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Noise Levels and Periods of Noise Experience within Residential Environment in Benin City, Nigeria

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Abstract
This study assessed the level of noise within two residential neighbourhoods in Benin City, Nigeria. Noise level in decibels (dB) was measured using a sound meters within some selected spots in the Government Reserved Area (GRA) and Ogbe quarters. Structured questionnaires were used to elicit information from residents on demographic, neighbourhood characteristics, and perceived level of noise. The data obtained were analyzed using descriptive statistics. Across the two residential neighbourhoods, the highest mean noise level (85.80dB) was recorded at Ogbe area with the least (50.10dB) observed at GRA area. Based on World Health Organization (WHO) 16-hour Daily Noise Level criteria of 55dB for residential areas, about 14.5%of the spotted readings in the residential neighbourhoodscomplied with the recommended limit. Strategies for noise abatement within residential dwellings were brought to fore.

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I. Introduction

Noise is a loud, unpleasant or unexpected sound that can affect man's quality of life(Singh and Davar, 2004). Sound becomes undesirable when it disturbs the normal activities such as working, sleeping, and conversations. Although to a large extent, noise is underrated as an environmental problem since it cannot be seen, smelt, or tasted (Dasarathy, 2015). However, World Health Organization (WHO, 2001) stated that "noise must be recognized as a major threat to human wellbeing". In fact, noise is no longer regarded as a mere nuisance, it has now been found to be hazardous, posing serious threat to the quality of life especially in the urban environment (Abel, 2015).

According to Debasish and Debasish (2012), noise pollution is one of the major environmental pollutants that has direct effects on human performance. Unlike other environmental problems, noise pollution continues to grow and complaints on noise disturbance has been on the increase over the years (Oyedepo, 2012).Evidently, the growth in noise pollution has resulted in cumulative impact on wellbeing, productivity and adverse health effects (WHO, 2001). The potential health effects of noise pollution are numerous, pervasive, persistent, and medically and socially significant. The implication of noiseexposure as noted by Oyedepo(2012) produces direct and cumulative adverse effects which impair health with corresponding real (economic) and intangible (well-being) losses.

Several studies have been conducted to determine noise levels (Singh and Daver 2004, Pucher *et al.*, 2005, Tansatcha *et al.*, 2005), as well as the magnitude of discomfort associated with noise resident's lives (Ali and Tamura 2003, Marius *et al.*, 2005; Oyedepo, 2012; Weinbold, 2015; Olamijulo, *et al.*, 2016; Preethi, *et al* 2016). For instance, Ehrampoush*et al.,* (2011) examined noise pollutionin different parts of the Yazd city, Iran and compare them with current standard levels.Based on the measurement times considered (morning, afternoon and evening), result showed that the rate of background noise in Yazd city was high as 74.3dBA and mean Leq was 66.7dBA. Comparing the noise level obtained within the standard level, the noise levels are higher than that of acceptable levels in most parts of the city. Also, in a study by Mangalekar*et al.,* (2011)in Kolhapur city, Maharashtra, India,the average noise level at industrial, commercial, residential and silence areas were 74.28 dBA, 65.52 dBA, 58.88 dBA and 50.02 dBA, respectively. The results showed that rising noise level increased with economic activitiesdue to increase in the number of vehicles and facilities of transportation.

The advent of urbanization, civilization or industrialization are the main catalyst for noise pollution. Growth in terms of economic, social development and population increases the tendency towards increasing noise generation. Particularly, the connectivity of vicinity, transport routes has resulted to an increase of noise volume generated in cities. In Nigeria. noise pollution in urban centers is relatively high when compared to recommended levels by World Health Organization (Oyedepo, 2012; Awosusi and Akindutire, 2014), yet, little attention is paid to the control of noise pollution in Nigeria (Oyedepo, 2012).Oloruntoba*et al.,* (2012) investigated the noise levels in selected residential neighbourhoods of Ibadan metropolis, Nigeria. Using a cross

sectional survey and noise level meter categorized mean noise values for the three residential neighbourhood groups based on population density. Result showed that of noise level in medium density (68.45± 2.10dB) and high density (68.36±1.92dB)exceeded but the low density (53.10±2.80dB) was within the 55dB recommended limitfor residential areas

Oyedepo (2012) investigated the noise levels of Ilorin metropolis, Nigeria by residential density. High density residential areashad noise levels higher than 70 dB while most locations in the low density residential areas had the least noise levels within the acceptable 55 dB limit.Given the rise in urban expansion, and the impact of noise pollution on healthy and sustainable living within cities, this study examinesurban neighbourhood noise pollution levels in Benin City, Nigeria. This is with a view to establishing the extent of the problems, with possible directions towards mitigating noise pollution.

