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ENVIRONMENTAL NOISE LEVEL ASSESSMENT AND ITS EFFECT ON STAFF WORK PERFORMANCE AND STUDENTS' COGNITIVE ABILITY AT YABA COLLEGE OF TECHNOLOGY, NIGERIA

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ABSTRACT

This study assessed environmental noise levels within Yaba College of Technology and examined their effects on staff work performance and students' cognitive ability. Over the course of 14 days, noise levels were measured at 23 different sites on campus using a digital sound level meter that had been calibrated. Data were gathered in the morning, afternoon, and evening, and 81 respondents comprising staff and students chosen by stratified sampling were given a standardized questionnaire. The World Health Organization's recommended limits of 35 dB(A) for indoor educational contexts and 55 dB(A) for outdoor settings were exceeded by the mean equivalent continuous noise levels (LAeq), which ranged from 63.5 dB (A) to 83.1 dB(A). The loudest noise levels were reported at the Main Gate and Sport Complex. Vehicle traffic, generators, educational activities, social events, and loudspeaker systems were the main sources of noise. Excessive noise exposure was confirmed by statistical analysis, which showed that observed noise levels deviated significantly from WHO norms ($p < 0.05$). Responses to the questionnaire revealed negative impacts on learning, productivity, communication, and focus. Stress, headaches, hearing problems, and trouble focusing were frequently noted. The study advises acoustic zoning, generator enclosures, traffic control measures, and institutional noise management policies after concluding that the campus acoustic environment is inadequate for the best possible teaching, learning, and work performance.

Keywords: Environmental noise assessment; Sound pressure level; Cognitive performance; Occupational performance; Educational environment; Yaba College of Technology

INTRODUCTION

Noise is generally defined as unwanted sound capable of interfering with human activities, communication, comfort, and health (Möser, 2020). Rapid urbanization, the expansion of transportation, industrialization, and an increase in social activity have all contributed to the growing concern over environmental noise in urban settings. Excessive background noise can seriously hinder learning effectiveness, cognitive function, communication, and professional productivity in educational settings.

Tertiary institutions in developing nations are often subjected to high levels of environmental noise from commercial activities, electricity generators, mechanical workshops, traffic, and dense population interactions (Baloye & Palamuleni, 2015; Olamijulo *et al*., 2016; Shaaban & Abouzaid, 2021). These sources of noise frequently produce sound levels that are higher than the internationally advised acoustic requirements for educational settings.

Elevated environmental noise levels in academic institutions have been documented in a number of studies. Anomohanran (2017), found that noise levels in a few Nigerian institutions were more than 70 dB(A), especially in the vicinity of generator installations and traffic lanes. In a similar vein, Aremu *et al*. (2018), found that excessive classroom noise has a detrimental influence on the effectiveness of instruction at Nigerian higher education institutions. International research has also shown that human activity, transportation systems, and campus architecture all have a major impact on environmental noise exposure and acoustic propagation (Murphy & King, 2022; Vijayalaxmi & Thomas, 2020).

Adverse physiological and psychological impacts, such as stress, annoyance, decreased focus, impaired speech intelligibility, sleep disturbance, hearing discomfort, and cardiovascular issues, have been linked to environmental noise levels over suggested limits (Basner *et al*., 2014; Münzel *et al*., 2018). Long-term exposure to excessive noise has been demonstrated to have detrimental effects on cognitive processing, memory retention, academic productivity, and occupational efficiency in educational contexts (Dockrell & Shield, 2016).

Maximum ambient noise levels of 35 dB(A) for indoor educational spaces and 55 dB(A) for outdoor learning environments are recommended by the World Health Organization (WHO, 2018). In a similar vein, Nigerian educational institutions are subject to permitted daytime noise restrictions of 50–55 dB(A) according to the National Environmental Standards and Regulations Enforcement Agency (NESREA, 2009).

Yaba College of Technology, Nigeria's premier tertiary institution located within the densely populated metropolitan environment of Lagos, Nigeria, experiences substantial academic, administrative, commercial, and transportation activities capable of influencing the campus acoustic environment. Heavy traffic, extensive reliance on electrical generators, mechanical workshop operations, social events, and a dense student body are characteristics of the university. Few empirical studies have methodically evaluated environmental noise exposure on campus, despite the institution's strategic significance.

