indicate that ambient noise levels in Nigerian lecture theaters frequently oscillate between 70 dB and 90 dB, effectively doubling the permissible limits (Edene & Eghomwanre, 2023; Onu et al., 2025).

Auditory perception is not a passive activity; it is an active, cognitively demanding process. When acoustic conditions are favorable, the brain requires minimal resources to process speech. However, in suboptimal acoustic environments, the listener must exert listening effort, defined as the deliberate allocation of mental resources to overcome obstacles in auditory perception (Pichora-Fuller et al., 2016). This construct is central to the Framework for Understanding Effortful Listening (FUEL), which posits that the brain draws upon a limited pool of cognitive resources to decode degraded signals (Pichora-Fuller et al., 2016). When the acoustic environment is hostile, marked by high reverberation times and intrusive background noise, the cognitive load required to listen increases exponentially. McGarrigle (2016) describes this as a state of effortful listening, where the brain recruits additional neural networks to fill in missing auditory information. This compensation is metabolically expensive. The sustained allocation of these finite resources to the task of hearing inevitably leads to listening related fatigue, a distinct form of exhaustion characterized by a depletion of cognitive stamina and a decline in processing speed (McGarrigle, 2016). This depletion of cognitive resources through acoustic strain provides a plausible physiological pathway to academic burnout. Academic burnout is increasingly recognized as a critical public health issue within Nigerian higher education, characterized by emotional exhaustion, cynicism, and reduced professional efficacy (Adesola et al., 2025;

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Ibikunle et al., 2025). While traditional etiological models focus on academic workload, sleep deprivation, and financial stress, the environmental contribution of the physical classroom is frequently overlooked.If a student enters a lecture hall already suffering from mild academic stress, and is subsequently subjected to 90 dB of noise for a two hour period, the additional cognitive load may push them over the threshold of their coping capacity. The emotional exhaustion component of burnout is, in this context, partially a manifestation of physiological fatigue induced by the environment. Evidence suggests that poor acoustics impair basic cognitive functions such as attention, memory, and information processing, which are essential for academic success (Ali et al., 2023). Therefore, the silent problem of classroom acoustics acts as a hidden curriculum of fatigue, systematically draining the mental energy of the student body.

Need for a Hybrid Review

Despite the severity of the problem, the current literature is fragmented. Engineering and environmental science studies in Nigeria have extensively mapped noise pollution levels and architectural deficiencies, yet they often stop short of evaluating the psychological or health consequences. Conversely, psychological and educational studies frequently report high rates of burnout and stress but rarely control for, or even measure, the acoustic environment of their participants. This disconnect creates a significant knowledge gap: we know the noise levels are high, and we know the students are exhausted, but the direct link between the two remains insufficiently synthesized. To address this, a hybrid review design is necessary. A scoping review is required to map the breadth, characteristics, and geographic distribution of the acoustic problem across the six geopolitical zones of Nigeria. This is essential to understand the scale of the exposure. Subsequently, a systematic review is required to synthesize high quality evidence that specifically examines the relationship between these acoustic exposures and health outcomes like hearing fatigue and burnout. By integrating these two approaches, this study aims to provide a comprehensive picture of how the physical architecture of Nigerian universities is influencing the mental health and academic viability of its undergraduates.

Objectives

1. Scoping Objective: To map the breadth of research regarding classroom acoustic parameters, identify primary noise sources, and characterize the knowledge gaps in the Nigerian tertiary context.
2. Systematic Objective: To critically evaluate and synthesize evidence regarding the relationship between chronic exposure to poor classroom acoustics and the development of hearing fatigue or academic burnout among Nigerian undergraduates