II. Material and Method

Benin City is located at latitude 06°19IE to 6°21IE and longitude 5°34IE to 5°44IE with an average elevation of 77.8 m above sea-level. Benin City is a pre-colonial city, the capital of Edo State, Nigeria. The city is located in the humid tropical rainforest belt of Nigeria with a population of 762,717 according to the 1991 national population census with a projected population of 1.3 million by 2010 at 2.9% growth rate (City population, 2017). The population of Benin was 1,495,800 by 2015, which is about 0.821% of Nigeria's population. Benin City belongs to AF category of Koppen's climatic classification. The rainy season in Benin begins in March/April and ends in October/November. Over the years, Benin City has witnessed, rapid territorial expansion mainly due to rapid rural-urban migration. Also the built environment comprised industrial, commercial and residential structures in different parts of the city.

Two neighbourhoods in Benin city were purposively selected for this study. The choice of these locations was premised on differences in neighbourhood characteristics and activities. Two neighbourhoods selected are: Government Residential Area, Benin City (GRA) and OGBE Residential Quarters, Benin City. GRA quarters is situated at the central area of Benin City district and lies just within the northern segment of Ring Road in Benin with adjoining facilities such as Government house, Hotel, Benin Club and Forces headquarters. Ogbe Residential Quarters represents a spontaneous neighbourhood located in an inner city core area of Benin City. Some of the adjoining facilities includes Ogbe stadium, Oba's Palace, shopping area, office complexes amongst others.

The research data were collected through experimental and survey methods. Measuring the physical data were done using Sound Level Meter (SLM) This instrument measures the sound pressure level in dB (A) i.e. decibels in a weighted scale. The sound level meter used, measures the sound frequency from 300 Hz to 8 kHz and from 30 dB to 130 dB in a weighted scale at four ranges, that is 30 to 80 dB (A) for low; 50 to 100 dB (A) for medium; 80 to 130 dB (A) for slightly high and 30 to 130 dB (A) automatic measurement range. The sound pressure level or sound level measured in decibel (dB) is a logarithmic measure of the effective sound pressure of a sound relative to a standard reference value. The dB (A) Leq denotes the time weighted average of the sound pressure level in decibels on scale 'A' which is relatable to human hearing. The sound level meter was handled at proper orientation to receive the maximum sound intensity. The instruments were calibrated by the internal level calibrator before making measurements at each site. All the instruments comply with IEC standards.

Data were collected in a one-week period using a Sound Level Meter. The noise level measurement was taken three-time period in a day. Six (6) selected locations in the 2 residential neighbourhoods were selected as sampling points for the field measurements. The measurements were made at street level based on access to the neighbourhood (outer street, median street and the inner street). The instrument was held comfortably in hand with the microphone pointed at the suspected noise source at a distance not less than 1 m away from any reflecting object. LAi (A-weighted instantaneous sound pressure level) measurements were recorded at intervals of 30 seconds for a period of 30 minutes, giving 60 meter readings per sampling location. This procedure was carried out for morning (7:30-8:00 a.m.), afternoon (1:00-1:30 p.m.), evening (4:00-4:30 p.m.) and night (8:30-9:00 p.m.) measurements.

The cross-sectional survey involves the use of structured questionnaires to obtain information from the resident. Most questions of the survey were designed to source information about the perceived level of noise among the residents. A total of sixty-six (66) residents were surveyed. Majority of the participants were male (59.1%) while about 40.9% were female. A greater proportion of respondents were in the age range 21-30 years, while only 1.5% was above 60 years of age across the areas. This result suggests that most of the respondents were within their active and productive ages. Most respondent were literate as over half of them had tertiary education (59.1%). This finding suggests that the information obtained from the respondents can be relied upon.

