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SOUND (NOISE) POLLUTION AND WELL-BEING RISK IN ACADEMIC SPACES: A CASE STUDY FROM BENIN CITY, EDO STATE

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Abstract
Noise pollution is increasingly recognised as a critical environmental challenge within academic institutions, particularly in developing regions where teaching and research activities demand concentration and minimal disturbance. Elevated indoor noise levels can impair student learning outcomes, reduce staff productivity, and contribute to adverse health effects. This study systematically assessed indoor noise levels and associated health effects across offices, laboratories, and lecture theatres within a Faculty of Life Sciences. Measurements were conducted using a digital sound level meter (Smart Sensor Model AS834) in 10 offices, 1 laboratory, and 2 lecture rooms per department, complemented by structured questionnaires administered to academic staff, non-academic staff, and students to capture perceived noise sources, ratings, and Regulation Enforcement Agency (NESREA) permissible limits of 45 dB (day) and 35 dB (night). Results revealed that most recorded values exceeded regulatory thresholds, with the lowest levels measured at 53 dBA in a lecture room, 48.46 dBA in a laboratory, and 43 dBA in an office. Reported health effects included headache (32%), dizziness (18%), fatigue, anxiety, and depression, underscoring the significant burden of noise exposure. This study highlights the dual importance of objective measurements and subjective perceptions in understanding campus noise pollution. Findings emphasize the urgent need for institutional interventions, including awareness campaigns, replacement of noisy equipment, enforcement of noise control policies, and visible reminders to maintain quiet environments. By integrating empirical data with user experiences, this research provides evidence-based recommendations for mitigating indoor noise pollution in academic settings, safeguarding both health and productivity.

Keywords: *Noise pollution, Indoor environmental quality, University environment, Sound level measurement, Environmental health*

Introduction

Environmental noise pollution has become a major, but also increasingly complex, public health worry in the 21st century, especially across regions that are urbanising quickly. Noise can be understood as unwanted or harmful sound that disturbs normal human actions like communication, learning, and even rest (Karki *et al*., 2024). At first, people mostly saw it as just a nuisance, though now it is viewed more like an environmental stressor, with noticeable impacts on health, everyday well-being, and work output. The World Health Organisation puts environmental noise among the top environmental risks for health, after air and water pollution, mostly because it is so common, and because the effects build up over time for people who are exposed (WHO, 2018; Karki *et al*., 2024). More recent studies have moved attention away from solely outdoor origins, such as transport systems or industrial operations, and instead toward indoor spaces where individuals actually spend most of their time. Indoor noise is particularly important inside places of learning, like universities, where ongoing exposure can alter cognitive ability, interrupt communication, and reduce overall work efficiency. In theory, academic places are expected to create supportive learning environments through suitable acoustic conditions, but in practice, that support gets weakened by a mix of internal and external noise sources.

In developing countries, Nigeria included, noise pollution in tertiary institutions appears to have intensified, largely tied to population increase, infrastructural growth, and weak urban planning (Auwalu and Bello, 2023). Many universities end up located in densely populated neighbourhoods, so traffic, commercial hustle, and social gatherings can spill into indoor spaces, even when classes are running. Inside campus buildings, the noise doesn't just "come from people"; it is also further produced by lab equipment, air movement systems, desk office devices, and everyday human contact. In fact, the continued reliance on electricity generators because of an unstable power supply tends to magnify the overall sound burden, both indoors and outdoors (Ali *et al*., 2023; Mbachu *et al*., 2024). To counteract, or at least limit these effects, regulatory standards have been put in place at international as well as national levels. The World Health Organisation suggests a ceiling noise level for indoor classrooms of 35 dB, so that learning stays effective and health risks are lowered, while the National Environmental Standards and Regulations Enforcement Agency in Nigeria sets a higher cap of 45 dB (NESREA, 2009; WHO, 2018). Still, research keeps showing that these limits are commonly surpassed in schools, especially in low- and middle-income countries, which means a higher probability of negative health and school performance consequences (Shukla *et al*., 2026). More importantly, the consequences of noise exposure are not just about hearing loss or tinnitus, they reach non- auditory outcomes that can appear even when the exposure seems moderate. Such outcomes cover annoyance, sleep disruption, weaker focus, psychological pressure, and reduced mental comfort. Prolonged exposure has also been associated with cardiovascular problems, like hypertension and heart disease, often because stress-related bodily processes are activated, including raised cortisol and impaired vascular function (Faria *et al*., 2022).

In universities and related academic environments, these kinds of outcomes can result in poor attention, lower output, and weaker learning outcomes for students. Some groups seem more at risk, because they react more strongly to the same sound conditions. Children who are exposed to too much noise in schools and learning spaces can end up with late reading development, less robust memory ability, and shorter attention spans (Gheller *et al*., 2023). People who are very sensitive to sound might also show more anxiety, irritability, and a generally lower quality of life. Taken together, these points underscore why acoustic conditions in classrooms and related spaces should be maintained at the right level so that students do well academically and feel better overall.

