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ENVIRONMENTAL NOISE LEVEL ASSESSMENT OF SELECTED TERTIARY HOSPITALS IN NORTH-CENTRAL NIGERIA

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ABSTRACT

Noise pollution is the second largest environmental threat to health after air pollution. It has been further aggravated by urbanisation, industrialisation and elevated use of large and sophisticated equipment and vehicles. High noise levels in hospitals have been associated with various adverse health impacts on both patients and staff. The environmental noise levels of three tertiary hospitals regarded as some of the best healthcare institutions in Northern Nigeria namely Benue State University Teaching Hospital (BSUTH), Federal Medical Centre (FMC Keffi), and National Hospital Abuja (NHA) were assessed. Ethical clearances and letters of introduction to undertake this study were obtained from the Health Research Ethics Committee (HREC) of each hospital. Hourly measurements were taken daily from ten sampling environments (seven indoor and three outdoor environments) over a two-week period and subjected to Statistical analysis. Mean noise levels ranged from 65.7 dBA (FRONT) to 86.8 dBA (GEN-H) in BSUTH, 55.7 dBA (BACK) to 86.2 dBA (IA) in FMC Keffi and 60.1 dBA (BACK) to 82.9 dBA (ESIA) in NHA. Thus, noise levels in all the hospitals exceeded the WHO recommended daytime threshold of 35 dBA. Therefore, the usage of sound-proofing and sound-absorbing materials and barriers, as well as Quiet Time Protocol (QTP) are recommended to reduce environmental noise levels in healthcare institutions.

Key words: Environmental noise, Healthcare institutions, Operating theatre, Northern Nigeria, Quiet Time Protocol

1.0 INTRODUCTION

Noise has been of public health and environmental concern for ages (WHO, 2018). According to the European Environmental Bureau (EEB) (2026), noise pollution is the second largest environmental threat to health after air pollution. Noise pollution has been further aggravated by urbanisation, industrialisation and increase in the use of large and sophisticated vehicles for transport (Berglund *et al.,* 1999; Kanu *et al.*, 2022). Environmental or community noise are noise generated from different sources, apart from that within industries (Berglund *et al.,* 1999). Outdoor sources of environmental or community noise include various means of transport, agricultural machines, defence equipment, public address systems, manufacturing industries, power generating sets, communication gadgets, while indoor sources include (WHO, 2018; Kanu *et al.,* 2022). Sources of indoor environment noise in hospitals include medical equipment, electronic devices, staff and patients' conversations, cleaning and maintenance, computers, doors and elevators, wheel-chairs and stretchers, patients snoring, moaning or crying, and movements, while outdoor sources include Ambulance sirens, vehicular noise, electromechanical machines, construction and renovation activities (Deswal and Deswal (2025). WHO recommended that noise levels in hospitals should be lower than in other environments, and should not exceed 35 dBA L_{Aeq} during the day, especially in hospital environments where patients are being treated and observed, because they are more susceptible to increased stress levels and other health disorders associated with excess environmental noise (WHO, 2018).

High noise levels in hospitals have been associated with adverse health impacts on patients such as hearing loss, sleep disturbances and deprivation, stress, anxiety, aggressive behaviour, disorientation, increased risks of high blood pressure and ischemic heart diseases, prolonged healing, while for staff, it has been linked to issues such as reduced productivity, concentration and cognitive abilities, stress and tension, occurrence of medical errors, reduced hearing and communication (Khademi *et al.,* 2011; Deswal and Deswal, 2025). Despite WHO recommendation, numerous studies have shown that noise levels in hospital environments all over the world are higher than regulatory limits (Berglund *et al.,* 1999; Khademi *et al.,* 2011; Darbyshire and Young, 2013; Kanu *et al*., 2022; Deswal and Deswal, 2025). The major

tertiary hospitals assessed are approved by the Medical and Dental Council of Nigeria (MDCN) to train medical personnel, run residency programmes and serve as referral centres for both primary and secondary healthcare institutions (NHA, 2018; BSUTH, 2024; FMC, 2024; FMHSW, 2024; MDCN, 2024). The aim of this study was to assess noise level in selected tertiary hospitals in the North Central Nigeria. It will provide essential data for the control and management of noise pollution in healthcare institutions in the study area.