This study therefore evaluates environmental noise levels across selected locations within Yaba College of Technology and investigates their effects on staff work performance and students' cognitive ability. Specifically, the study measures sound pressure levels using standard environmental noise assessment procedures, compares measured values with WHO recommended standards, identifies dominant sources of environmental noise, and evaluates the perceived effects of noise exposure on members of the campus community.

MATERIALS AND METHODS

Experimental Method

Study area and research design

The study was conducted at Yaba College of Technology (YCT), Lagos, Nigeria. The institution is a major urban tertiary institution comprising lecture halls, laboratories, workshops, administrative offices, hostels, and commercial activity zones (Fig. 1). A mixed-method research design was adopted, integrating quantitative environmental noise measurements with questionnaire-based perception surveys.

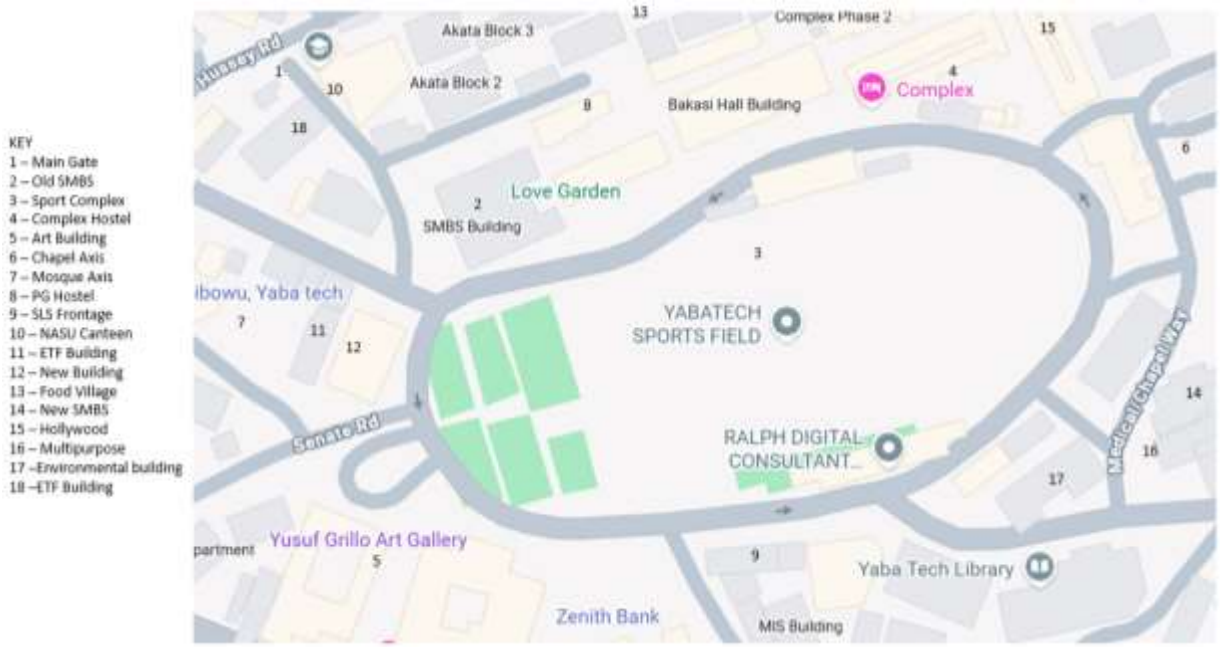


Figure 1: Study area (adapted from www.google.com/maps)

Twenty-three locations within the campus were purposively selected based on academic significance, population density, traffic intensity, and operational activities. These locations included the Main Gate, Sport Complex, Multipurpose Hall, Engineering Building, Environmental Building, Art Building, SLS Frontage, Bursary, ETF Building, New SMBS, Old SMBS, Chapel Axis, Mosque Axis, Automobile Workshop, New Building, Business Centre, Food Village, NASU Canteen, and selected Hostel environments.