Conceptual Framework

Figure 1. Conceptual Framework

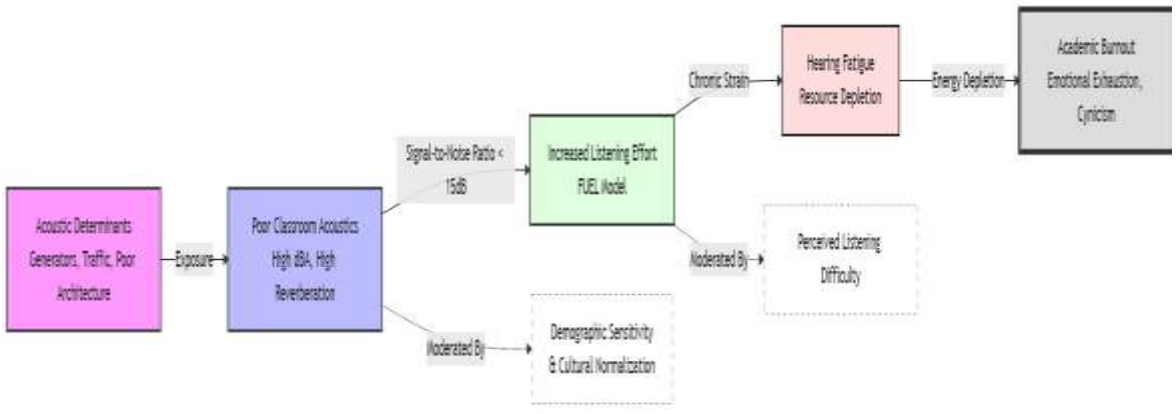

Figure 1: Conceptual model illustrating the pathway from environmental acoustic determinants to academic burnout. The model proposes that poor acoustics necessitate increased listening effort, mediated by the Framework for Understanding Effortful Listening (FUEL), which leads to hearing fatigue and subsequently academic burnout.

Methodology

This study employed a hybrid design comprising two distinct yet integrated components: a scoping review to map the breadth of evidence regarding acoustic conditions in Nigerian tertiary institutions, and a systematic review to evaluate the relationship between acoustic exposure and student burnout. The protocol was registered a priori on the Open Science

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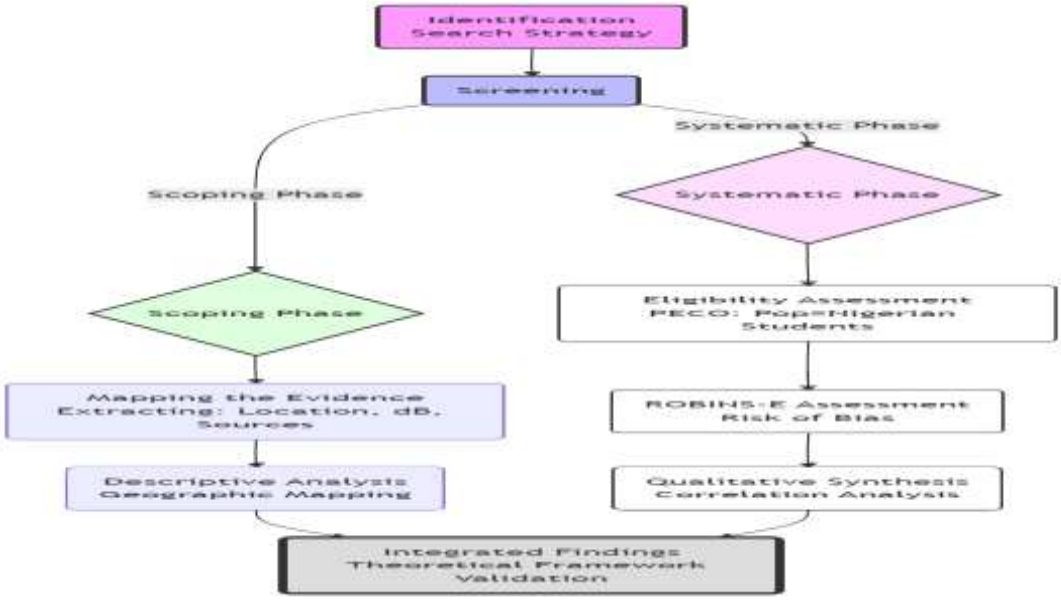
Framework. The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta Analyses extension for Scoping Reviews (PRISMA-ScR) and the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) 2020 guidelines. The search strategy was guided by two distinct frameworks corresponding to the two review phases. The scoping review utilized the PCC (Population, Concept, Context) framework. We included university students, lecturers, and staff within Nigerian tertiary institutions (Population). The Concept included classroom acoustics, environmental noise pollution, speech intelligibility, reverberation time, and sound pressure levels. The Context was limited to tertiary educational institutions located within the six geopolitical zones of Nigeria. We excluded studies conducted in primary or secondary settings unless explicitly comparative to higher education.