Noise pollution does not stop at humans. For animals, human-made noise can mess up communication, shift behaviour, and even interfere with things that are vital, like feeding and reproduction, which in the end threatens ecological stability and biodiversity (Paul *et al*., 2025). Plants don't "hear" sound exactly the same way, yet newer work hints that sound vibrations might still steer plant processes indirectly, especially when they affect pollinators and other living partners (Demey *et al*., 2023). So overall, noise pollution seems to impact on a broader ecological frame, and it should be handled with a more joined-up environmental health approach. In the Faculty of Life Sciences, University of Benin, indoor noise pollution looks like a plausible challenge, but it still feels underexplored. Activities in the faculty include: teaching, research, and administrative tasks. Put together, each part of these activities can create different noise levels. Lecture halls, laboratories, and offices are supposed to stay quiet enough for intellectual activities, but there are several noise sources that can disturb that expectation, sometimes quietly, sometimes not. There is limited evidence on indoor noise exposure in this specific setting and what health risks might come with it.

This study addresses this gap by assessing the indoor noise levels in the Faculty of Life Sciences and ascertaining the associated health outcomes they might have on staff and students. In other words, merging actual measurements with people's own perceptions, gives evidence that can help shape policy making, environmental management approaches, and even institutional actions. Ultimately, the findings will contribute to improving academic environments and advancing knowledge on environmental noise pollution.

Study area

The study was conducted at the Faculty of Life Sciences located in the University of Benin, Edo State, Nigeria. The Faculty of Life Sciences has a total of seven NUC-accredited departments, namely: Animal and Environmental Biology (AEB), Biochemistry (BCH), Microbiology (MCB), Optometry (OPT), Plant Biology and Biotechnology (PBB), Science Laboratory Technology (SLT), and Environmental Management and Toxicology (EMT). In the Faculty, there are buildings for educational services such as laboratories, lecture theatres, or classrooms and libraries; for administrative services, there are offices for staff (academic and non- academic staff), board rooms, and for social services such as halls, all of which generate noise when in use.

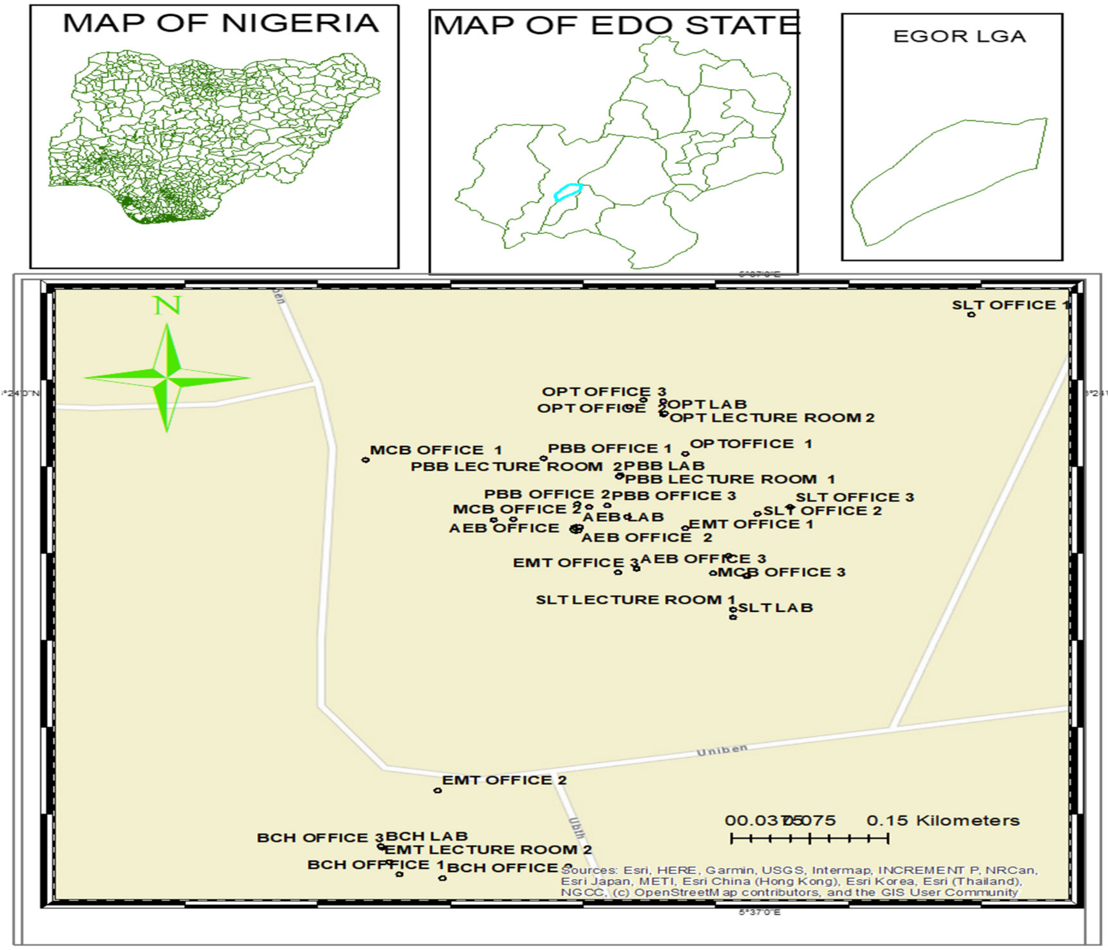

Fig. 1: Map of the study area indicating the different points where sound levels were measured

