



Impact Analysis of Noise Pollution on Human-Health: A Case Study of Southern Region of Nigeria

Ohaeri E. C. ^{a*} and Obafemi A. A. ^b

^a *Institute of Natural Resources, Environment and Sustainable Development, University of Port Harcourt, Rivers State, Nigeria.*

^b *Department of Geography, University of Port Harcourt, Rivers State, Nigeria.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JENRR/2024/v16i2332

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/106018>

Original Research Article

Received: 09/10/2023

Accepted: 15/12/2023

Published: 03/02/2024

ABSTRACT

Noise pollution, though not a new problem, has increased in recent times in reflection of human activities. Noise is an unpleasant sound capable of causing psychological and physiological problems for human health and society. This study aimed to assess the impact of noise pollution on the health of residents in the capital cities of Calabar, Port Harcourt, Uyo and Yenagoa. Data was obtained through a structured questionnaire designed to get firsthand information from respondents on variables such as socioeconomic characteristics, noise effect, neighbourhood noise awareness and sources. Across all the cities, multiple choices of noise were picked by the respondents, mostly vehicular traffic and generating plants. Mental stress (16.6%) was reported as the common effect of noise pollution, followed by distraction and lack of concentration to work (13.4%), while the least effect was a risk of accident (2.1%), followed by speech interference (1.8%). Thus, it is recommended that cities with high noise generation activities should adopt noise pollution regulation policies and also have potential mitigation measures in place, which should include noise-absorbing structures.

*Corresponding author: E-mail: ebelecn@gmail.com;

Keywords: Noise pollution; health; impact; mental stress; distraction.

1. INTRODUCTION

Noise is defined as sound that becomes "unwanted" or "uncomfortable" [1]. Noise pollution is a new type of pollution that has emerged as a result of modern life. With their constant loudness, crowded cities and towns, mechanized modes of transportation, and new technology for amusement and entertainment pollute the atmosphere. Noise is, without a doubt, a natural occurrence that has evolved into one of the most powerful alarm systems in man's physical environment.

Environmental noise pollution still poses a serious threat to millions of people's health and quality of life on a global scale [2]. It has been noted that while it is difficult to find calm areas in developed nations, noise has been declared to be a necessary part of life in developing nations without much thought given to the potential negative effects. This is due to a lack of knowledge and negligence regarding unplanned urban and semi-urban areas, which led to the indiscriminate citation of businesses, stores, busy city centres, roads, and commercial areas, as well as motor packs, without proper consideration for the impact of environmental noise. This problem has produced the ongoing loudness threshold-raising and release in worldwide urban and suburban areas [3,4]. The World Health Organization (WHO) has set a standard for the permitted level of noise at 90 decibels (dB), which is the highest level of noise to which humans can be exposed, in an attempt to limit noise pollution.

Noise is an example of environmental pollution that hurts people's quality of life, particularly in urban places around the world. World Health Organization [5] described noise as an underappreciated hazard that can result in a variety of short- and long-term health issues, including sleep disruption, cardiovascular impacts, decreased work and school performance, hearing damage, and so on. In the current era of industrialization and technical growth, it has increased. According to the World Health Organization [4], noise pollution in large cities is the third most hazardous type of pollution, preceded only by air and water pollution and traffic noise affects at least 100 million individuals in the European Union each year, resulting in the loss of at least 1.6 million years of healthy life.

According to a large body of research [6-8], nonauditory stress effects include physiological changes (such as elevated blood pressure), various cognitive deficits (such as poor sustained attention, and memory/concentration problems), sleep disturbances, changes in social behaviour, psychosocial stress-related symptoms, and emotional/motivational effects, (such as annoyance, learned helplessness).

Due to insufficient noise pollution regulations/legislation in many cities in Nigeria and the negative impact of noise on environmental life and the ecosystem, it is necessary to assess the current level of noise in the State capitals of South-South, Nigeria to propose some concrete remedies that can help to lower noise levels and their associated health repercussions.