Instrumentation and measurement procedure

Environmental noise measurements were conducted using a calibrated digital sound level meter compliant with IEC 61672-1 (2013) standards. Measurements were obtained using A-weighting and fast response mode to approximate human auditory perception.

The sound level meter was positioned approximately 1.2–1.5 m above ground level to simulate ear height and placed at least 3 m away from reflective surfaces to minimize measurement interference. Measurements were carried out over 14 consecutive days during three daily periods: morning (8:00–10:00 am), afternoon (12:00–2:00 pm), and evening (7:00–9:00 pm).

The measured parameters included maximum sound pressure level (Lmax), minimum sound pressure level (Lmin), and equivalent continuous sound level (LAeq). The LAeq values were computed using equation 1 and subsequently averaged across the monitoring duration for each location and time period.

$$LA_{eq} = 10log_{10}[\frac{1}{T}\int_0^T \left(\frac{p_A(t)}{P_o}\right)^2 dt] \quad (1)$$ (Bies *et al.*, 2018)

where: LA_{eq} - Equivalent continuous A-weighted sound level (dB); T - Total measurement time; $P_A(t)$ - Instantaneous A-weighted sound pressure at time; P_o - Reference sound pressure

The measured values were compared with WHO and NESREA environmental noise guidelines for educational environments. In addition, a one-sample t-test was conducted to determine whether the measured mean LAeq values differed significantly from WHO recommended standards using equation 2

$$t = \frac{\bar{x}-\mu}{s/\sqrt{n}} \quad (2) \qquad \text{(Smith } et\ al.\text{, 2022)}$$

where: $\bar{x}$ - sample mean LAeq; μ - WHO recommended limit; s - sample standard deviation; n - number of observations

Questionnaire survey

A structured questionnaire was administered to 81 respondents comprising 24 staff members and 57 students selected through stratified sampling. The questionnaire assessed respondents' perceptions regarding major noise sources, frequency of noise exposure, effects on concentration and productivity, communication interference, academic performance, and health-related symptoms associated with environmental noise exposure.

Data obtained from the questionnaire were analyzed using descriptive statistics, including frequency distribution and percentage analysis.

RESULTS AND DISCUSSION

Field Measurement Results

Table 1 presents the mean LAeq values at each campus location across the three daily measurement periods, averaged over 14 days of monitoring.

The measured equivalent continuous sound levels (LAeq) across the sampled locations revealed considerable spatial and temporal variations within the campus environment. Morning measurements recorded the highest mean LAeq value of 79.239 dB(A) at the Main Gate, while the lowest value of 59.636 dB(A) was observed at the Complex Hostel. The elevated noise levels at the Main Gate were primarily associated with intense vehicular and human traffic during early academic hours. Afternoon measurements produced the highest overall campus mean noise level of 73.1 dB(A), reflecting periods of peak academic and administrative activity. The Sport Complex recorded the highest afternoon mean LAeq value of 78.725 dB(A), likely due to sporting and social events commonly hosted within the facility.

Evening measurements indicated particularly high noise levels within the hostel environments, recreational zones, and religious gathering areas. Hollywood Hostel recorded the highest evening mean LAeq value of 77.764 dB(A), attributable to increased student interactions and recreational activities during evening periods.

Generally, locations characterized by intense human activity, commercial operations, traffic movement, and social gatherings consistently recorded higher noise levels than relatively quieter academic and residential zones. The observed trends demonstrate the strong influence of land-use activities on the campus acoustic environment.

The measured mean LAeq values (Fig. 1) across all monitored locations ranged from 63.5 dB(A) to 83.1 dB(A), substantially exceeding WHO recommended standards for educational environments. The Main Gate, Sport Complex, and Multipurpose Hall recorded the highest overall noise levels, whereas Old SMBS recorded comparatively lower sound levels due to reduced academic activities within the facility.

These findings indicate that environmental noise exposure within the institution is widespread and persistent.

