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COMPARATIVE ASSESSMENT OF NOISE SOURCES IN TWO RESIDENTIAL NEIGHBOURHOODS IN BENIN CITY, NIGERIA

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ABSTRACT: *The study assessed sources of noise between two residential neighbourhood in Benin City, Nigeria using a cross-section survey. Mann-Whitney Test was employed to identify relative differences in noise sources between the locations. Results showed that prominent sources of noise across the two locations were those from generator and market activities, however with varying magnitude. However, the test results revealed statistically significant difference in noise sources from generator, market activities, vehicular across the two locations considered. Relevant measures for noise control actions necessary to mitigate noise pollution were identified.*

KEYWORDS: noise sources, residents, Mann-Whitney test

INTRODUCTION

Noise is usually described as unwanted and disturbing sound beyond the acceptable threshold (Darbyshire et al., 2019). Controlling the level of noise in urban areas is critical to human wellbeing and performance. However, predicting noise exposure tends to be more challenging within residential areas as a result of different socioeconomics and cultural values. Urban development and renewal have been responsible for variation in sources of noise most especially in urban areas. This is the case of Nigeria with significant changes in urban environment due to industrialization, urbanization and the expansion of urban cities (Kucha, 2014). These changes with subsequent increase in noise exposure levels is associated with health implications which affect the quality of life in urban areas (Ogunseye, et al., 2018). To safeguard against the effects of noise pollution, different governmental agencies in Nigeria were created with the responsibility to improve the quality of the environment from pollutant and other environmental hazards (Abolade and Adeboyejo, 2013). Despite this, noise pollution has been on the increase in major cities due rise in developmental activities and built environment, and as a result, there have been low response from such environmental policies.

Consequently, the effects of noise pollution beyond a certain limit ranges from physical, psychological and physiological (Weinbold, 2015; Abel, 2015; Bulunuz, 2014). Noise pollution has assumed alarming proportions and has become even more dangerous than water and air pollution. With continued increase in magnitude of urban population growth, urbanization, and the associated growth in the noise pollution from differences sources will become unmanageable (Oyedepo, 2012). Residential noise pollution compared to other noise pollution has a direct effect on comfort and conducive environment. As a common urban nuisance, several studies examined different sources of noise in many cities of the world (Singh and Davar, 2004; Kucha, 2014; Oyedepo, 2012; Anomoharan, 2013). Studies have shown different noise sources from various institutional, industrial and commercial areas with resultant impact on human well-being (van Praag and Baarsma 2005; Anomohanran and Osemeikhian, 2006; Oloruntoba, et al., 2012; Babisch, 2014; Weinhold, 2015; Abel, 2015; Olamijulo et al., 2016). This study focused on comparative assessment of different noise sources within urban neighbourhood and help proffer sustainable strategies to noise pollution. Considering rapid urban growth, expansion of built environment and associated rise in noise level, it may be that some control measures would be possible if empirical understanding of location-specific sources of noise is investigated.

METHODOLOGY

The study used cross sectional data from two neighbourhoods purposively selected from urban neighbourhoods in Benin city. These are: Government Residential Area, Benin City (GRA), situated at the central area of Benin City district and OGBE Residential Quarters, Benin City, a residential neighbourhood located in an inner core area of Benin City. The choice of these locations was premised on differences in neighbourhood characteristics and activities. Also, the study area noise sources are expected to vary because of the population difference in the selected residential areas. The targeted populations are the dwellers of the residential neighbourhood, which include tenants and homeowners, who had stayed in the area for more than a year and are above 18 years of age. These respondent will have matured enough in age and have adequate experience within the area on noise levels and its sources in the neighbourhoods. The neighbourhood characteristics and perceptions of the respondents on sources of noise, were collected using structured questionnaires.

To identify disparities in sources of noise in the studied locations, a Mann-Whitney U statistical test was conducted because the sample is not largely distributed for a T-test to be carried out. When the assumptions underlying the *t*-test are not met, then, the non-parametric equivalent, the Mann-Whitney U test, may be used. The test discusses the differences in sources in noise between the two selected areas. It involves generating the overall arithmetic mean scores for different sources of noise in the two areas; GRA and OGBE separately. Afterwards, the Mann-Whitney U test was performed to examine the differences in the sources of noise in the two location. The Mann-Whitney U test is a nonparametric test that compares the central locations of two population distributions when there are two independent random samples from these populations. It is based on the combination of mean scores of the samples and ranking them in ascending order (Newbold et al., 2012; Arditi et al., 2017). The null hypothesis is that there is no difference between the ranks of the two locations. In order to test this null hypothesis, the Mann-Whitney U statistic and Z value must be calculated. It is specified as:

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1 \tag{1}$$

$$E(U) = \mu_U = \frac{n_i n_2}{2} \tag{2}$$

$$Var(U) = \sigma_U^2 = \frac{n_1 n_2 (n_1 + n_2 + 1)}{12} \tag{3}$$

$$Z = \frac{U - \mu_U}{\sigma_U} \tag{4}$$

where n_1 = sample size for GRA; n_2 = the sample for OGBE; R_1 = the sum of the ranks of the GRA sample, σ^2_U = the variance of the Mann–Whitney U, and μ_U = the mean of the Mann Whitney U. After calculating the Z value, decision to reject or accept the null hypothesis based on level of significance is determined.

