Implication of Noise Pollution on Residents' Wellbeing in Benin City, Nigeria

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Abstract: This paper investigates the effect of noise exposure on resident's wellbeing in Benin city. Using a cross-sectional survey of urban residents, an ordinal regression analysis was estimated to determine factors that influenced neighbourhood wellbeing. From the results, communication and interference with sleep were found to be the major effect of urban neighbourhood noise pollution.Also, the regression estimates revealed the independent effect of sleep disturbance, stress, communication hindrances and annoyance as outcome of perceived effect of noise.Finding suggests a greater percentage of residents perceived the effect of neighbourhood noise as detrimental to health and might stimulate aggression and other anti-social behaviour.
Keywords: Noise exposure level, noise health effects, urban neighbourhood, Nigeria.

I. INTRODUCTION

The world is rapidly urbanizing with improved developmental activities. Given the rapid growth in economic activities, urban populations due to rural-urban migrations and changing socioeconomic status, most urban areas are center of economic activities and wealth creation. As a result of this, more people in search of better livelihood tends to results in overcrowding urban and semi-urban areas and cities.The changes in socio-behavioral characteristics of urban dwellers and the growing pace of residential expansion has further aggravated urban congestion with possible rise of urban slump due to poor planning. This tends to heightened the extent of environmental pollution especially noise and air pollution.

Noise pollution is generally defined as the unwanted and disturbing sound which is higher than the normal level of sound comfortable to the human ear and has a negative effect on people and society (World Health Organization (WHO), 2001; Preethi et al., 2016). Virtually all human activities generate noise, but at a varying threshold. However, those produced beyond the accepted level poses discomfort to wellbeing.Based on International Labour Organization (ILO),the acceptable limit of noise exposure with respect to human wellbeing in an environment should be within the range of 80-90 dBA, while 90 dBA andabove is set as the hazard limit with potential risk. As urban areas evolve, noise at workplaces, vehicular traffic from public and private transportationoften become unmanageable (Preethi et al., 2016; Ogunseye et al., 2018).Specifically, residential noise can definitely be an irritant and studies have shown urban noise pollution to be associated with lower overall life satisfaction (Weinhold, 2015; Preethi et al., 2016). This form of noise pollution is quite different from other environmental pollutants because it is invisible. However, its effects on human health take place gradually which could be auditory, physiological, psychological and performance (Debasish and Debasish, 2012). Studies have shown that the impact of noise is progressively becoming pervasive, yet it is often overlooked compared with air pollution in developed and developing countries (Akande and Ologe, 2001; Aluko and Nna, 2015).

In Nigeria, different agencies both at Federal and State level have been established to improve the quality of the environment from pollutant and other environmental hazards (Abolade and Adeboyejo, 2013). For instance, Federal Environmental Protection Agencies (FEPA) was saddled with the responsibility to protect, restore, and preserve the ecosystem. In this respect, the agency has appropriated guidelines and standard for industrial effluents, gaseous emissions hazardous wastes as well as permissible noise levels. Despite thegovernmental strategies especially on noise control, there have been low response from such policies. This could be attributed to noncompliance to erection of structures and buildings such as industrial, residential outside government stipulated areasspecially in urban centres. All these underline the fact that the problem of noise, especially in urban areas demand some necessary action (Abel, 2015).

Literature have documented the impact of noise pollution in city centers such as airports, train stations, and factories, with corrective measures (Williams and McCrae, 1995; Tang and Tong, 2004; Thorsson, et al., 2004;). Most of this studies focused on noise exposure and its associated impact on work performance

(Rabinowitz et al., 2010; Sirajus et al., 2014); work/market spaces (Bisong, et al., 2004; Ighoroje et al., 2004; Yesufu et al., 2013), strategic locations within urban centres (Ogunseye et al., 2018). Also some studies have looked into effect of noise pollution based on both subjective and objective outcome indicators. Thiswas the stance of Kroesen et al., (2010) who examined the effect of aircraft noise exposure in residential areas within a 25-km radius in Netherlands using structural equation model based onobjective (e.g. high blood pressure, anxiety, depression) and subjective (e.g. annoyance, qualify of life) outcome. Results for subjective outcome revealed that noise annoyance variables inhibit residential satisfaction. while the objective measures of aircraft noise exposure were found to be a major predictor of residential satisfaction.