Materials and Methods

A handheld Global Positioning System (GPS) device was used to obtain the geographical coordinates of each sampling location. This ensured spatial accuracy and reproducibility of measurements. In addition, a digital sound level meter (Smart Sensor Model AS824) was used for noise measurement. The instrument is designed to measure sound pressure levels in decibels using A-weighting, which closely reflects human auditory sensitivity. Sound level meters remain the standard tool for environmental noise assessment due to their precision and compliance with international measurement protocols (Michael and Michael, 2024). The study comprised physical measurements and a social survey involving the use of questionnaires (Yang *et al*., 2022).

Sampling Design

The sampling time for this study was during the day (between the hours of 8 am and 3 pm) as this period is characterised by the maximum educational, administrative, and other student activities when the University is in session (Ali *et al*., 2023). Three different locations were selected for measuring noise levels during this study: Offices, Laboratories and Classrooms/ Lecture theatres. For

Sampling points, ten (10) Offices, one (1) laboratory, and two (2) Classrooms/ Lecture theatres, each from the seven (7) departments in the faculty of Life Sciences, were selected for measurement in this study.

Data Type and Sources

The data collected were: coordinates for sampling points, specified number of offices, laboratories, and classrooms or lecture theatres' noise level measurements expressed in dB(A) as specified by the National Environmental Standards and Regulation Enforcement Agency (NESREA). The corresponding coordinates for sampling points were obtained using a handheld GPS meter, and noise level measurements were taken using a handheld digital sound level meter (Smart Sensor Model AS824) (Edene and Eghomwanre, 2023).

Method of Data Collection

At each sampling location, the sound level meter was positioned at a height of approximately 1.0 to 1.5 metres above ground level, corresponding to the average human ear level. The instrument was allowed to stabilise for five minutes to ensure calibration and accuracy before readings were taken. Noise measurements were then recorded continuously for five minutes at each location. This process was done hourly, spanning eight hours of monitoring, giving eight readings per sampling point. The measurements were taken at the centre of each spot, so they could reflect representative ambient noise levels. Each reading was recorded on a structured field data sheet. At the same time, GPS coordinates were noted from 9th to 15th March, 2023 (Edene and Eghomwanre, 2023).

Social Surveys

A structured social survey was carried out using questionnaires administered to 200 respondents, involving academic and non-academic staff, along with students. The instrument had 20 items, which were arranged to draw reactions through multiple-choice options, and also open comments. At the start, the first section of the questionnaire collected demographic plus contextual details, like sex, residential address, type of office building, length of time working or studying, and an estimate of how far the office laboratory, classroom, or workshop was from the closest big source of noise. Before any noise-related questions were introduced, respondents were also asked whether they had hearing problems that existed already, and what health effects they associated with acute noise exposure, or if anything like that had happened. After that, later sections looked into how noise disturbs daily activities within the Faculty of Life Sciences, University of Benin, and they also pointed out what kinds of noise people felt were coming from both indoor and outdoor surroundings. Some items were added to check whether anyone had ever submitted complaints about noise pollution to the school authority. Lastly, the questions covered how respondents view noise control measures inside the faculty. The responses were analyzed by working out the frequency and percentage spread of participants choosing each option. This method followed recognised procedures for analysing social surveys as outlined by Adamu *et al*. (2025).

Data Analysis

The noise measurements that were collected were analysed with descriptive statistical methods. For each sampling spot, the mean and standard deviation (Mean ± SD) were worked out from eight separate readings, so it provides a representative picture of the ambient sound levels. After that, those values were matched up with the allowed limits stated in the National Environmental (Noise Standards and Control) Regulations (NESREA, 2009). Per these rules, the upper daytime noise level for educational settings is 45 dB(A), and for nighttime it is 35 dB(A). The comparison against the regulatory standards formed the basis for judging compliance and also spotting possible risks for health and learning environments. When the measurements go beyond the set limits, it becomes especially worrying, because long-term exposure to louder background noise has been associated with negative health effects and weaker academic performance.