The systematic review utilized the PECO (Population, Exposure, Comparator, Outcome) framework. The Population was Nigerian undergraduate students. The Exposure was chronic or acute exposure to poor classroom acoustics, defined as environmental noise levels exceeding 35 dBA (WHO standard for classrooms) or subjective reporting of high noise annoyance. The Comparator included students in environments meeting WHO acoustic standards or those with low perceived noise exposure. The Outcome included hearing fatigue (self reported or objectively measured), academic burnout (measured by validated instruments such as the Maslach Burnout Inventory-Student Survey or Oldenburg Burnout Inventory), or cognitive performance scores. A comprehensive literature search was conducted by a librarian specialized in environmental health sciences. We searched PubMed, MEDLINE (via Ovid), Embase (via Ovid), Web of Science Core Collection, Scopus, African Journals Online (AJOL), and Google Scholar. Databases were searched from inception to May 2024 to ensure maximum sensitivity. The search strategy was developed iteratively in PubMed and adapted for other databases using subject headings and keywords. No language restrictions were applied. The core Boolean string included terms for Nigeria, universities, acoustics or noise, and fatigue or burnout.

Screening was performed using Covidence. Two independent reviewers screened titles and abstracts against the eligibility criteria. Full texts of potentially eligible records were retrieved and independently assessed. Disagreements were resolved through discussion or consultation with a third senior reviewer. A standardized data extraction form was developed. For the scoping review, we extracted bibliographic details, geopolitical zone, acoustic parameters, and noise sources. For the systematic review, we extracted population demographics, exposure characteristics, outcome measures, and statistical findings. To assess methodological rigor for the systematic review, we utilized the Risk of Bias in Non randomized Studies of Exposure (ROBINS-E) tool. The tool evaluates seven domains, including confounding, selection of participants, and measurement of outcomes. Each study was classified as having Low, Moderate, Serious, or Critical risk of bias. For the scoping review, descriptive statistics and narrative synthesis were used to map the data. Findings were categorized by noise levels, noise sources, geographical distribution, and reported health impacts. For the systematic review, due to the anticipated heterogeneity in study designs and outcome measurements, we employed a narrative synthesis approach following guidance on the conduct of narrative synthesis. We synthesized the data by grouping studies based on outcome type and qualitatively exploring the direction and strength of associations with acoustic exposure.



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Results

The scoping phase identified a consistent failure of Nigerian lecture halls to meet international acoustic standards. A literature-based review by Roberts et al. (2025) highlights that acoustic deficiencies, such as excessive reverberation and ambient noise (mean 70–90 dBA), impair speech intelligibility, which is directly linked to increased mental effort for listeners. This pattern of high acoustic exposure is geographically widespread.

Table 1: Summary of Noise Levels in Nigerian Tertiary Institutions

Location (Zone)	Institution/Setting	Noise Level (dBA)	Primary Sources	Standard Exceeded?	Reference
South-East	University of Nigeria, Enugu	Above recommended standards	People, Automobiles	Yes	Egbenta et al., 2024
South-West	Ladoke Akintola Univ. of Tech.	Excessive Reverberation (57.1% of halls)	Architectural Design	Yes	Ayinla et al., 2023
South-South	Ignatius Ajuru Univ., PH	94 (LNP)	Generators, Traffic	Yes	Onu et al., 2025
South-West	University of Lagos	41.9 to 96.6	Commercial Areas, Transport	Yes	Alademomi et al., 2020
North-Central	Plateau State University	77 to 80	Students, Traffic	Yes	Zitta et al., 2025
North-Central	University of Jos	> Limits	Students, Traffic	Yes	Akintunde et al., 2022
North-East	Schools in Jalingo	Mean: 61 to 75	Traffic, Activity	Yes	Kanu et al., 2022

As shown in Table 1, the noise pollution is geographically widespread, with levels often exceeding 75 dBA, double the recommended limit for educational settings. Adedokun et al. (2025) further note that high background noise, echoes, and prolonged reverberation create distraction and fatigue, with students being the most dissatisfied user group in these auditoria.