In addition, Weinhold (2015) analyzed the health effects of residential noise using a longitudinal survey of over 5000 adults in the Netherlands between 2007 and 2013. Result showed thatimpact of neighbourhood noise on perceived health outcomes included; cardio-vascular symptoms, joint and bone disease, and headache which contributed to variety of health disorders.A study by Olamijulo et al. (2016) revealed that health disorders such as ear pains, headache, tiredness and tinnitus are more pronounced among occupants with noise from portable generators within an institutional environment in Nigeria.Awosusi and Akindutire (2014) on the other hand, assessed perceived health awareness associated with noise pollution in, Nigeria. Level of health effects of noise pollution was well understood by occupants, while a significant relationship was established between location and the perceived health effects of noise pollution. Most of these studies focused more on places where noise pollution is paramount with few literatures on place of residence. This study, however, contributes to literature on effect of neighbourhood noiseon residents' wellbeing.

There is need for more empirical understanding of impact of noise in residential areas owing to rising urban expansion. As noise remains an environmental stressor and nuisance, its effect on human existence as disruption of conducive environment may lead to dysfunction in his health status (Olamijulo, et al., 2016). While the resultant adverse effects of noise pollution are numerous,which cuts across health and socialfactors, there is need for appropriate control measures. The objective of thispaper is to assess the implication of noiseexposure levels at urban neighbourhoods in Benin City. Empirical understanding on possibleimplication of noise pollution would therefore, provide basis to manage urban space and integrate health-environment nexus in an urbanizing era towards a peaceful and livable environment suitable for human wellbeing.