RESULTS AND DISCUSSION

The neighbourhood characteristics as shown in Table 1 revealed that on the average, compound building (29.2%) and single flat bungalows (26.2%) were more prevalent, while twin flat bungalow were (3.1%) the least building type. There was a similar trend with this building type across the two areas. A greater proportion of occupants (38.5%) were in the range 6-10 including OGBE area whereas in GRA more occupants were in range 1-5 (13.8%) (the two areas. The perceived population density revealed that about 46.9% of residents classified their areas as highly populated, but across the two areas, there was evidence of densely population in GRA (25.0%) compared to OGBE (21.9%). Residents perception of low density was the same across the two neighbourhood. The differential in neighbourhood features suggest varying level of residential noise as noted by Olamijulo et al. (2016)

Table 1: Percentage distribution of Neighbourhood characteristics

Variables		GRA	OGBE	Total
Building types	Face2face	9 (13.8%)	6 (9.2%)	15 (23.1%)
	Compound	10 (15.4%)	9 (13.8%)	19 (29.2%)
	Single flats	10 (15.4%)	9 (13.8%)	19 (29.2%)
	Twin bungalow	1 (1.5%)	1 (1.5%)	2 (3.1%)
	4 flats building	1 (1.5%)	6 (9.2%)	7 (10.8%)
	Duplex	6 (9.2%)	1 (1.5%)	7 (10.8%)
Nos of Occupants/Bldg.	1-5	9 (13.8%)	5 (7.7%)	14 (21.5%)
	6-10	13 (4.6%)	12 (18.5%)	25 (38.5%)
	11-15	3 (4.6%)	12 (18.5%)	15 (23.1%)
	16-20	4 (6.2%)	1 (1.5%)	5 (7.7%)
	Above 21	6 (9.2%)	0 (0.0%)	6 (9.2%)
Perceived Density	Highly populated	16 (25.0%)	14 (21.9%)	30 (46.9%)
	Moderately populated	14 (21.9%)	14 (21.9%)	28 (43.8%)
	Lowly populated	3 (4.7%)	3 (4.7%)	6 (9.4%)

The mean ranks of the different sources of noise from the two areas considered is shown in Figure 1. Across the two locations, differences were observed with respect to noise sources, however, with varying magnitude. The radar chart revealed that residential noise was dominated by generator noise (37.1) in GRA. The large magnitude of generator noise compared to others was supported by Olamijulo et al. (2016) who identified this source as a risk factor. It could be deduced that most residential areas are affected by poor electricity supply in this location which necessitated alternative source of power. Also the higher demand for power through the use of generating sets could be influenced by residents' socioeconomic status. On the other hand, noise from market activities (41.15) was most severe in OGBE areas. This suggests presence of market and economic activities in the neighbourhood which might be as a result of indiscriminate siting of market by road sides along the neighbourhood. Further, a large proportion of residents in OGBE were also affected by noise emanating from other sources such as pets, vehicles and other household activities. However, the extent of noise from ceremonial and religious events through widespread use of sound instruments were almost similar across the two locations which can cause several health hazards as reported by Abel (2015). The findings suggest that differential in noise sources is associated with neighbourhood features which is accentuated by increasing urban population. In both neighbourhoods, although there was observed differences in the sources of noise, however, they were more intense in OGBE compared with GRA, as evident in their higher mean ranks.