Results and Discussion

Mean Noise Levels at Selected Offices, Classrooms and Laboratories

The mean noise levels recorded in offices throughout the Faculty of Life Sciences departments are presented in Figures 2a to 2g. For the Department of Environmental Management and Toxicology (EMT) (Figure 2a), the numbers ranged from 48.95 dB to 53.86 dB, slightly above the suggested daylight threshold of 45 dB for learning spaces. A pattern quite similar to that was seen in the Department of Plant Biology and Biotechnology (PBB) (Figure 2b), where the values recorded were in a similar range, indicating a fairly uniform acoustic measurement across office rooms in the two departments. In the Department of Microbiology (MCB) (Figure 2c), the noise went from 47.16 dB up to 54.19 dB, suggesting increased background noise levels. Then, in the Department of Animal and Environmental Biology (AEB) (Figure 2d), mean readings stayed in the same band, reflecting how everyday human presence and routine operations shape office sound. The noise levels from the departments of Science Laboratory Technology (SLT) (Figure 2e) and Biochemistry (BCH) (Figure 2f), also looked similar, with most values falling roughly between 43.44 dB and 54.31 dB, and that suggests people are getting exposed to levels that aren't really ideal if the goal is a quiet office. For the Department of Optometry (OPT) (Figure 2g), the observed span follows the same rhythm, so the elevated indoor noise seems common across the faculty, not just stuck in particular units. Taken as a whole, office noise levels range from about 43.44 dB to roughly 55.19 dB. Even though these values were lower than those commonly reported for classrooms, they were close to or sometimes beyond the permissible limits set by the National Environmental Standards and Regulations Enforcement Agency, NESREA (2009). Hence, the results from this study suggest that acoustic control inside the administrative spaces is not really adequate. The noise levels that showed up as relatively high can be traced mostly to everyday indoor human activities like casual conversations, movement along the corridors, and those routine academic interactions that happen all the time. There are also mechanical sources, air conditioners, ceiling fans, plus office equipment that keep adding a steady background sound. In Nigeria, the regular use of electricity generators because of the unstable power situation actually worsens things, even in offices. These findings match earlier works where indoor noise in education settings is said to be driven by a mix of people-related and machine-related activities (Quartey *et al*., 2021; Mealings, 2022). If staff are exposed to such conditions over and over, it can interfere with clear communication, lower task efficiency, and raise the mental workload. Over time, that may translate into stress, fatigue and weaker concentration (Hao *et al*., 2022). Noise measurements taken in the offices were lower than in classrooms, but the levels were still above what is needed for the best working conditions, which implies that a steady moderate exposure might still build up and affect health and productivity. Aside human consequences, higher noise levels could also reach the surrounding ecosystems by changing animal behaviour and communication. Plants might not be affected directly, but there can be indirect effects through environmental disturbances linked to the noise (Senzaki *et al*., 2020), though these are still secondary compared to the direct effects on human well-being.