II. MATERIAL AND METHODS

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. As a pre-colonial city, itis 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. The population of Benin, capital of Edo Statewas 1,495,800 by 2015, which is about 0.821% of Nigeria's population. The population reach 1,617,579 in 2017 at 3.99% annual growth rate (City Population, 2017). Figure 1 shows the major city centers in the study area.A cross-sectional survey was used which involved questionnaire administration. Information were sourced from respondents above 18 years of age with adequate experience within the areaon noise levels and sources in the neighbourhoods. Two urban neighbourhoods were purposively selected, these areas areGovernment Residential Area, Benin City (GRA), a central area of Benin City district and OGBE Residential Quarters, Benin City, a representative case of an informal development of new neighbourhoods in the Benin. The choice of these locations was premised on differences in neighbourhood characteristics and activities which is expected to have varying noise exposure because of the population difference in the selected residential areas. Information sourced included personal data of the respondents; residential features and perceived effect of noise pollution on respondents' wellbeing and quality of life.
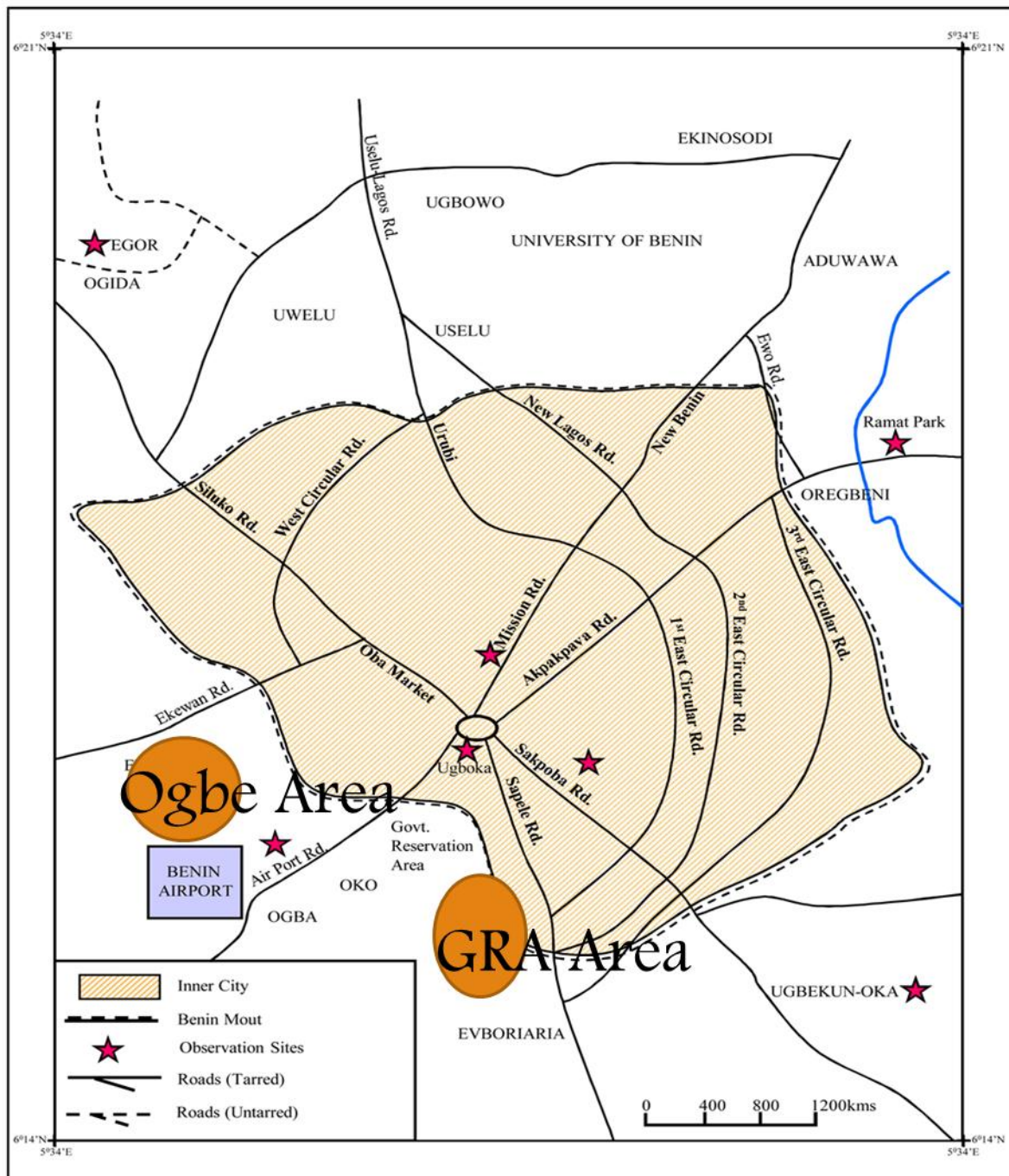
Figure 1: Map of Benin City, showing the major Neighbourhoods (source: Oviasogie, 2018)

Empirical model
Ordinal regression model

The choice of model for determining factors influencing residential noise exposureis conditioned on the method used for the perceived effect of noise. In this regard, the dependent variable was categoricalwith a meaningful sequential orderfrom "very serious" to "not at all serious",therefore the ordered logit regression model was used.The model is based on the cumulative probabilities of the response variable as the logit of each cumulative probability is assumed to be a linear function of the covariates with regression coefficients constant across response categories (Grilli and Rampichini, 2014). The coefficients show that for a unit increase in the predictor (independent variable), the response variable(dependent variable) is expected to change by its respective regression coefficient value,while the othervariables in the model are held constant. It is expressed as:

$$Y_i^* = \sum_{k=1}^{K} \beta_k X_{ki} + \varepsilon_i \qquad (3)$$

where $Y_i^*$is an ordinal response variable with Kcategories for the *i*-threspondent for k=0,1,2, that is the perceived noise categories alongside the vector of covariates X*i* and ε_i, is the error term.