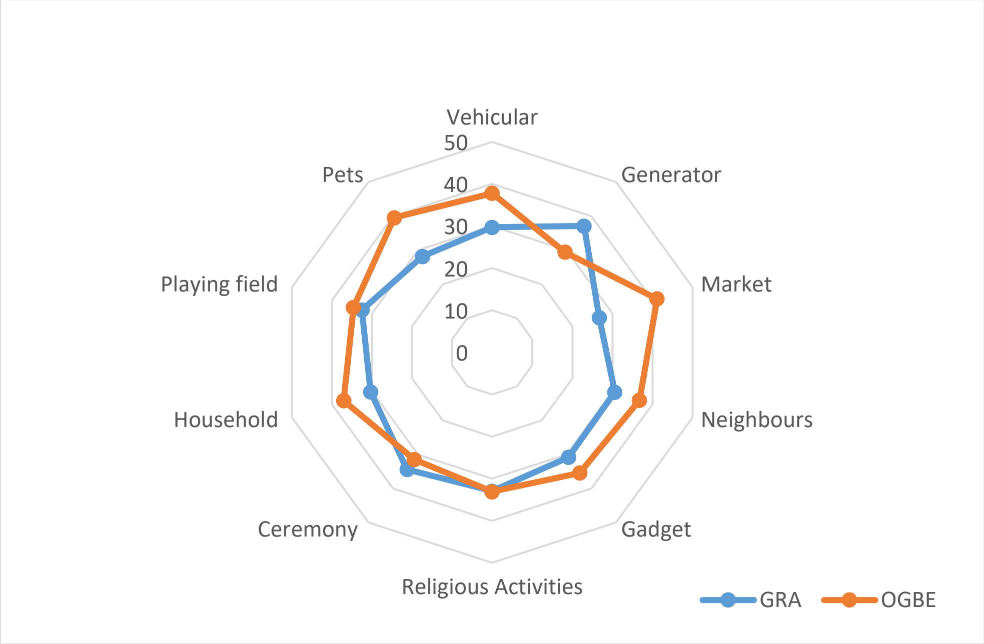

Figure 1: A radar chart showing the differences in sources of noise across neighbourhoods

To further determine whether there is any significant variation in the sources of noise in the two locations, a Mann-Whitney test was conducted. Table 2 showed the test result for the independent locations mean rank and their associated *Z*-value and significant levels. The result revealed significant differences in sources of noise across the two locations consideredat different levels. Based on the statistically significant sources represented in bold (table 2) noise from generators, pets, vehicular and market activities were the major sources of noise pollution in the two locations. These suggests that growing economic activities, means of transportation, household security and power source often determine to a greater extent level of noise in urban areas. This finding might be related to the rising effect of various developmental activities as residents demands morecomforts and changing socioeconomic status. In line with Olamijulo et al., (2016), an alternative source to power generation will check the threat posed by noise from generators in a conducive environment. Rising vehicular traffic, significant at 10% could be linked to increased movement of goods and passenger. This according to Preethi, et al. (2016) had become uncontrollable with no possible alternative public transport modern systems. High level significance (1%) of market noise further corroborates the finding of Ogunseye et al. (2018). It is likely that areas prone to market activities with higher noise level would be at risk of psychological distress such as stress and sleep disturbance, while associated health effects could result in increase in blood pressure and stroke. Review of the existing and enforcing noise control and compliance with siting buildings in metropolis is most essential. The observed difference in the noise sources in both locations considered is consistent with the studies that maintained variation in sources of noise (Singh and Davar, 2004, Darbyshire et al., 2019).

Table 2: Mann-Whitney test by sources of noise across locations

Sources of noise	Location	Mean Rank	Sum of Ranks	U test value	Z value	Significance level
Vehicular	GRA	29.69	1039.00	409.00	-1.783	**0.075**
	OGBE	37.81	1172.00			
Neighbours	GRA	30.61	1071.50	441.50	-1.359	0.174
	OGBE	36.76	1139.50			
Pet	GRA	28.16	985.50	355.50	-2.478	**0.013**
	OGBE	39.53	1225.50			
Religious Activities	GRA	32.93	1119.50	524.50	-0.036	0.972
	OGBE	33.08	1025.50			
Household activities	GRA	30.36	1062.50	432.50	-1.461	0.144
	OGBE	37.05	1148.50			
Gadgets	GRA	30.82	1048.00	453.00	-1.006	0.314
	OGBE	35.39	1097.00			
Market	GRA	26.73	935.50	305.50	-3.143	**0.002**
	OGBE	41.15	1275.50			
Generator	GRA	37.10	1298.50	416.50	-1.716	**0.086**
	OGBE	29.44	912.50			
Ceremonial	GRA	34.38	1169.00	480.00	-0.634	0.526
	OGBE	31.48	976.00			
Playing field	GRA	32.50	1137.50	507.50	-0.465	0.642
	OGBE	34.63	1073.50			

CONCLUSION

The differences in noise sources between two neighbourhoods in Benin city was assessed using cross sectional data. Across the locations, variation in the sources of noise was established, as findings revealed that generator was the dominant source of noise in GRA residents, while market noise was most prominent in OGBE areas. Mann Whitney U test results revealed that there was a statistically significant difference in noise sources such as generator, pet, market, vehicular between the two locations. This study provided information on different sources of noise and offers ways of controlling noise pollution in residential environment as developmental activities continue to increase. Residential development need to be properly controlled to avoid rising informal settlements. Policy relevance of this study brought to fore strategies for developers, planners and designers to adopt best practices in noise mitigation and control within residential environment. Also technical actions on the city planning, land-use mix policy can help mitigate against incessant noise pollution. Information and education campaigns should be well disseminated which corresponds to environmental action plans.

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