Table 1: Mean L_{Aeq} (dB) for 14 days at each time period for each location

Categorization	Location	Morning Mean L_{Aeq}(dB)	Afternoon Mean L_{Aeq}(dB)	Evening Mean L_{Aeq}(dB)
Indoor Areas	Multipurpose	76.49	77.73	71.16
	New SMBS	72.86	74.66	70.79
	New Building	73.22	74.05	71.26
	Engineering Building	69.72	73.87	74.90
	Environmental Building	73.07	74.65	73.32
	Bursary	68.53	71.18	69.08
	ETF Building	72.38	74.01	71.41
	Art Building	73.20	75.16	71.65
	Old SMBS	70.50	65.92	63.56
	Akata Hostel	65.36	69.71	74.84
	Hollywood	73.77	74.41	77.76
	Complex Hostel	59.64	70.41	73.36
	PG Hostel	63.45	69.34	71.12
Outdoor Areas	Automobile	69.61	71.30	71.85
	Chapel Axis	68.10	68.11	70.68
	Main Gate	79.24	78.83	76.85
	Mosque Axis	71.02	72.28	72.11
	SLS Frontage	74.16	74.75	70.26
	Business Centre	74.83	75.39	70.78
	Sport Complex	75.82	78.73	75.31
	NASU Canteen	67.46	70.54	65.24
	Food Village	66.36	74.16	72.86
	Business Center (2)	67.50	75.00	69.72
	Mean	**70.40**	**73.10**	**71.70**

Comparison of Measured Noise Levels with WHO Recommended Limits

Table 2 presents the results of a one-sample t-test comparing measured equivalent continuous sound levels (LAeq) in indoor and outdoor environments with the World Health Organization (WHO) recommended environmental noise limits.

The findings indicate that the mean indoor noise level (71.61 ± 2.97 dB) was substantially higher than the WHO recommended limit of 35 dB. The observed difference was statistically significant ($t = 44.43$, $df = 12$, $p < 0.001$), indicating that indoor noise exposure within the study environment consistently exceeded acceptable standards. Similarly, the mean outdoor noise level (72.03 ± 3.15 dB) significantly surpassed the WHO outdoor

limit of 55 dB (t = 17.10, df = 9, p < 0.001). The low standard deviations observed in both categories suggest relatively uniform exposure levels across sampled locations.

Despite identical mean noise levels in both settings, the much higher t-value for indoor environments highlights the severity of indoor noise pollution and reflects the stricter WHO criteria for enclosed areas. These results suggest that exposure to noise on campus is systematic and ongoing rather than accidental.

The findings support earlier research that found high levels of ambient noise in educational institutions in underdeveloped nations. Excessive classroom noise negatively impacted teaching and learning activities at Nigerian tertiary institutions, according to Aremu *et al.* (2018). Additionally, the results corroborate the findings of WHO (WHO, 2018; Basner *et al.*, 2014), who connected extended exposure to high noise levels with negative health consequences such as poor focus, stress, disturbed sleep, and cardiovascular risks. Therefore, the current findings offer compelling empirical evidence that noise levels on campus might have an impact on both academic achievement and occupational well-being.