2.0 MATERIALS AND METHODS

2.1 Study Area

This study was undertaken in North Central Nigeria using three tertiary healthcare institutions namely Benue State University Teaching Hospital (BSUTH) in Makurdi, Benue State; FMC Keffi in Keffi, Nasarawa State; and National Hospital Abuja in the Federal capital territory (FCT). Ten environments from each hospital were sampled. Seven were indoor environments namely theatre at rest (TAR), electrosurgery (ES), inhalational anesthetics (IA), electrosurgery + inhalational anesthetics (ESIA), accident and emergency ward (A&E), intensive care unit (ICU), and microbiology lab (M-LAB), while three were outdoor environments namely back of the hospital (BACK), front of the hospital (FRONT), and generator house area of the hospital (GEN-H).

2.2 Ethical Approval

Ethical clearances and letters of introduction to undertake this study were applied for and obtained from the Health Research and Ethics Committee (HREC) of each of the hospitals assessed. In addition, informed consent was sought and received from the heads-of-department of all the sampled environments.

2.3 Noise Pollution Sampling

Environmental noise levels were measured using the Extech type 2 sound level meter (Extech Model 4770). The measuring device was calibrated before use according to the manufacturer's instructions and for the purpose of standardization. The instruments were held at a measuring height of about 1.5 m above ground surface according to Juang *et al*. (2010). In each hospital, measurements were taken on a daily basis over a two-week period. In each sampled environment, hourly measurements were taken once a day for three consecutive days.

The average number of occupants present during the period of sampling in each sampled environment were also recorded.

2.4 Data Analysis

From the triplicate measurements in each environment, the averages were computed. The obtained averaged values were then used for further analysis. Statistical analysis was done using Minitab 17.0, and one-way ANOVA. Mean separation was done using Fisher's LSD at 95% confidence level (0.05 level of significance).

3.0 RESULTS

3.1 Number of Occupants

In BSUTH, average number of occupants ranged from 1 person in GEN-H to 26 persons in A&E. The most populated areas were A&E (26 persons), ES (15 persons) and ESIA (14 persons) while the least populated were GEN-H (1 person), TAR and BACK (2 persons each). In FMC Keffi, it ranged from 1 person in TAR, BACK and GEN-H to 27 persons in A&E. Thus, the most populated areas were A&E (27 persons), ES, ESIA and FRONT (10 persons each) while the least populated were TAR, BACK and GEN-H (1 person each). In NHA, average occupancy ranged from 2 persons (TAR, BACK and GEN-H) to 14 persons (ICU). Thus, TAR, BACK and GEN-H had the lowest mean occupants, just like FMC Keffi, but they had 2 persons each, instead of 1 person. The most populated areas were ICU (14 occupants), ES (10 occupants), ESIA, FRONT and A&E (8 occupants each).

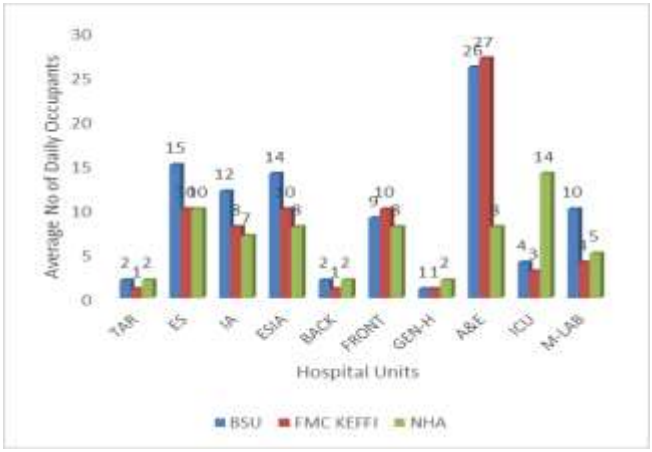

Figure 1: Average Daily Mean Occupants Counted at Different Areas in the Hospitals

3.2 Noise Level Assessment

3.2.1 BSUTH

Mean noise levels ranged from 65.7 dBA (FRONT) to 86.8 dBA (GEN-H). Thus, the least noisy areas in BSUTH were FRONT (65.7 dBA), M-LAB (72.3 dBA) and TAR (74.3 dBA) while the noisiest were GEN-H (86.8 dBA), IA (86.6 dBA) and BACK (86.4 dBA).