2. MATERIALS AND METHODS

2.1 Study Area

The study area is located in Nigeria's southern region, between latitudes 4° 21' 43.2" N and 7° 40' 52.8" N, and longitudes 5° 8' 42" E and 9° 30' 7.2" E, and covers an area of about 84,640km². It includes the following states: Bayelsa, Rivers, Cross River and Akwa Ibom states (Fig. 1). The Niger Delta is crisscrossed by creeks, estuaries, and rivers, and it gets its name from its location near the mouth of the Niger River, which eventually finishes at the Atlantic Ocean's edge. The topography of the south-south region consists of a gently sloping lowland with an average slope of less than 10 degrees in most areas, and the highest part of the lowland, which is well-drained, forms a mosaic with an altitude of 15 to 25 meters; and a flat monotonous low relief interspersed by several wetlands.

Rainfall is the most important climate variable in the study area, and it varies spatially. Thus, as in the rest of the country, there are two seasons: rainy and dry. The area's vegetation at the time of its founding was dominated by high rainforest, mangrove forest, and brackish swamp forest. The area is heavily inhabited by about 30 million people, most of whom live in metropolitan areas. It is home to over forty ethnic groups, including the Ijaw, Ikwerre, Calabari, and Annang who speak over 150 languages. The area of study in which the research was carried out was Calabar, Port Harcourt, Uyo, and Yenagoa, South-South, Nigeria. Yenagoa City is located between 4° 51'

N and 5° 22' N, and 6° 12' E and 6° 33' E longitudes. The relative humidity is high all year and only marginally lowers in the dry season.

2.2 Population for the Study

The 2006 population figures showed that the selected capital cities had a population of 1,690,797 [9]. The projected National Population Census 2021 population for the selected south-south capital cities was projected to be 5,499,951 people (Table 1). The study's sample size was calculated using population projections from the NPC 2006 population.

2.3 Sample and Sampling Techniques

The sampling technique for the determination of noise level and administration of a structured questionnaire for this study in the selected South-south capital cities included multi-stage, cluster and simple random sampling procedures.

For this study, four capital cities in south-south, Nigeria were randomly picked; Calabar, Port Harcourt, Uyo and Yenagoa Metropolis.

Respondents at high-noise locations make up the experimental group, while those at low-noise locations make up the control group. Personal information about the respondents, information about their homes, and perceptions of the impact of noise pollution on their well-being and quality of life were all included in the information gathered.

2.4 Data Collection

Data was collected between February 2022 and January 2023, a period of 12 months. A structured questionnaire designed to get firsthand information from respondents on variables such as socioeconomic characteristics, neighbourhood noise awareness and sources, the influence of neighbourhood noise on other activities, noise effect, and coping mechanisms.