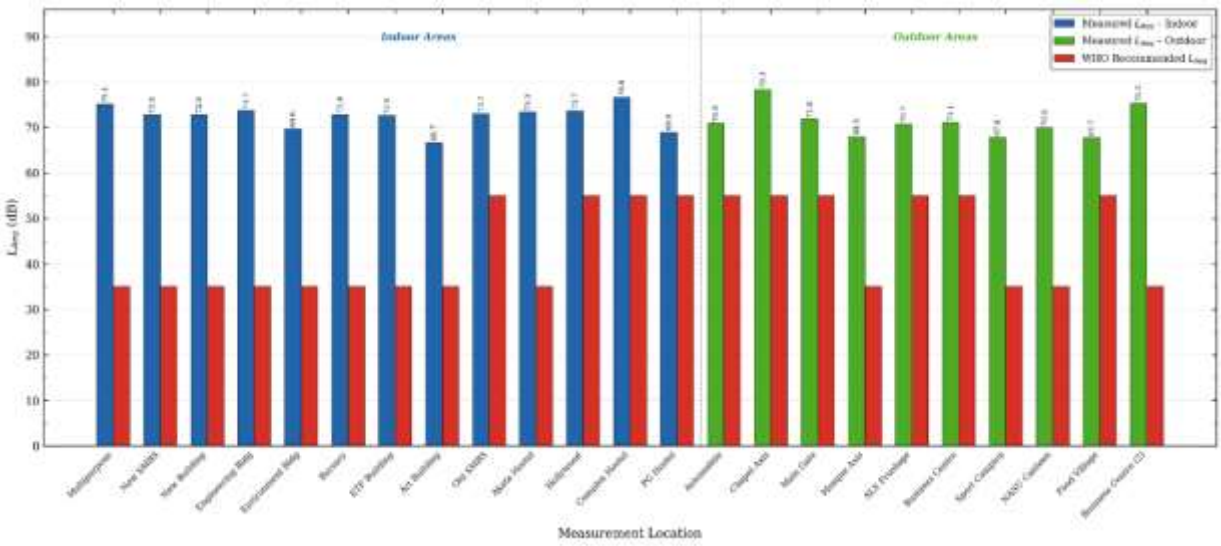


Figure 2: Measured equivalent continuous sound level (L_{Aeq}, dB) compared with WHO recommended noise guidelines at indoor and outdoor campus locations

Table 2: One-sample t-test comparison of measured mean L_{Aeq} Values with WHO recommended noise limits

Category	WHO Limit (dB)	Mean LAeq (dB)	SD	n	t-value	df	p-value	Decision
Indoor Areas (35 dB)	35	71.61	2.97	13	44.43	12	<0.001	Significant
Outdoor Areas (55 dB)	55	72.03	3.15	10	17.10	9	<0.001	Significant



Figure 3: Main sources of noise on campus

Major Sources of Noise on Campus

Figure 3 presents respondents' perceptions of the major sources of noise within the campus environment. The results reveal notable differences between students and staff in terms of dominant perceived noise sources.

Social events were the most commonly reported source of noise among students (75.4 %), followed by public address systems and loudspeakers (33.3 %) and classroom activities (31.3 %). On the other hand, the most common sources of ambient noise, according to staff responses, are traffic noise (62.5 %), generator noise (70.8 %), and classroom activity (79.2 %). The greater exposure to dormitory activities, leisure activities, and peer-related social events may be the cause of the higher student response for social gatherings. On the other hand, employees seemed more sensitive to ongoing operational and infrastructural noise sources like traffic and generators. This is probably because administrative and academic work necessitates focus and little disturbance.

The findings of Olamijulo *et al*. (2016) and Mohammed *et al*. (2022), which identified inconsistent energy supply and extensive generator use as key contributors to environmental noise pollution in poor nations, are supported by the fact that generator noise appeared as a prominent worry among staff. In a similar vein, the prevalence of traffic noise is consistent with the findings of Baloye and Palamuleni (2015), who identified vehicle movement as the primary cause of noise pollution in metropolitan institutions.

Overall, the results show that campus noise pollution is multifactorial, resulting from both social activity and infrastructure. This implies that effective noise management techniques should take a focused strategy that can handle the various exposure patterns and functional requirements of employees and students.

Effect of Noise on Irritation and Stress

Figure 4 presents respondents' perceptions regarding the extent to which environmental noise contributes to irritation and stress among students and staff. The findings show that just a small percentage of respondents – 7.8 % of students and 8.3 % of staff said they had never been irritated or stressed out by noise exposure. Most respondents said they were at least occasionally irritated and stressed out by noise, with 40.0 % of students and 45.8 % of staff choosing the "sometimes" option.

Additionally, 28.1 % of students and 20.8 % of staff said they frequently felt stressed and irritated as a result of being around noise, whilst 12.9 % of students and 20.8 % of staff said they always felt this way. The significantly larger percentage of employees in the "always" category indicates that employees are either more sensitive to environmental noise or have been exposed to it more frequently.

These results show that campus noise is a significant psychological stressor. The findings are in line with (Basner *et al*., 2014; Münzel *et al*., 2018), who found that prolonged exposure to noise was a significant factor in stress, irritation, decreased wellbeing, and worse cognitive function. In a similar vein (WHO, 2018) highlighted that extended exposure to ambient noise can cause physiological and psychological problems.