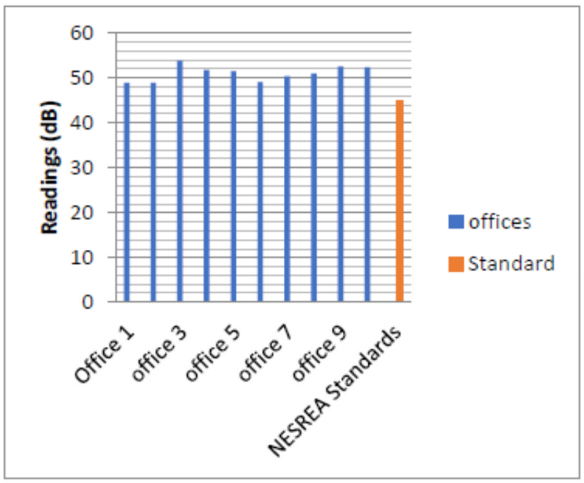

Fig. 2a: Mean noise levels for offices in EMT department

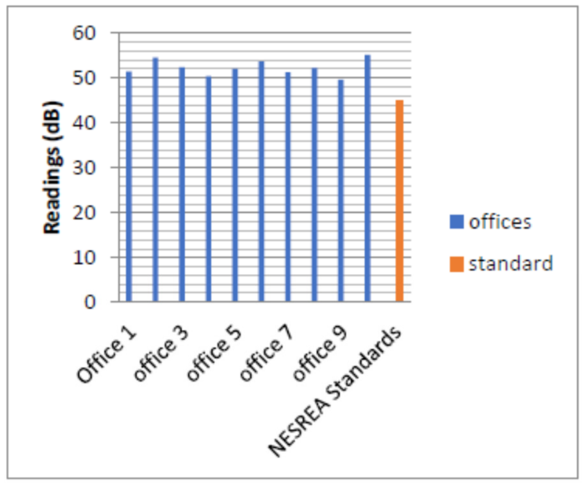

Fig. 2b: Mean noise levels for offices in PBB department

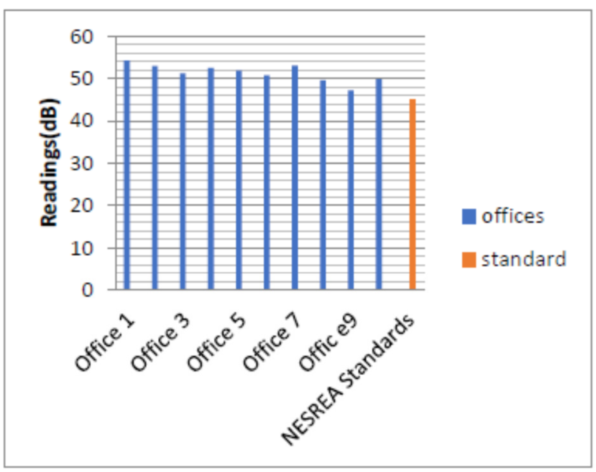

Fig. 2c: Mean noise levels for offices in MCB department

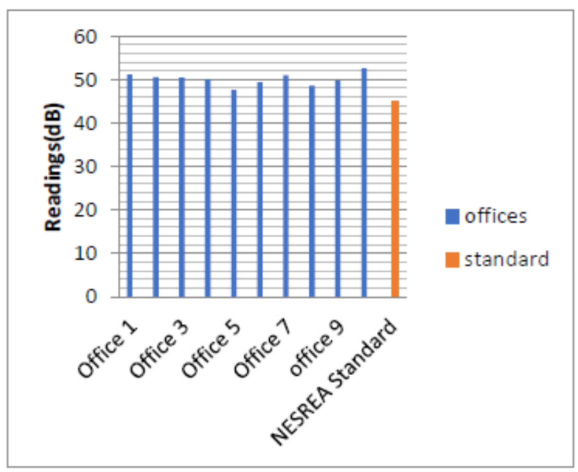

Fig. 2d: Mean noise levels for offices in AEB department

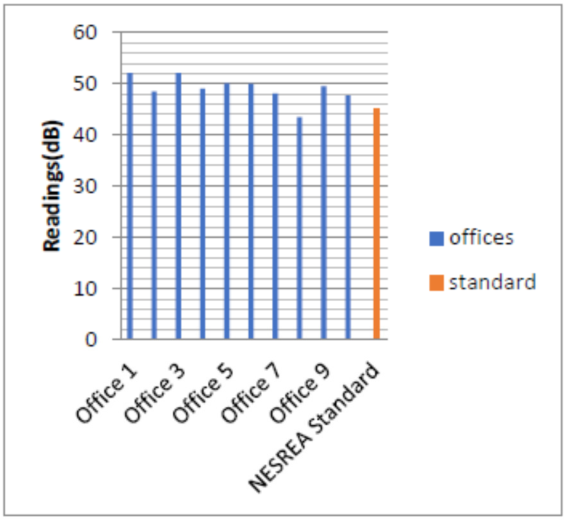

Fig. 2e: Mean noise levels for offices in SLT department

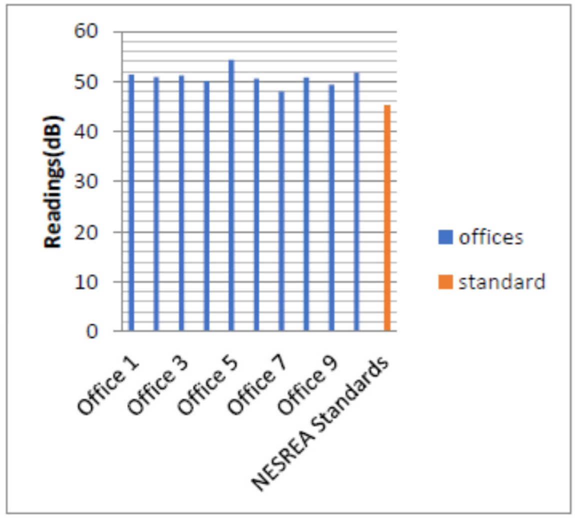

Fig. 2f: Mean noise levels for offices in BCH department

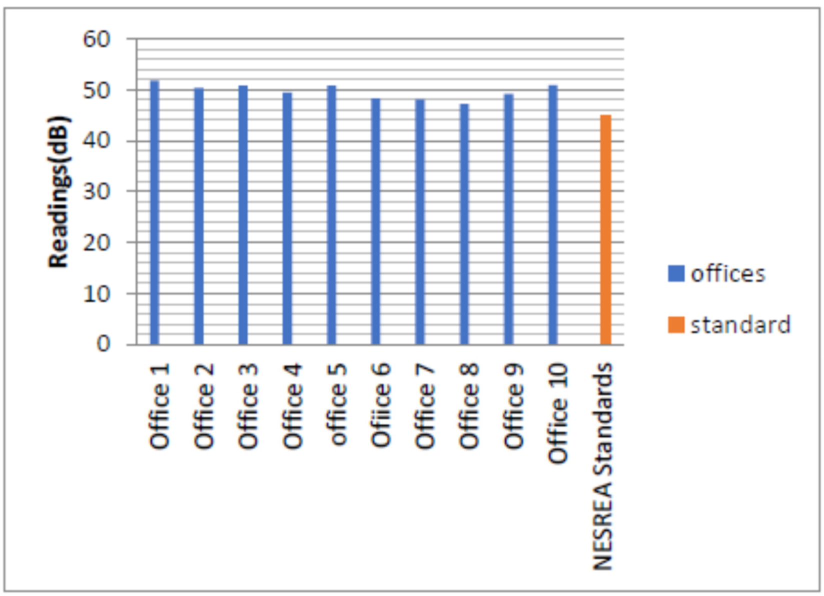

Fig. 2g: Mean noise levels for offices in OPT department

The average noise levels recorded in classrooms and lecture theatres throughout the Faculty of Life Sciences are shown in Figure 3, and the values range from 53.73 dB to 58.83 dB. The upper end value (58.83 dB), was recorded in departments that are basically characterized by bigger class sizes and quite intensive teaching routines, while the smallest figure (53.73 dB), still appears relatively high. In general, these readings were always higher than the suggested 45 dB threshold for educational spaces, as set by the National Environmental Standards and Regulations Enforcement Agency, hence, it clearly overshoots the standard. Long periods of classroom noise beyond 50 dB have been tied to reduced speech clarity, lessened concentration, and weaker academic outcomes for students (Mealings and Buchholz, 2024). Lecturers working under these same circumstances can also face vocal strain, tiredness, and a drop in instructional impact. There is also empirical support that ongoing exposure to higher indoor noise promotes cognitive fatigue, triggers stress reactions, and lowers overall productivity within learning settings (Mealings, 2022; Hao *et al*., 2022). The observed noise levels are largely attributable to internal sources, especially student interactions, overlapping discussions, and repetitive instruction occurring in densely occupied lecture spaces. External contributors, including generator operation, vehicular movement, and nearby commercial activities, can also make the indoor noise worse, particularly in buildings with limited acoustic