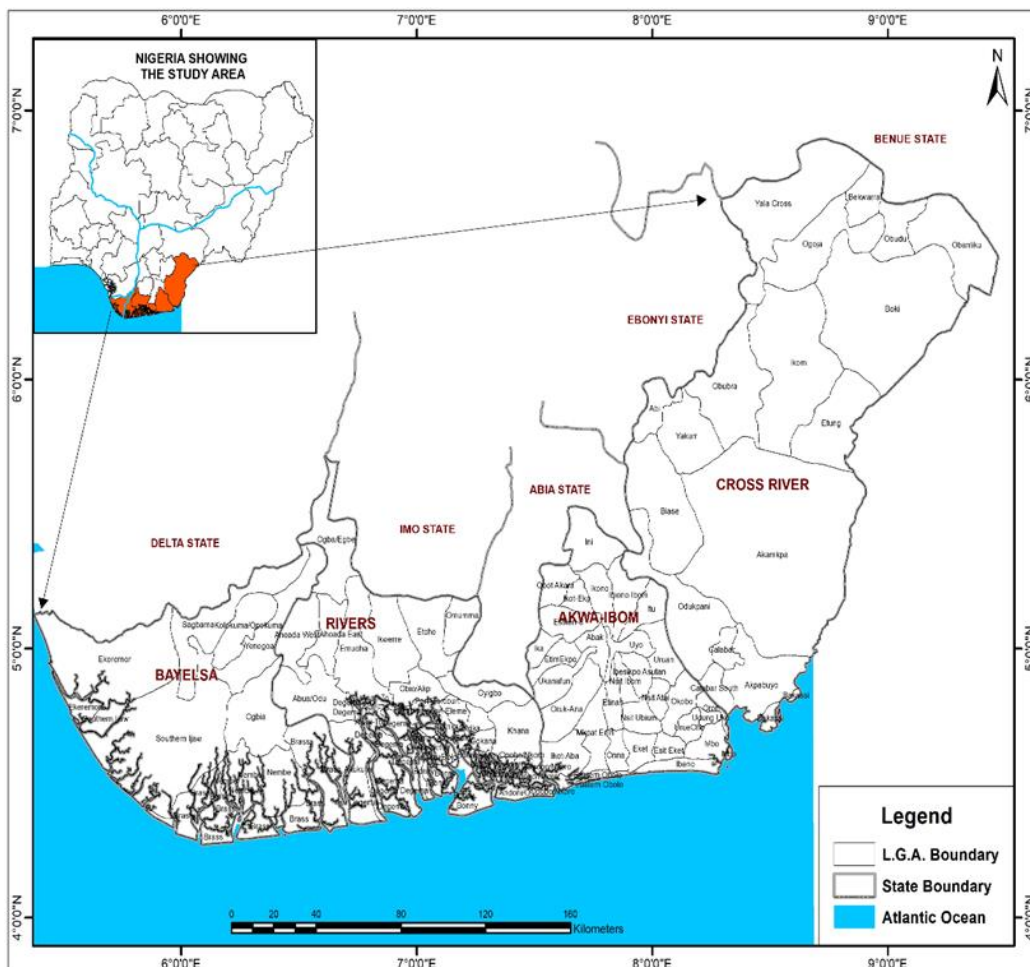


Fig. 1. Location map of the study area

Table 1. Population figures for selected south-south capital cities used for sample size determination

States	Capital Cities	Population Census for Capital Cities	*Projected Population	Proportional Sample sizes
Akwa Ibom	Uyo	427,873	1,199,929	87
Bayelsa	Yenagoa	353,344	524,400	39
Cross River	Calabar	371,022	604,546	44
Rivers	Port Harcourt	538,558	3,171,076	230
Total		1,690,797	5,499,951	**400

Source: NPC, 2006; *Projected population estimate for capital cities for year 2021; **Determined Sample size

The questionnaire used a modified Likert scale with a 5-point scale. The Likert scale's scoring represents how strongly one agrees or disagrees: There are five possible responses: strongly agree (5 points), agree (4 points), undecided (3 points), disagree (2 points), and strongly disagree (1 point). Using multi-stage, cluster and simple random sampling survey techniques, a structured questionnaire was administered to 400 respondents between the ages of 18 and above 60 years in the neighbourhood of the four South-South capital cities. Of the 400 recipients of the questionnaire, 381 were successfully retrieved, a total of 95% successful retrieval of the questionnaire.

2.5 Data Analysis

Following the survey, the questionnaire responses were analysed using descriptive statistics. The returned questionnaire samples were coded, stored in Google Worksheet 2023, and imported into the SPSS 24.0 edition for data analysis. The Chi-square statistic was used to test research hypotheses.

3. RESULTS

Table 2 shows the demographic background of respondents. Male respondents were significantly higher than female respondents in Yenagoa, Port Harcourt and Calabar at a percentage of 54.3%, 55.1% and 52.5% respectively while Uyo recorded higher female respondents with 53.8%. The majority of the respondents were between the ages of 25-40 years while the least were those above 60 years across all the cities. In Port Harcourt and Uyo, more than half of the respondents were married while in Yenagoa and Calabar more than half were singles. On the other hand, 31.4% of respondents were traders/hawkers in Yenagoa, Port Harcourt (33.8%), and Uyo (66.3%) while in Calabar 57.5% of the respondents were students. Similarly, not less than 85% of respondents across all the cities were Christians

with only a few fractions of Muslim and idol worshippers. Educationally, more than 80% of the respondents across all the cities were functional literate. In terms of income, 37.1% of respondents in Yenagoa earn between N41,000 and N50,000 monthly while in Uyo 57.5% of respondents earned between N31,000 and N40,000 monthly. Only Port Harcourt respondents recorded high-income earners (24.9%) above N50,000.