According to the results, employees' and students' mental health, productivity at work, and academic achievement may all suffer from prolonged exposure to high campus noise levels.

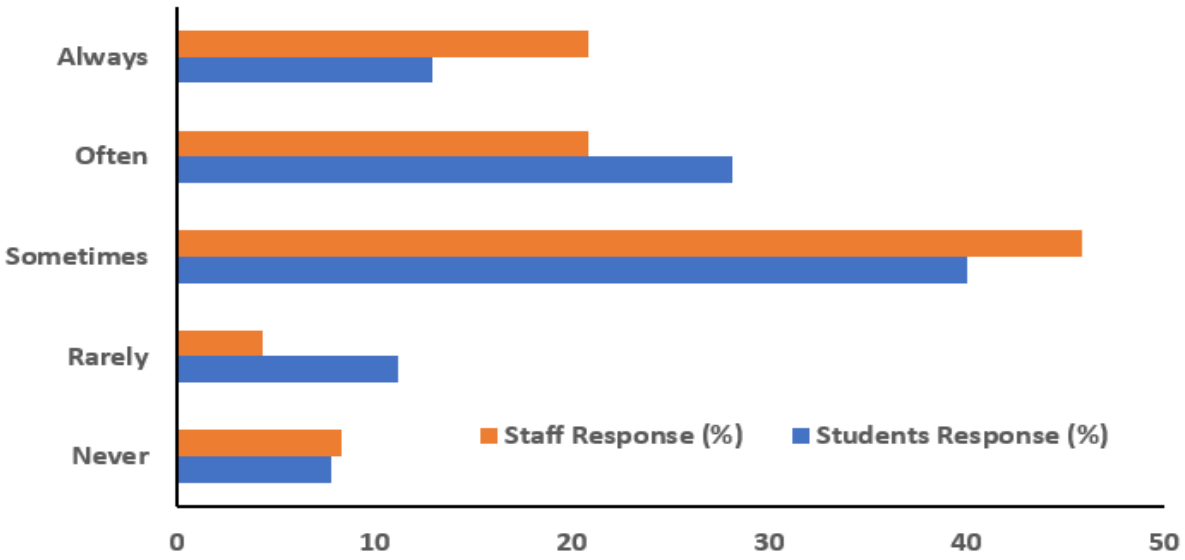


Figure 4: Effect of noise on irritation and stress of students and staff

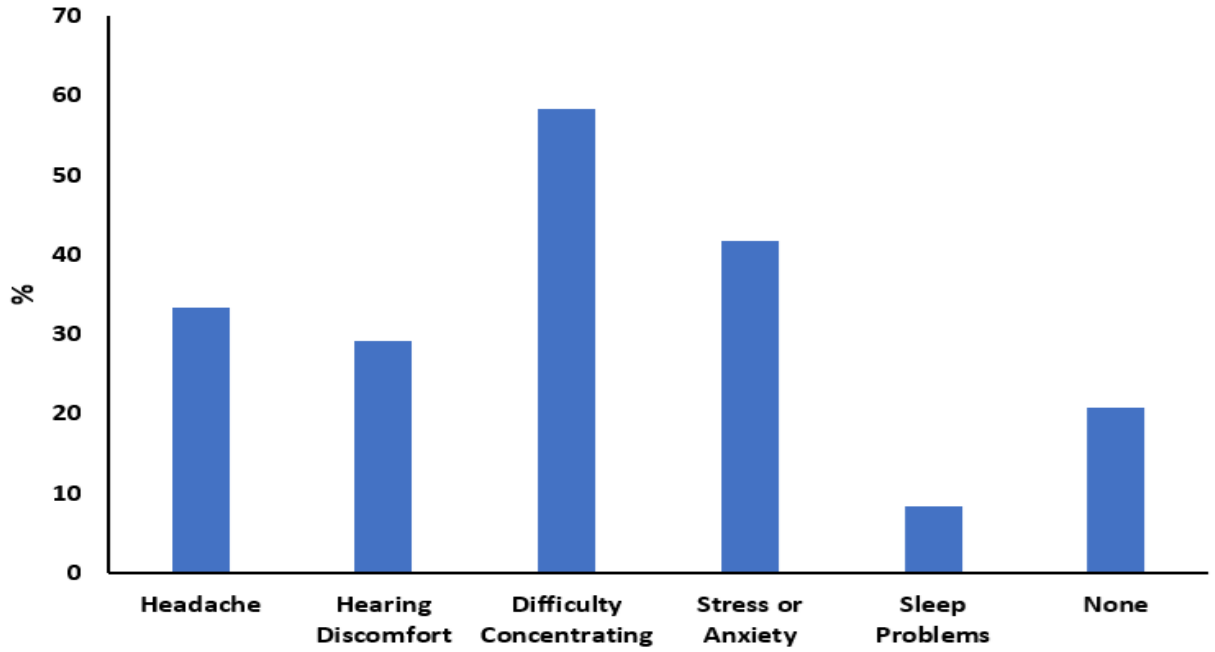


Figure 5: Major symptoms associated with noise felt by staff

Symptoms Associated with Noise Exposure Among Staff

Figure 5 presents the major symptoms associated with noise exposure as reported by staff respondents. The main symptoms of noise exposure as indicated by staff respondents are shown in Table 5. Concentration problems were the most commonly reported symptom (58.3 %), followed by headaches (33.3 %), stress or worry (41.7 %), and hearing problems (29.2 %). Only 8.3 % of respondents reported having sleep issues, while 20.8 % said they had no symptoms at all. The high frequency of concentration problems emphasizes how detrimental environmental noise is to cognitive function and productivity at work. This result corroborates the findings of (Dockrell & Shield, 2016), who found that high background noise considerably impairs focus, attention, and task efficiency in educational settings. In a similar vein, WHO (2018) observed that excessive noise reduces productivity and learning effectiveness by increasing cognitive load and impairing voice intelligibility.

Evidence connecting environmental noise to psychological health issues is further supported by the significant percentage of respondents who reported feeling stressed or anxious. Chronic noise exposure was found to be a significant environmental stressor that can cause physiological stress reactions and long-term health issues (Basner *et al*., 2014; Münzel *et al*., 2018).

Furthermore, the prevalence of headaches and hearing problems indicates that extended exposure to high decibel levels may exacerbate auditory fatigue and strain. These results are consistent with those of (Yasmin *et al*., 2023), who linked early signs of hearing loss and reduced physical health to long-term exposure to environmental noise.