III.   RESULTS AND DISCUSSION
Socioeconomic Characteristics of the Respondents

The characteristics of the respondents as indicated in Table 1 showed that on the average, 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%). Also half of the respondents 50.0% were single, about48.5% were married, while 1.5% of them indicated other categories of divorced, widowed etc. Furthermore,with respect to the occupational status of the respondents, a larger percentage (47.7%) were in the private sector while about 26.2% run their own businesses. The result on the average income of the respondents shows that about 26.6% earned less than 18,000 minimum monthly wage, however, greater proportion of respondents (37.5%) were in the income category 18,000-50,000 naira monthly. This differential suggests disparities in income level in the study area. The duration of tenure revealed that most respondents had stayed in the neighbourhood for less than 5 years whereas only about 7.6% had stayed above 20 years. This finding suggests thatdifferences in social andeconomic characteristics of the respondents would provide information needed on the noise pollution level in their neighbourhoods and the perceived effects.

Table 1: Percentage distribution of respondents by socioeconomic characteristics

Variables	Categories	GRA	OGBE	Total
Gender	Male	33.3	25.8	59.1
	Female	19.7	21.2	40.9
Age	21-30	27.7	21.5	49.2
	31-40	10.8	10.8	21.5
	41-50	9.2	9.2	18.5
	51-60	3.1	6.2	9.2
	Above 60	1.5	0.0	1.5
Martial	Single	30.3	19.7	50.0
	Married	21.2	27.3	48.5
	Others	1.5	0.0	1.5
Education	No education	0.0	7.6	7.6
	Primary school	1.5	0.0	1.5
	Secondary school	19.7	12.1	31.8
	Tertiary school	31.8	27.3	59.1
Occupation	Trader	1.5	12.3	13.8
	Civil servants	7.7	3.1	10.8
	Private sector	30.8	16.9	47.7
	Own Business	10.8	15.4	26.2
	Others	1.5	0.0	1.5
Income	< 18,000	23.4	3.1	26.6
	18- 50,000	14.1	23.4	37.5
	51- 100,000	4.7	21.9	26.6
	101-200,000	7.8	0.0	7.8
	Above 200,000	1.5	0.0	1.5
Duration of Stay	1-5 years	25.8	1.5	27.3
	6-10 years	12.1	13.6	25.8
	11-15 years	4.5	21.2	25.8
	16-20 years	6.1	7.6	13.6
	Above 20	4.5	3.0	7.6

The health and social impact of noise on residential quality is presented in Table 2. Result revealed that communication and interference with sleep were the major effect of urban neighbourhood noisepollution with mean scores of 3.94 and 3.66, respectively. This finding was consistent withOlamijulo et al., (2016) and Ogunseye et al., (2018). Further, noise causes distraction and stress as evident in their mean scores and the least ranked was annoyance (2.66)

Table 2: Descriptive Statistics of Impacts of Noise Pollution on Residents' Wellbeing

	Mean	Std. Deviation
Affect communication	3.94	1.333
Disturb sleep	3.66	1.417
Distraction	3.54	1.562
Cause stress	3.28	1.485
Annoyance	2.66	1.661