III. Results

Noise levels within the study residential neighbourhoods were observed based on field measurements and people's perception through a structured questionnaire. Since the residential neighbourhoods are exposed to noise levels over duration exceeding 12hours, the WHO 16-hour DNL criteria of 55dB for residential areas was used in this study.

Level of Noise Pollution

The site measurement was done using the sound level meter or SLM to measure the noise levels at the study site. The noise level measurements were gathered for period of 8 hours at an interval of 5 seconds which were later tabulated according to the sound pressure level (Decibel, db (A) versus sampling spot. The data were obtained for a period of one week and readings were taken at on Monday, Wednesday, Friday and Sunday consecutively. The observed average level of noise and the sampling point were as presented in Table 1.

Table 1: A week Periodical Noise Reading

		Morning (dBA) 7am-10am				Afternoon (dBA) 12noon-3pm				Evening (dBA) 4pm-7pm			
		Mon	Wed	Fri	Sun	Mon	Wed	Fri	Sun	Mon	Wed	Fri	Sun
1	**GRA1**	71.2	76.2	82.2	52.5	56.6	76.6	75.0	54.6	75.4	72.4	83.1	54.2
2	**GRA2**	75.2	70.4	81.2	50.1	77.9	60.9	82.1	56.5	73.4	84.5	82.6	55.7
3	**GRA3**	73.4	75.4	82.1	52.3	66.2	64.5	72.9	53.5	79.4	81.1	83.5	60.6
4	**OGBE1**	76.1	75.3	83.7	50.3	76.3	67.8	81.6	60.2	76.2	88.3	85.2	57.9
5	**OGBE2**	76.2	82.1	85.2	53.3	64.3	65.1	77.2	54.3	76.9	81.5	86.4	59.5
6	**OGBE3**	77.9	80.2	82.1	49.7	62.1	82.7	79.6	50.4	67.9	84.5	84.6	62.5

The data were also expressed graphically using charts to show the variations of noise distribution in the locations. The data for the decibel values of noise levels for the time period was placed in a chart as shown in Figures 1, 2, 3 and 4. Figure 1 shows all reading obtained which indicates a general increase in noise meter reading on Friday and a significant reduction in the readings on Sunday. The chart also shows that most location reading exceeded the EPA standard of 55 dBA for residential neighbourhoods. The maximum value obtained was 88.3 for Ogbe 1 whereas the minimum value was 50.3 for GRA 2.