Systematic Review: Synthesis of Fatigue and Burnout

The systematic phase examined the transition from auditory strain to psychological exhaustion. A recurring theme was the direct health impact of these high noise levels.

Table 2: Summary of Health Outcomes and Burnout Indicators

Study	Location/ Population	Key Exposure	Health/Fatigue Outcomes	Burnout/Stress Indicators	Key Finding
Edene & Eghomwanre (2023)	Edo State Tertiary Inst.	Classroom Noise	20% Fatigue, 5% Hearing Defects	Not specified	High noise causes direct physiological fatigue.
Ana et al. (2009)	Ibadan Schools	69.5-76.1 dBA	"Tiredness" (Prevalent)	Not specified	Tiredness identified as primary health complaint.
Onu et al. (2025)	Port Harcourt Univ.	94 dBA (LNP)	Acoustic discomfort, Headaches	Decrease in intellectual ability	Acoustic discomfort links to reduced mental capacity.
Makun & Lawal (2025)	Kaduna School	75 dBA vs 38 dBA	Significant Annoyance	Impaired Mental Task Performance	Cognitive performance drops significantly in noise.
Balogun et al. (2025)	Comparative Study	High vs Low Noise	Cognitive Fatigue	Sleep Disruption, Chronic Stress	Cultural normalization

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					masks risks; noise disrupts sleep.
Adesola et al. (2025)	Ibadan Medical Students	Academic Stress	Not specific	Emotional Exhaustion (Score: 20.93)	High emotional exhaustion; environment cited as stressor.
Gustafson et al. (2021)	International Comparison	Varying dB	Self-reported Fatigue	N/A	Perceived difficulty predicts fatigue more than measured dB.
Polewczyk & Jarosz (2020)	Acoustic Treatment	Pre/Post Treatment	Drop in Fatigue (Reported)	N/A	Acoustic treatment objectively reduces student fatigue.

Table 2 illustrates that fatigue is a direct consequence of the acoustic environment. Edene and Eghomwanre (2023) found that in a tertiary institution in Edo State, 20 percent of students suffered from fatigue and 5 percent reported hearing defects specifically as a result of noise exposure. Similarly, Onu et al. (2025) linked acoustic discomfort to fatigue, headaches, annoyance, and a decrease in intellectual working ability. Ana et al. (2009) in Ibadan identified tiredness as a prevalent health problem associated with classroom noise. The literature suggests a dose response relationship between noise and burnout. Makun and Lawal (2025) found that students in Kaduna were significantly more annoyed and performed worse on mental tasks in a noisy 75 dBA classroom compared to a quiet one. Okechukwu et al. (2020) noted that students in sick buildings, characterized by poor acoustics, exhibit signs of mental fatigue and frustration. A critical finding is the role of perceived listening difficulty. Gustafson et al. (2021) demonstrated that perceived listening difficulty, rather than just measured noise levels, predicts fatigue. This aligns with the concept that acoustic quality must support speech intelligibility to reduce cognitive strain (Polewczyk & Jarosz, 2020). However, Balogun et al. (2025) observe that a cultural normalization of chronic noise among Nigerian students masks these long term risks, including cognitive fatigue and sleep disruption.