3.1 Sources of Noise

Fig. 2 shows the sources of noise in the study area. Vehicular traffic accounted for 33%, 42%, 39% and 40% of cause of noise pollution in Yenagoa, Port Harcourt, Uyo and Calabar respectively, while Yenagoa recorded 12%, Port Harcourt 15%, Uyo 13% and Calabar 17% noise from generating sets. The least source of in the area is noise from aircraft which was 1%, 5%, 1%, and 5% for Yenagoa, Port Harcourt, Uyo and Calabar respectively. Followed by neighbourhood noise recorded as 3% in Yenagoa, 2% in Port Harcourt, 5% in Uyo and 3% in Calabar.

3.2 Noise Awareness

Table 3 shows the noise awareness level in the study area, with the frequency of 88.6%, 88.4%, 77.5% and 92.5% for Yenagoa, Port Harcourt, Uyo and Calabar respectively.

3.3 Perception Level of Noise Pollution on Health

Table 3 Perception level of noise pollution on health. Mental stress (16.6%) was reported as the common effect of noise pollution, followed by distraction and lack of concentration to work (13.4%), while the least effect was a risk of accident (2.1%), followed by speech interference (1.8%). More than one of the perceived health effects of noise exposure was reported as 38%.

Table 2. Demographic background of respondents

Variable		Yenagoa		Port Harcourt		Uyo		Calabar	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%
Gender	Male	19	54.3	124	55.1	37	46.3	21	52.5
	Female	16	45.7	101	44.9	43	53.8	19	47.5
Age	18-24	14	40.0	48	21.3	22	27.5	21	52.5
	25-40	12	34.3	113	50.2	37	46.3	12	30.0
	41-60	8	22.9	55	24.4	14	17.5	5	12.5
	Above 60	1	2.9	9	4.1	7	8.3	2	5.0
Marital status	Single	22	62.9	81	36.0	26	32.5	31	77.5
	Married	6	17.1	119	52.9	52	65.0	5	12.5
	Divorced	6	17.1	9	4.0	1	1.3	1	2.5
	Widowed	1	2.9	6	2.7	1	1.3	2	5.0
	Others	0	0	10	4.5	0	0	1	2.5
Employment Status	Students	6	17.1	30	13.3	9	11.3	23	57.5
	Unemployed	5	14.3	7	3.1	3	3.8	4	10.0
	Trader/hawker	11	31.4	76	33.8	53	66.3	4	10.0
	Employee/company worker	3	8.6	26	11.6	2	2.5	2	5.0
	Civil Servant	4	11.4	33	14.7	3	3.8	3	7.5
	Artisan/business	6	17.1	53	23.6	10	12.5	4	10.0
Religion	Christianity	30	85.7	208	92.4	78	97.5	37	92.5
	Muslim	2	5.8	11	4.9	2	2.5	3	7.5
	Idol worshippers	3	8.6	6	2.6	0	0	0	0
	Others	1	2.9	0	0	0	0	0	0
Education	No Formal	2	5.7	6	2.7	9	11.3	0	0
	Primary	3	8.6	45	2.2	4	5.0	11	27.5
	Secondary	17	58.5	121	53.8	52	65.0	4	10.0
	Tertiary	13	37.1	92	40.9	15	18.8	25	62.5
Monthly Income	N20,000 – N30,000	10	28.6	77	34.2	17	21.3	21	52.5
	N31,000 – N40,000	6	17.1	61	27.1	46	57.5	7	17.5
	N41,000 – N50,000	13	37.1	31	13.8	4	5.0	6	15.0
	N51,000 and above	6	7.1	56	24.9	13	16.3	6	15.0