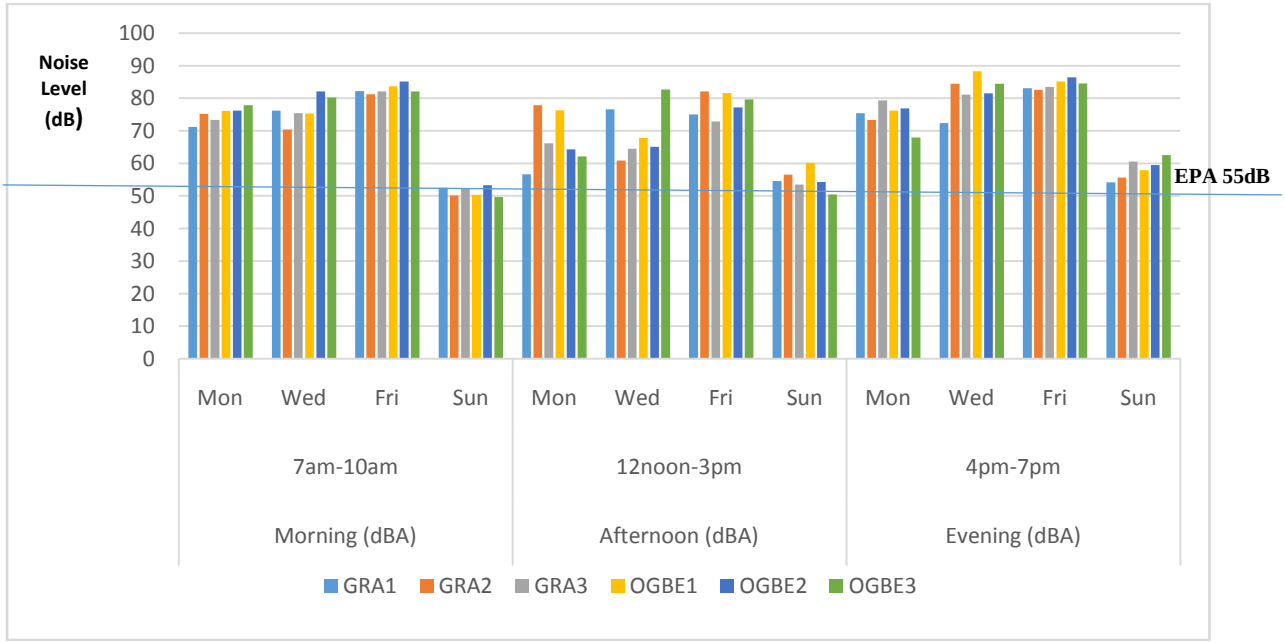

Figure 1: Noise levels for one week

Figure 1 showed that all week day noise readings greatly exceed the EPA standards of 55 dBA residential noise levels. However, all the Sunday readings fell below the internationally accepted noise levels. This could be attributed to reduction in most economic and vehicular activities on Sundays.

The noise level measurements were further disaggregated into morning, afternoon and evening session. This was done to further show disparity in noise level cross locations. The morning chart as shown in Figure 2 revealed that all weekdays noise readings greatly exceed the EPA standards of 55dBA for residential noise levels. However, all Sunday readings fell below the maximum noise levels.

All afternoon readings as indicated by Figure 3 exceeds the EPA noise level limit of 55dBA, while all Sunday afternoon readings other than at the Ogbe 1 noise readings were below the EPA standard. Also, all weekday Friday readings at all the sampling points exceed the EPA limit for residential noise levels. This might be as a result of increase in commercial and ceremonial activities towards the close of the week.

Figure 4 reveals that all weekday and weekend evening readings exceeds the EPA noise limits for residential noise levels.