3.2.2 FMC Keffi

Mean noise levels ranged from 55.7 dBA (BACK) to 86.2 dBA (IA). Therefore, the least noisy areas in FMC Keffi were BACK (55.7 dBA), M-LAB (58.1 dBA) and ICU (62.1 dBA).

Conversely, IA (86.2 dBA), A&E (84.8 dBA) and ESIA (83.6 dBA) were the noisiest.

3.3.3 NHA

Mean noise levels ranged from 60.1 dBA (BACK) to 82.9 dBA (ESIA). Thus, the least noisy areas in NHA were BACK (60.1 dBA), M-LAB (61.4 dBA) and A&E (62.3 dBA). On the other hand, the noisiest areas were ESIA (82.9 dBA), ES (75.0 dBA) and ICU (74.4 dBA).

Table 1a: Day Time Noise Level at BSUTH

	TAR	ES	IA	ESIA	FRONT	BACK	GEN-H	A&E	ICU	M-LAB
BSUTH										
MDNL Day 1	74.4	84.2	86.7	85.0	63.7	86.9	85.4	86.1	84.0	72.3
MDNL Day 2	73.9	84.4	86.6	85.4	66.6	85.5	87.6	86.6	84.4	72.4
MDNL Day 3	74.5	84.6	86.5	84.9	66.8	86.8	87.4	86.5	84.8	72.3
ADNL3	**74.3**	**84.4**	**86.6**	**85.1**	**65.7**	**86.4**	**86.8**	**86.4**	**84.4**	**72.3**

Table 1b: Day Time Noise Level at FMC Keffi

FMC Keffi	TAR	ES	IA	ESIA	FRONT	BACK	GEN-H	A&E	ICU	M-LAB
MDNL Day 1	63.9	74.6	86.1	83.3	79.8	54.9	63.7	82.8	62.1	58.5
MDNL Day 2	63.9	74.4	86.3	84.5	79.6	56.2	63.9	85.9	62.1	57.7
MDNL Day 3	64.6	74.5	86.2	82.9	77.4	56.0	60.8	85.7	62.1	58.1
ADNL3	**64.1**	**74.5**	**86.2**	**83.6**	**78.9**	**55.7**	**62.8**	**84.8**	**62.1**	**58.1**

Table 1c: Day Time Noise Level at NH Abuja

NHA										
MDNL Day 1	70.1	77.0	73.6	81.9	70.7	61.1	69.5	62.4	74.4	61.4
MDNL Day 2	70.0	72.0	73.4	83.9	72.3	60.9	69.5	62.3	74.4	61.0
MDNL Day 3	70.2	76.0	72.9	82.8	72.1	58.3	69.6	62.3	74.4	61.8
ADNL3	**70.1**	**75.0**	**73.3**	**82.9**	**71.7**	**60.1**	**69.5**	**62.3**	**74.4**	**61.4**

Values are given in decibels (dBA). MDNL= Mean Daytime Noise Level, ADNL3= Average Daytime Noise Level in Three Consecutive Days

Table 2: Comparative emitted Noise levels at the Hospitals

Hospital	BSUTH	FMC KEFFI	NHA
MNL	81.2±7.58 A	71.1±11.78 B	70.1±7.12 B
P-value	0.019		

Values are given in decibels (dBA). Grouping Information Using the Fisher LSD Method and 95% Confidence Interval. Means that do not share a letter are significantly different.

4.0 DISCUSSION

NHA was the least populated of the 3 hospitals assessed. Thus, it is most likely to have better air quality and less air pollution and contamination than BSUTH and FMC Keffi. This is because occupants, especially humans and animals are common sources of noise and other pollutants that can be released into indoor or outdoor air (Parry, 2012; WHO, 2018; WHO, 2024). Thus, high level of occupants in any environment can increase the level of pollutants such as noise within and around any environment, while environments with low numbers of occupants often have lower levels of noise and other pollutants. This can increase the rate of healthcare acquired ailments and other adverse health effects in patients as well as staff.