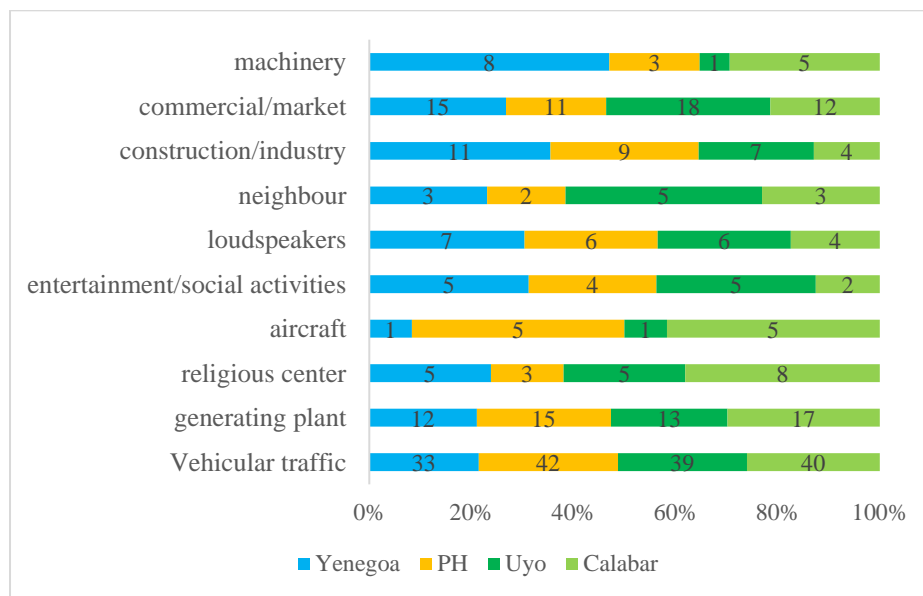


Fig. 2. Source of noise in the study area

Table 3. Awareness of noise pollution

Awareness of Noise	Yenagoa		Port Harcourt		Uyo		Calabar	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	31	88.6	199	88.4	62	77.5	37	92.5
No	4	11.4	26	11.6	18	22.5	3	7.5