Discussion of the Findings

The findings of this hybrid review illuminate a critical but often overlooked environmental determinant of student wellbeing in Nigeria. The synthesis reveals that the acoustic landscape of Nigerian tertiary institutions is characterized by a pervasive failure to meet international standards, creating a high dose of chronic noise exposure for undergraduates. This acoustic environment is not merely a nuisance but acts as a physiological stressor that significantly impacts cognitive functioning. Our results indicate that noise levels frequently exceed 70 dBA, often reaching up to 94 dBA in specific high traffic areas like Port Harcourt. When these levels are interpreted through the Framework for Understanding Effortful Listening (FUEL), the pathway to burnout becomes clear. High background noise and excessive reverberation times degrade the signal to noise ratio. To compensate, students must allocate a disproportionate amount of cognitive resources to auditory processing, a state defined as listening effort. As McGarrigle (2016) notes, the prolonged allocation of these limited mental resources results in listening related fatigue. Our review confirms that this fatigue is not an abstract concept but a tangible reality reported by students across geopolitical zones, manifesting as tiredness, reduced intellectual ability, and annoyance. A particularly salient finding of this review is the distinction between objective noise levels and perceived listening difficulty.

Gustafson et al. (2021) demonstrated that perceived difficulty predicts fatigue more accurately than raw decibel measurements. This suggests that in the Nigerian context, the challenge is twofold: reducing the actual noise levels from generators and traffic, and addressing the acoustic design that forces the brain to work harder to fill in missing information. The widespread dissatisfaction reported by students regarding auditorium design (Adedokun et al., 2025) supports the view that architectural failures amplify the effects of environmental noise. Furthermore, the review uncovered a complex sociocultural barrier to intervention. Balogun et al. (2025) describe a cultural normalization of noise among Nigerian students. This normalization may lead to an underreporting of symptoms or a dismissal of noise as a serious health risk, masking the insidious onset of cognitive fatigue and sleep disruption. Consequently, students and administrators may not attribute the rising rates of academic burnout to the acoustic environment, instead focusing solely on workload or financial

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stressors. The physiological evidence supports this psychological link. High noise exposure triggers the hypothalamic pituitary adrenal axis, releasing stress hormones like cortisol. Melamed and Bruhis (1996) established a link between chronic industrial noise and fatigue, mediated by physiological stress responses. In the academic setting, this physiological arousal depletes the energy reserves required for learning, leaving students in a state of constant exhaustion. This exhaustion is the primary precursor to the emotional exhaustion dimension of burnout identified in medical students by Adesola et al. (2025).

Conclusion

Poor classroom acoustics constitute a significant, silent driver of hearing fatigue and academic burnout among Nigerian undergraduates. This hybrid review has mapped a consistent pattern of excessive noise exposure across Nigerian universities, driven primarily by power generators, vehicular traffic, and poor architectural design. The synthesis of evidence confirms that these environmental stressors deplete cognitive resources through increased listening effort, leading to physical fatigue and emotional exhaustion. While the cultural normalization of noise may mask the perceived severity of the problem, the physiological and psychological toll is evident. Addressing this issue requires a paradigm shift that views the acoustic environment as a critical component of educational quality and student mental health. Without specific interventions to mitigate noise and improve acoustics, efforts to combat academic burnout through counseling or workload reduction alone are likely to remain insufficient.

Recommendations

Based on the findings of this review, the following recommendations are proposed for stakeholders in Nigerian higher education:

1. Institutional Acoustic Audits: Universities should conduct comprehensive acoustic audits of all lecture theaters and hostels. These audits should measure not only noise levels but also reverberation time to identify spaces that degrade speech intelligibility.
2. Retrofitting Interventions: Priority should be given to retrofitting existing high traffic lecture halls. Simple interventions such as installing heavy curtains, acoustic ceiling boards, and ensuring doors and windows seal properly can significantly reduce noise intrusion.
3. Generator Management: Given the reliance on generators, universities should implement soundproofing measures for generator housings and relocate generator sets away from academic buildings. Where possible, solar or hybrid power solutions should be explored to reduce the acoustic footprint of power generation.
4. Awareness Campaigns: Universities should launch awareness campaigns to educate students and staff on the health impacts of noise, moving beyond viewing it as a mere inconvenience to recognizing it as a health hazard.