Even while a comparatively lesser percentage of respondents reported experiencing sleep disturbance, its existence is nonetheless noteworthy because prior research has shown a link between environmental noise and sleep disturbance. It has been demonstrated that even moderate amounts of continuous noise can disrupt recovery and sleep quality, which can have an impact on general health and productivity.

Overall, the results show that environmental noise on campus has negative effects on employees' physical comfort, psychological health, and ability to concentrate. The findings highlight the necessity of implementing efficient institutional noise management strategies to enhance occupational health and foster a more favorable learning environment.

CONCLUSION

This study provides convincing, physics-based proof that Yaba College of Technology's acoustic environment is essentially incompatible with efficient instruction, learning, and professional performance. With mean LAeq values ranging from 63.5 to 83.1 dB, field measurements showed that continuous sound levels significantly exceeded WHO-recommended thresholds across all monitored sites (A). Vehicle traffic at the Main Gate, diesel generators, social gatherings, classroom noise transmission, and amplified loudspeaker systems were the main sources of noise. These conclusions were supported by survey results, which demonstrated that high noise levels directly degrade cognitive function, lower academic production, obstruct staff-student contact, and lead to common physical and psychological health issues among campus residents.

Installing acoustic barriers at traffic-heavy boundaries, building generator enclosures with sound-absorbing linings, regulating amplified sound systems, retrofitting classrooms with absorptive materials, implementing campus-wide acoustic zoning, and adopting a comprehensive noise management policy in line with

NESREA and WHO standards are all necessary targeted interventions to address these issues. The institution's academic mission will continue to be undermined by the prevailing acoustic conditions, which also pose long-term threats to the community's health and well-being if prompt action is not taken.

Conflict of interest: The authors declare no conflict of interest.

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