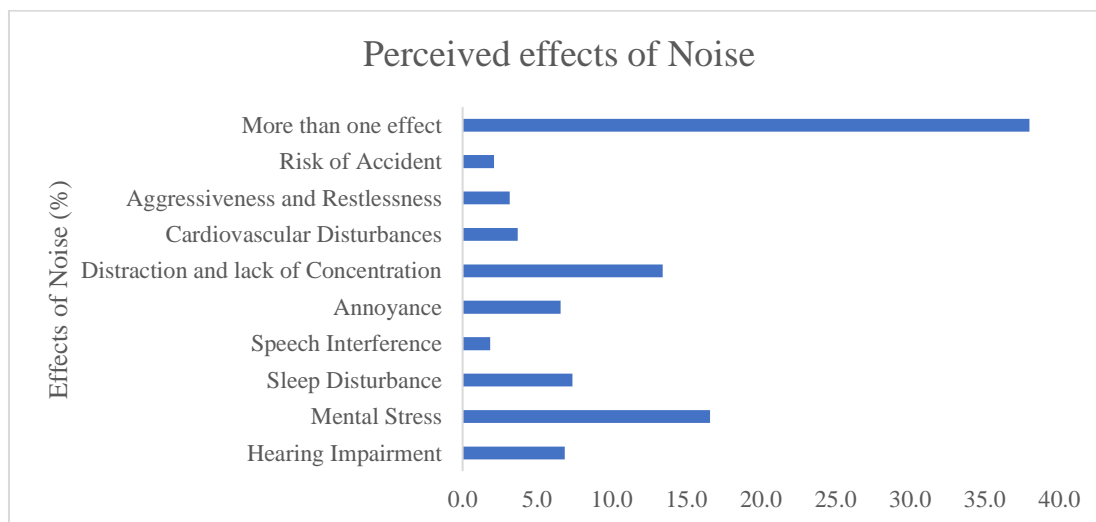


Fig. 3. Perceived effects of noise on the studied population

4. DISCUSSION

From the responses of the respondents on the impact assessment of noise pollution and neighbourhood characteristics of locations in the cities of Yenagoa, Port Harcourt, Uyo and Calabar, the demographic profiles show that male respondents were willing to receive and provide responses, about 52.9% male and 47.1% female elicited responses to the administered questionnaire. The availability of male respondents and local culture and individual ideologies were some of the factors that might have led to the inequalities, although it appears that males participate in noise-related activities at a higher rate than females. This is consistent with Shehu et al.'s [10] conclusion that male respondents made up the majority (61.1%) of the sample. Respondents aged between 18 and 60 years (economic active age was the majority). This is in support of Ogbodo et al [11] that about 80% of the respondents under study fall within the active age groups of 14-57 years. Most of the respondents (57.1%) were self-employed. This demographic tended to be more predisposed to the environmental effects of noise levels above the human-specified receiving threshold as advised by the WHO for various categories of anthropogenic activities [3,4], because they frequently found themselves working in areas

with high levels of human activity and where noise pollution is not regulated. This is supported by the study of Tunde and Abdulquadri [12]. Not less than 85% of respondents across all the cities were Christians with only a few fractions of Muslim and idol worshippers. Residents of the South-South states are mostly Christians [13].

This study assessed the sources of noise pollution in the capital cities of Yenagoa, Port Harcourt, Uyo and Calabar. The study revealed that there were numerous sources of noise pollution in the study area, including roads (vehicles, bikes, tricycles), music studios, nightclubs, hotels, markets, power generating plants, religious institutions like mosques and churches, construction, industrial activities, private sporting events, aircraft, the incessant ringing of bells by peddlers, hawkers, road advertisements, and grinding machines. Vehicular noise, generating plants, commercial/markets, construction/industries, loudspeakers, religious centres, entertainment centres, machineries, neighbourhood noise and aircraft were ranked in descending order as the most noticeable sources of noise in the study area. Across all the cities, multiple choices of noise were picked by the respondents, mostly vehicular traffic and generating plants. This is because vehicular movement is high in today's

modern cities. Overall, 53.7% of the respondents thought that the main cause of environmental noise pollution is vehicular traffic. The second major source of noise across the cities was the generating plant due to the epileptic nature of the electricity supply. This is consistent with the research done by Farooqi et al [14], which found that traffic noise is a significant source of noise. The result also collaborated with the findings of Ugbebor et al [15] and Idoko et al [2] that vehicular traffic along with other commercial areas and locations where musical instruments are being used are the main sources of environmental noise pollution in Nigerian urban cities. In addition, Onwuka et al. [16] and Datti and Okonkwo [17] found that traffic and generating plants are also significant sources. However, the study concentrated on the investigation of noise pollution from generators on the people at Robinson Plaza, Effurun, Delta state, Nigeria.

Mental stress (16.6%) was reported as the common effect of noise pollution, followed by distraction and lack of concentration to work (13.4%), while the least effect was a risk of accident (2.1%), followed by speech interference (1.8%). However, more than one of the perceived health effects of noise exposure which includes hearing impairment, mental stress, sleep disturbance, speech interference, annoyance, distraction and lack of concentration, cardiovascular disturbances, aggressiveness and restlessness, and risk of accident, was reported as 38% effect of noise. Basner et al [18] and Münzel et al [19], hearing impairment and discomfort are among some of the adverse impacts of noise pollution. The impacts of noise on man and his environment have been examined by several researchers, including a wide spectrum of physiological effects, ranging from innocuous to unpleasant and physically harmful [20,21].

5. CONCLUSION

The main sources of noise pollution in the study area were vehicular traffic and generating plants. Hearing impairment, mental stress, sleep disturbance, speech interference, annoyance, distraction and lack of concentration, cardiovascular disturbances, aggressiveness and restlessness, and risk of accident, were among the identified effects of noise pollution. Noise pollution regulation and mitigation policies should be adopted and implemented.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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