insulation. This observation matches prior work, the kind that emphasises bad building design and insufficient soundproofing as major drivers of high classroom noise in developing regions (Khan *et al*., 2021). Even though the main issue is human well-being and academic performance, the persistent noise may still produce indirect environmental consequences. Human-caused noise can interfere with animal communication and behaviour, mainly in urban ecosystems, and plant responses can be affected through stress-related physiological pathways (Arcangeli *et al*., 2022). Still, these wider effects stay secondary compared to the direct cognitive and health impacts that are actually seen in people (Hao *et al*., 2022).

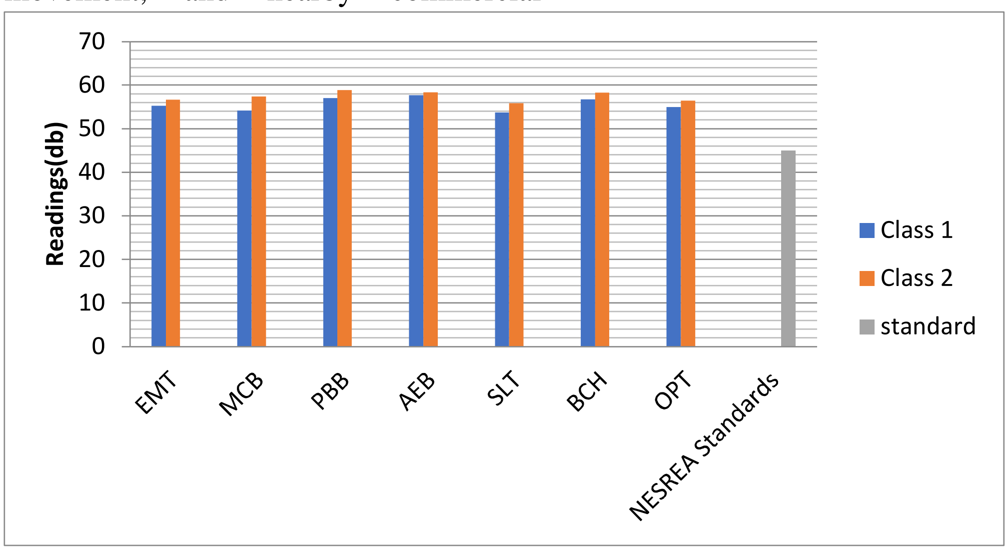

Fig. 3: Mean values for noise levels in Classrooms

The mean noise levels measured in laboratories, as presented in Figure 4, ranged from 46.98 dB to 53.36 dB. These figures exceed the NESREA-recommended limit of 45 dB for educational settings, roughly a 1 dB to 9 dB rise above what's considered acceptable. It also suggests that laboratory spaces within the faculty are basically showing steadily higher background noise all the time, not just occasional spikes. Most of the observed levels seem tied to daily laboratory chores, like the handling and operation of equipment such as centrifuges, refrigerators, and mechanical stirrers, along with student presence, and yes, interactions during practical sessions too. Even though these levels are usually lower than those noted in classrooms, they are still high enough to mess with concentration, reduce the precision of tasks, and slow down overall work effectiveness. From a health and performance view, being exposed for long periods to this kind of sound field could contribute to fatigue, lower cognitive efficiency, and heightened stress for both students and staff (Mealings, 2022; Hao *et al*., 2022). Also, the continual background murmur in laboratories might, in a quiet way, affect experimental outputs by pulling attention away, and in work that involves laboratory animals, it can set off stress-related physiological reactions. This kind of response could then compromise the consistency of research findings, in the sense of research validity.