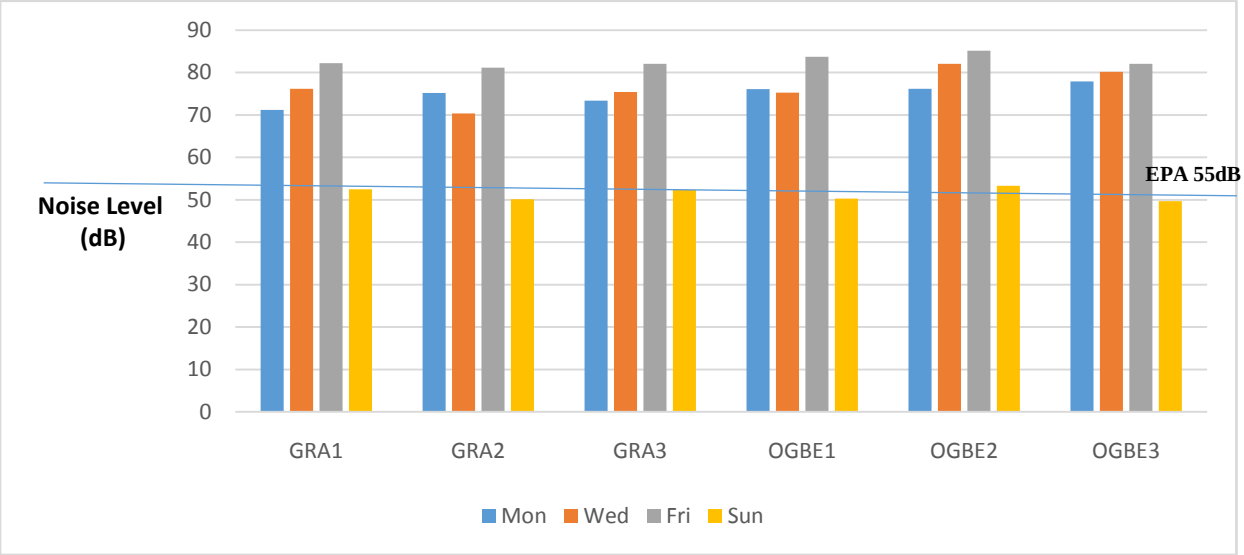

Figure 2: Morning Noise Chart

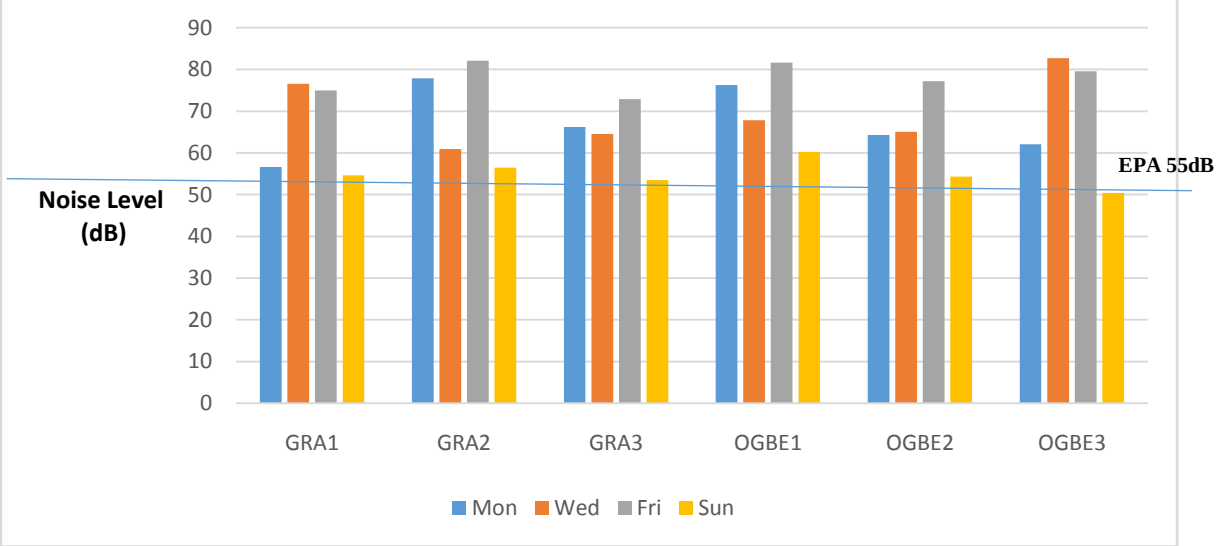

Figure 3: Afternoon Noise Chart

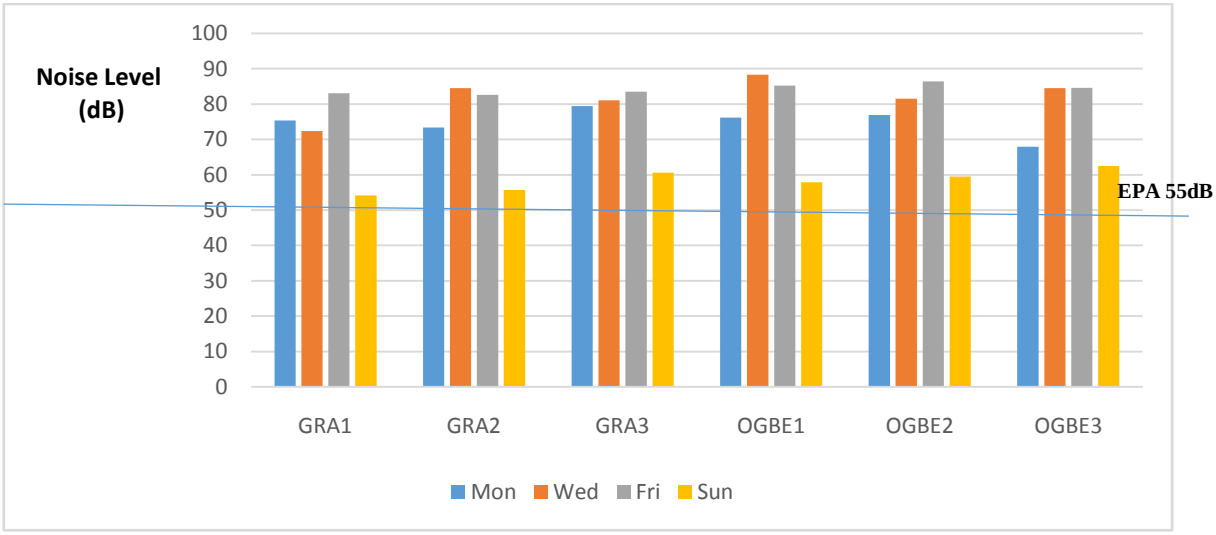

Figure 4: Evening Noise Chart

In sum, the information presented in the chart and tables generated from data obtained from the study area made it overwhelmingly clear that noise levels in all 6 sampling points have weekday readings that exceeded the EPA standards of 55dBA for residential areas. Also, about half of all weekend readings exceed the residential standard of these organizations. It could thus be concluded that the people residing or working in and around Ogbe and GRA area of Benin City area are at a very high risk of noise related ailments.

Perception of Noise Experience by Residents

Apart from the physical site data measurements, data from survey are also important to make sure the study achieves its objectives. Therefore, surveys in the form of questionnaires were administered to the residents of the two neighbourhoods. Results from the questionnaires was helpful in the assessing the perceived frequency of noise in the two neigbourhood. The questionnaires were circulated systematically to residents in the selected neighbourhoods. The survey result for the periods of noise pollution from the resident's perspective shows that Afternoon noise had the most serious degree of noise (M=2.33), followed by Evening noise (M=2.27), then Morning noise (M=2.27) and the least was Night noise (M=1.61).

Table 2: Descriptive Statistics on Perception of Noise experience

	Morning	Night	Evening	Afternoon
Most times	13 (19.7%)	5 (7.6%)	9 (13.1%)	37 (56.1%)
Sometime	22 (33.3%)	32 (45.3%)	29 (45.3%)	15 (22.7%)
Not at all	23 (42.4%)	26 (40.6%)	26 (40.6%)	12 (18.2%)
Missing	3 (4.5%)	3 (4.5%)	2 (3.0%)	2 (3.0)
Mean	2.27	1.61	2.27	2.33

The survey also sought the perception of the residents on the frequency of noise pollution. The result as indicated in Table 4.5 suggest that the residents have a low perception of noise level as 42.4% stated that they do not experience noise and 45.5% stated that the noise level is just a little serious. This suggests that the residents don't perceive noise as a serious problem. Table 4.5 presents the group statistics. The Mean value for Ogbe (M=4.26, SD= .944) was higher than GRA (M=4.14, SD= .930). Hence, we can deduce that Ogbe resident's experiences greater effect of noise that those of GRA area.