The OT environments (TAR, ES, IA, and ESIA) in all the hospitals were some of the noisiest environments assessed even when there was no surgery taking place as is the case of TAR. Thus, IA being the noisiest area in Keffi and ESIA being the noisiest in NHA adequately represented the level of noise in the OT. Even in BSUTH where GEN-H was the noisiest, the next noisiest was IA (an OT area) and so if the readings had been taking when the generating sets were off (all hospitals have different energy generating sources so the noisy generating sets do not have to be used all the time), IA may be the noisiest area in BSUTH, exactly similar to FMC Keffi where IA was the noisiest area. Interestingly, the outdoor environments were not as noisy as most of the indoor environments with FRONT and BACK being the least noisy of all the areas assessed in all 3 hospitals.

GEN-H, IA and BACK were the noisiest environments in BSUTH. GEN-H was the noisiest due to the sound of generating sets switched on. Medical equipment like vital signs monitors and IA machines, as well as conversations among the surgical staff in the OT contributed to high noise levels in IA, while construction work ongoing in a nearby facility generated most of the environmental noise in BACK. GEN-H and BACK had occupants but they were very few and there was no conversation among them.

In FMC Keffi, 2 of the 3 noisiest areas were in the OT (IA and ESIA). Such high noise levels may be as a result of medical equipment such as electrosurgical devices, vital signs monitors and IA machines, as well as discussions among the surgical staff during surgeries in the OT. The high level of noise in the other noisiest area (A&E) was due to the large volume of occupants (staff, patients and caregivers) present there. It was most populated of all the environments assessed and there were limited restrictions on entry and movement, compared to other indoor environments.

In NHA, the 2 noisiest areas were also in the OT (ESIA and ES) but the noise levels were slightly lower than in FMC Keffi. The source of the high noise levels is similar to that of FMC Keffi (medical equipment such as electrosurgical devices, vital signs monitors and IA machines, as well as discussions among the surgical staff during surgeries in the OT) but the noise levels were slightly lower due to fewer occupants. ICU is the second noisiest in NHA due to a number of occupants, predominantly staff, who were constantly in conversation.

In all the areas assessed across the 3 hospitals, noise levels far exceeded acceptable limits of 35 dBA both indoors and outdoors. However, the indoor environments were noisier than the outdoor environments, except in BSUTH but most of the outdoor noise there came from a nearby facility and not from the hospital itself. Such exceedance could result in health challenges such as anxiety, increased heart rate, stress, sleep deprivation, and an extended stay in hospital for patients, while it could lead to stress, decreased cognitive abilities and decreased productivity in staff (WHO, 2018; Deswal and Deswal, 2025). Its adverse effects may also result in decreases in the well-being of human populations (EEB, 2026). Statistically, there was a significant difference between the noise levels in BSUTH and those in FMC Keffi and NHA, but there was no significant difference between the noise levels in FMC Keffi and those in NHA. This study is in agreement with numerous studies such as Berglund *et al*. (1999), Khademi *et al.* (2011), Darbyshire and Young (2013), Kanu *et al. (*2022), and Deswal and Deswal (2025) where noise levels were higher than WHO limits for environmental noise in hospital environments that were assessed.

5.0 CONCLUSION

This study assessed the environmental noise levels of three tertiary hospitals regarded as some of the best healthcare institutions in Northern Nigeria and found them to have exceeded acceptable limits. This exceedance is a serious public health concern that has been linked to several health challenges and thus needs to be addressed. Therefore, the hospitals need to increase the distance between noisy pieces of equipment and the occupants' ears, employ relaxation techniques for patients and staff, such as mindfulness exercises, music therapy, or guided meditation, as well as the use of ear-protective devices to help them cope with the negative effects caused by noise pollution. In addition, the usage of sound-proofing and sound-absorbing materials and barriers, as well as Quiet Time Protocol (QTP) (which is a set of guidelines put in place to promote a quiet environment in healthcare institutions) is essential for the reduction of environmental noise pollution in healthcare institutions.

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