References

Adedokun, R., Ibitoye, O. A., & Olaoye, G. O. (2025). Demographic Variations in Acoustic Sensitivity: Implications for Auditorium Design in Nigerian Higher Education. *African Journal of Environmental Sciences and Renewable Energy*, *20*(1), 01-21.

Adesola, A. A., Akoki, D. M., Aderemi, T. V., Fola-Oyetayo, O. C., Asogwa, C. S., Ojile, M. O., & Ijezie, I. C. (2025). Exploring burnout in medical education: a mixed-method study among university of Ibadan medical students. *BMC Medical Education*, *25*(1), 647.

Agaja, T. M., & Akande, G. P. (2024). Impact of noise pollution on the academic performance of students in the University of Ilorin's learning environment, Nigeria. *FUDMA Journal of Earth and Environmental Sciences*, *1*(02), 42-57.

Akintunde, E. A., Bayei, J. Y., & Akintunde, J. A. (2022). Noise level mapping in University of Jos, Nigeria. *GeoJournal*, *87*(4), 2441-2453.

Al-Asmar, A. M. (2025). Assessment of noise pollution and specific mitigation measures to reduce it in educational settings and its impact on students' academic performance: A review. *World Journal of Advanced Research*, *8*(2), 1-14.

Alademomi, A., Okolie, C., Ojegbile, B., Daramola, O., Onyegbula, J., Adepo, R., & Ademeno, W. (2020). Spatial and statistical analysis of environmental noise levels in the main campus of the University of Lagos. *The Journal of Engineering Research*, *17*(2), 75-88.

Ali, H. H. M., Farhan, A. H., & Jawad, A. S. (2023). Comprehensive Review of Noise Pollution Sources, Health Impacts, and Acoustic Environments Affecting College and University Students. *Mesopotamian Journal of Environmental Sciences*, *5*(2), 45-58.

Ali, S. M. (2018). *Measured and Perceived Conditions of Indoor Environmental Qualities (IEQ) of University Learning Environments in Semi-arid Tropics* (Doctoral dissertation, University of Portsmouth).

ISSN 2705-2559
E-ISSN 2705-2567

Ana, G. R., Shendell, D. G., Brown, G. E., & Sridhar, M. K. C. (2009). Assessment of noise and associated health impacts at selected secondary schools in Ibadan, Nigeria. *Journal of Environmental and Public Health*, *2009*(1), 739502.

Balogun, G. Y., Owolabi, O. A., Ifesanmi, O. S., & Banjo, A. V. (2025, July). Noise to Silence: A Comparative Study of Black University Students Transitioning from High to Low Noise Environments. In *INTER-NOISE and NOISE-CON Congress and Conference Proceedings* (Vol. 271, No. 1, pp. 1078-1089). Institute of Noise Control Engineering.

Chan, T. C., Wu, B. S., Lee, Y. T., & Lee, P. H. (2024). Effects of personal noise exposure, sleep quality, and burnout on quality of life: An online participation cohort study in Taiwan. *Science of the Total Environment*, *909*, 168660.

Egbenta, I. R., Elugwaraonu, N. F., Ndukwu, R. I., & Okosun, A. E. (2024). Analysis of Noise pollution level in Enugu campus, of the University of Nigeria. *SAGE Open*, *14*(2), 21582440241254910.

Edene, A. O., & Eghomwanre, A. F. (2023). Indoor Noise Exposure and Related Health Risks in a Tertiary Institution within Edo State, Nigeria. *Journal of Applied Sciences and Environmental Management*, *27*(3), 631-637.

Gustafson, S. J., Camarata, S., Hornsby, B. W. Y., & Bess, F. H. (2021). Perceived listening difficulty in the classroom, not measured noise levels, is associated with fatigue in children with and without hearing loss. *American Journal of Audiology*, *30*(4), 956-967.

Hébert, S., Canlon, B., & Hasson, D. (2012). Emotional exhaustion as a predictor of tinnitus. *Psychotherapy and Psychosomatics*, *81*(6), 354-360.