Table 3: Group Statistics for Noise Frequency

	Location	N	Mean	Std. Deviation	Std. Error Mean
Frequency of Noise	GRA	35	4.14	0.944	0.160
	OGBE	31	4.26	0.930	0.167

The noise level estimates at GRA and Ogbe neighbourhoods in Benin City, Edo State, Nigeria at the different time interval exceeded the World Health Organization (WHO) limits. The WHO guideline set the maximum noise levels of 55dB in residential area (WHO, 2001). The minimum noise level recorded in this study area was 50.1 dB and the maximum was 88.3 dB and this significantly higher than the WHO guideline limit. All the 6 sampling points have weekday readings that exceeded the EPA standards of 55dBA for residential areas. Also, about half of all weekend readings exceed the residential standard of these organizations and all the 6 sampling points have weekday readings that exceeded the EPA standards of 55dBA for residential

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5.1. Conclusion

In this study, comprehensive assessment of environmental noise levels of two Benin City neighbourhoods was carried out. Six (6) selected sites were surveyed for noise pollution levels within Ogbe and GRA areas. Questionnaires were also administered to 66 residents of these areas to determine their level of perception of level of noise. The results of this study show that at locations near the busy roads/ road junctions, commercial centers and passengers loading parks the equivalent noise level, background noise level and peak noise level are higher compared to monitoring station near low density residential areas. This investigation reveals that noise levels at 5 of 6 measurement points exceeded the recommended limit of 60dB (A) by values of 1–27 dB (A). Hence, the present status of noise pollution in Benin neighbourhoods poses a severe health risk to the residents. Furthermore, discomfort and irritation being caused by the pollution can drastically reduce productivity, both in public service and private sectors. In addition, some areas may soon reach the threshold of pains and lead to permanent loss of hearing and death.

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