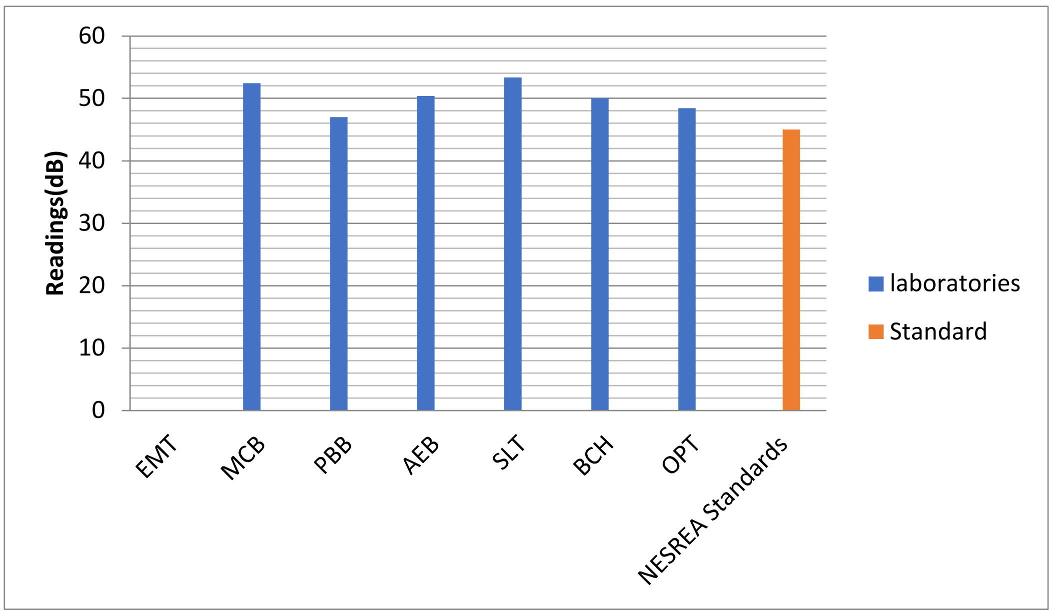

Fig. 4: Mean values of the measurement of noise levels for Laboratories and NESREA Standards

The distribution of responses from students and staff about noise sources, how noisy they felt it was, and the health effects linked to it, points to indoor noise in the Faculty of Life Sciences being mostly steered by human activity. As shown in Figure 5, verbal exchange and everyday interactions made up about 48.0% of the noise sources that were identified, and this really shows how high occupancy plus constant involvement are common in a learning environment. This arrangement, therefore, implies that regular teaching, back-and-forth discussions, and student movements really act as the main determiners of the soundscape inside the Faculty. Still, mechanical and infrastructure items also added quite a bit to the total noise level. Power generators were 20.2% of what people reported, which seems tied to the fact that the campus uses backup electricity systems when the power supply is not steady. Other notable factors included misbehaving air conditioning units at 10.4% and public address systems at 9.6%, both of them producing ongoing background noise. Laboratory equipment accounted for 6.4%, whereas music from mobile devices plus a few other smaller sources accounted for 3.2% and 2.2% respectively. When all of that is taken together, it becomes clear that indoor noise pollution within the Faculty comes from a mix of human-related and mechanical sources, with people-based actions clearly being the strongest driver of the prevailing acoustic conditions.

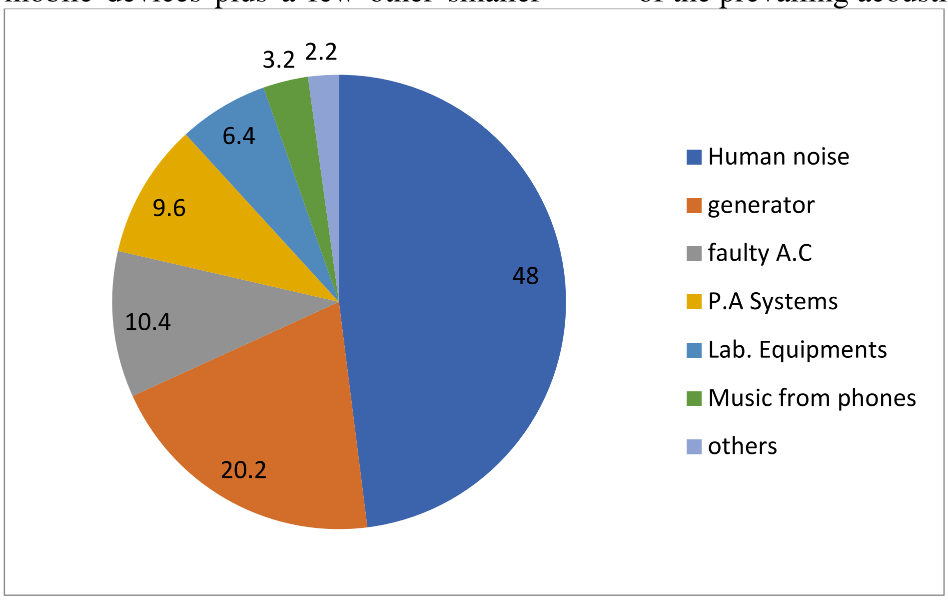

Fig. 5: Noise sources heard in the Faculty of Life Sciences

The evaluation of the acoustic environment by respondents as shown in Figure 6, indicates an unfavourable perception of the noise situation within the Faculty. A fairly large share of participants, 40.0%, mentioned the setting as "Not Very Quiet," whereas 27.6% called it "Noisy" and 11.4% chose "Very Noisy." On the other hand, only 7.8% saw the environment as "Quiet," and a tiny 2.8% rated it "Extremely Quiet." Overall, it points to roughly 79.0% of respondents feeling the Faculty noise level is acoustically unsatisfactory. These results suggest that noise levels in the Faculty often go beyond comfortable boundaries, and that, in turn, may disrupt effective communication, lower focus, and weaken academic performance. This tendency matches earlier findings showing that higher indoor noise can reduce speech clarity and also lower learning efficiency in learning spaces (Mealings, 2022).