Results from Figure 2showed the perceived severity of noise pollution on by residents. On the average, category of response "Serious" had the highest percentage (47.7%) of perception towards noise pollution, with the least effect in "Not at all serious" (3.1%). Finding suggests a greater percentage of residentsperceived the effect of neighbourhood noise as detrimental. Other perceived category revealed that about 27.7% stated that the effect was "Very Serious", 13.8% were "Not serious", 7.7% perceived it as "Moderately serious". This result indicates severity of noise pollution in the study area washigh. The implication of this result is that most residents in the study locations were frequently exposed to high neighbourhood noise levels which often impact on their quality of life.
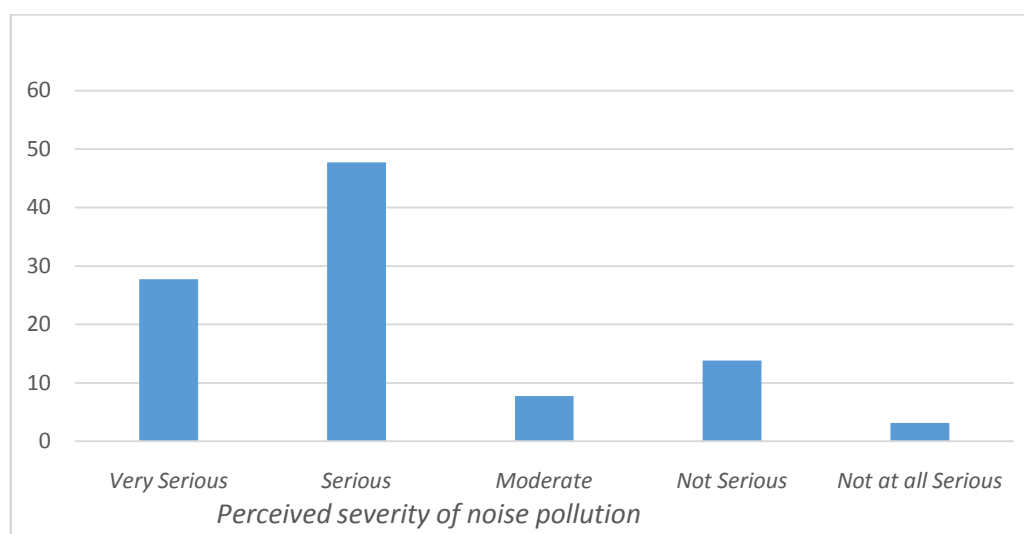
Figure 2: Percentage distribution of perceived severity of noise pollution

An ordered logit regression was fitted to estimate the relationship between perceived effect of noise and resident wellbeing. The result of the ordered logit regression presented in Table 3 with a log likelihood of -84.9 (χ= 78.32; p<0.01) implies that all the coefficients in the model are different from zero. Four out of five variables contributed significantly to the prediction of effects of noise on wellbeing. The results presented show that the probability of having very serious noise effect increased significantly stress problems (p<0.01). It also positively interferes with sleep (p>0.05), which corroborates the findings of Omokhodionet al., (2008), Oloruntoba et al. (2012), Bulunuz, (2014) and Abel, (2015). In addition, result revealed likelihood of misunderstanding in communication (p<0.05) and increased annoyance (p<0.1) as effect of noise pollution becomes very serious in the neighbourhood. Although, perceived effect of noise exposure influenced almost all covariates, a greater effect was revealed by the elastic nature of stress (1.95) induced from noise pollution. This psychological effect might aggravate to other physiological problems such as high blood pressure, stroke as reported by Sorensen et al., (2011) and Akinkuade and Fasae (2015). This finding suggests that higher exposure to noise pollutionexposes residents to discomfort in wellbeing and low productivity in work places. Therefore, it

is quite reasonable that exposure to noise pollution might lead to human disorder and impaired wellbeing with increased neighbourhood activities.

Table 3:Ordinal regression estimates

Variables	Coefficients	Standard error	Z statistics	P>|z|
Disturb sleep	0.9262	0.3619	2.54	0.019
Cause distraction	0.3548	0.3899	0.75	0.516
Cause Stress	1.9563	0.3672	54.62	0.000
Affects communication	0.6798	0.2678	2.71	0.031
Cause Anger	0.6512	0.3838	1.93	0.073
Log likelihood		-84.90055		
LR chi2(6)		78.32***		
Pseudo R2		0.7848		

Statistical significance: * p<0.10; ** p<0.05; *** p<0.01

IV.   CONCLUSION

This study examines how perceived effect of noise pollution affects wellbeing on urban neighbourhood in Benin city, Nigeria. Results showed that a greater percentage of residents perceived the effect of neighbourhood noise is detrimental to wellbeing. Also, the regression estimates revealed the independent effect of sleep disturbance, stress, communication hindrances and annoyance as outcome ofperceived effect of noise.This study also suggests that the major social and health problems experienced by respondents might stimulate aggression and other anti-social behaviour.The findings provided strategies that will improve integration of health-environment nexus in urban space for a suitable for human wellbeing.Controlling the effect of high exposure of residents to neighbourhood noise involves a collaborative effort and proper urban planning as cities are rapidly urbanising to avert its drastic changes on human health.

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