Ibikunle, P. O., Umeakubuilo, G. N., & Opara, C. E. (2025). Determining the stress levels and burnout among undergraduate medical students. *Advances in Biomedical Research*, *14*(1), 15-22.

Kanu, M. O., Joseph, G. W., Targema, T. V., Andenyangnde, D., & Mohammed, I. D. (2022). On the Noise Levels in Nursery, Primary and Secondary Schools in Jalingo, Taraba State: Are they in Conformity with the Standards?. *Present Environment & Sustainable Development*, *16*(2), 102-115.

Karaiskos, C., Vlastos, I., Farantos, G., & Kyriafinis, G. (2025). Chronic Noise Exposure with Normal Hearing is Related to Adverse Quality of Life and Burnout. *ESI Preprints*, 1-12.

Lin, Y. T., Chiang, H. Y., Liang, S. J., Chen, W. C., Lin, R. T., & Guo, H. R. (2024). Association between residential noise exposure and burnout among healthcare workers in Taiwan: a cross-sectional study. *Scientific Reports*, *14*(1), 3691.

Makun, C. Y., & Lawal, L. A. (2025). Effects of Exposure to Noise on Mental Performance and Emotional Well-being of students at a school in Kaduna, Nigeria. *IREPOs Journal of Science and Technology*, *10*(1), 45-58.

McGarrigle, R. (2016). *Listening-related effort and fatigue in young adults and school-aged children* (Doctoral dissertation, University of Manchester).

Melamed, S., & Bruhis, S. (1996). The effects of chronic industrial noise exposure on urinary cortisol, fatigue, and irritability: a controlled field experiment. *Journal of Occupational and Environmental Medicine*, *38*(3), 252-256.

Nyong, D. M. K., & Onyemaobi, A. T. (2025). Students' Perception of the Spatial Distribution of Lecture Halls and its Implications in the University of Calabar, Nigeria. *Preprint*, Research Square. https://doi.org/10.21203/rs.3.rs-7897521/v1

Okechukwu, C. O., Okafor, C. V., & Okeke, A. U. (2020). User's Satisfaction of Higher Educational Buildings In Nigeria: A Case-Study Of Nnamdi Azikiwe University Awka. *J. Multidiscip. Eng. Sci. Technol.* (JMEST), *7*, 2458-9403.

Okoyeh, I. I., & Ezezue, A. M. (2025). Assessment of noise levels in architectural design studios in universities in South-East Nigeria. *International Journal of Building Pathology and Adaptation*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/IJBPA-10-2024-0210

Onu, B. O. N., Wokoma, O. A. F., Mmom, T. C., & Chindah, G. C. (2025). Assessment of Noise-Induced Hearing Loss among Staff and Students of Ignatius Ajuru University of Education, Port Harcourt. *Faculty of Natural and Applied Sciences Journal of Scientific Innovations*, *6*(3), 57-64.

Perez, W. D. D., & Vasquez, A. B. (2021). Relationship of Noise Level to the Mental Fatigue Level of Students: A Case Study during Online Classes. *International Journal of Operations Management*, *3*(1), 1-15.

Polewczyk, I., & Jarosz, M. (2020). Teachers' and students' assessment of the influence of school rooms acoustic treatment on their performance and wellbeing. *Archives of Acoustics*, *45*(2), 323-332.

Roberts, A., Ibitoye, O. A., & Olaoye, G. O. (2025). University Auditorium Design and User Comfort: A Literature-Based Review of Acoustic Considerations in Nigeria's Higher Education Architecture. *Journal of Built Environment and Geological Research*, *8*(4). https://doi.org/10.70382/ajbegr.v8i4.049

Tang, M., Liu, L., Cai, Y., & Yang, Y. (2024). Effect of noise in the emergency department on occupational burnout and resignation intention of medical staff. *Noise and Health*, *26*(122), 1-8.

Zitta, W. S., Ogbole, S., & Timothy, S. (2025). Higher Education Institution (HEI) Noise Level Mapping: The Case Study of Plateau State University Bokkos, Nigeria. *PLASU Journal of Environmental Sciences*, *1*(2), 119-133.