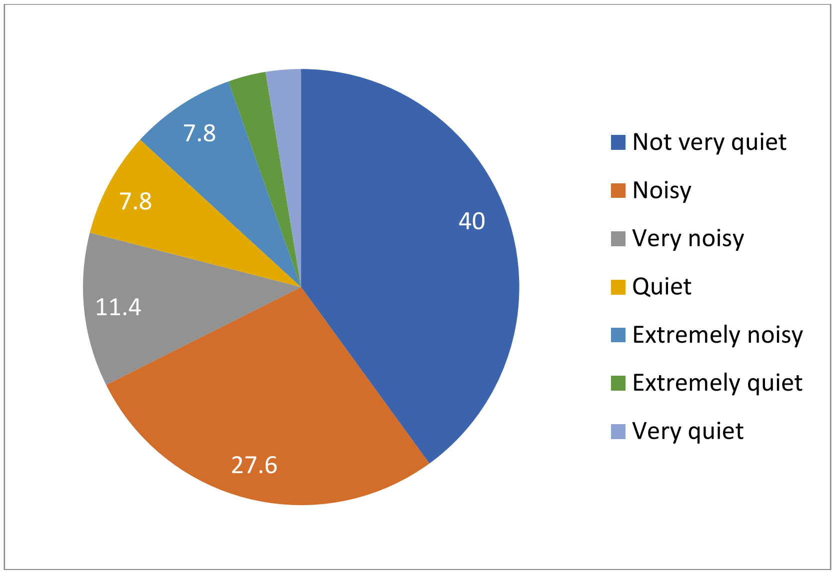

Fig. 6: Noise rating of the faculty of Life Sciences

The pattern of health effects, as shown in Figure 7, that is linked with noise exposure, reveals that noise pollution does have real and measurable effects on physical and psychological well-being. Headache is the most common symptom, making up about 32% of the responses, and then dizziness at 18%, reduced concentration at 16%, fatigue at 15%, and annoyance at 14%. A key piece here is that many respondents mention trouble concentrating, which is especially important in a school or academic environment, because you really need steady attention for learning and work output. This suggests that the prevailing noise conditions may be undermining cognitive performance among both students and staff. This corresponds with recent work suggesting that staying around higher noise levels for long periods contributes to stress, cognitive fatigue, and less mental efficiency (Hao *et al*., 2022). In addition, ongoing exposure to environmental noise has been connected to broader health issues, like physiological stress reactions, impacts on the cardiovascular system, and disruptions to sleep, which basically heightens the wider public health concern for controlling noise in educational spaces.

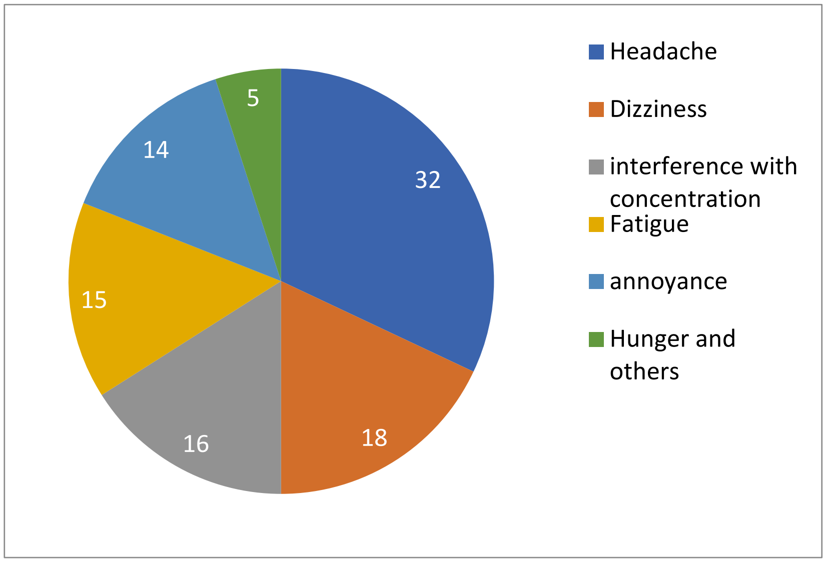

Fig. 7: Some Health effects of noise at the Faculty of Life Sciences

Conclusion

The acoustic assessment of the indoor noise levels within the Faculty of Life Sciences showed values consistently exceeding the permissible thresholds set by the National Environmental Standards Regulation and Enforcement Agency (NESREA). Offices, classrooms, lecture theatres, and laboratories all ended up recording noise intensities higher than what is recommended for higher education spaces; it therefore appears the Faculty is dealing with disturbing indoor noise levels. With this kind of high noise level exposure, both staff and students could face adverse health effects and also experience reduced academic productivity, which is not ideal. Overall, these results highlight the urgent need for better environmental noise control strategies and preventive measures across the Faculty. Basically, raising awareness among staff and students about what noise pollution can do, together with institutional policies that track and reduce noise sources, will be key for protecting well-being and keeping a learning environment that actually supports focus.

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