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Health Risks Assessment of Noise Pollution: A Mixed-Methods Approach Using Rel-Pele & O-P

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ABSTRACT

The growing issue of noise pollution exceeding acceptable limits poses environmental risks globally. In Nigeria, particularly in semi-urban areas, there is a lack of documented data on noise levels. This study sought to fill this gap by documenting, mapping, and assessing the health risks associated with noise levels in Omu-Aran Township, Nigeria.

Twenty-one (21) locations were selected within the town; handheld GPS was used to pinpoint the locations. The noise levels were measured with a sound level meter of model SL4010, the mapping was done using ArcGIS 10.3, and the health risk assessment was evaluated using a mixed-methods approach of both REL-PELE and opinion polls.

The study found that certain areas, including Central Roundabout, Central Market, and Landmark University Chapel, exceeded permissible noise levels of 87.24 dB, 86.78 dB, and 83.16 dB respectively, identifying them as high-risk zones. The respondents claim was linked to health issues, including birth complications (18.4%), cardiovascular problems (17%), sleep disturbances (70.31%), headaches, and muscle tension (45%).

Noise pollution in residential areas is primarily caused by population growth, anthropogenic factors, and inadequate urban planning, necessitating prompt local authorities' public awareness and enforcement of existing laws.

Key Words: Noise Levels, Health, Risk, NoiseS Map, Decibel, Omu-Aran

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I. INTRODUCTION

The anomaly of pressure variation that the human ear can perceive over time is denoted as noise, which had been tagged harmful to public health and had devalued the quality of life enjoyed, especially in urban areas [1, 3, 5, 6, 12, 26]. Both developed and developing countries experience environmental threats from high noise level exposure due to activities that accompany every migrant and settler within urban areas and the illegal location and activities formation of both formal and informal industries [27]. According to the European Environment Agency (EEA), chronic noise exposure contributes to forty-eight thousand (48,000) new cases of ischemic heart disease and twelve thousand (12,000) premature deaths annually in Europe [37, 38, 39]. According to the World Health Organization (WHO), noise is the second biggest contributor to illness in Western Europe after air pollution [39, 40]. There is proof that people's health suffers when they are exposed to ambient noise [30,31]. Long-term exposure to environmental noise can have detrimental effects on the heart and metabolism, impair cognitive function, cause extreme discomfort, and disrupt sleep [38,39].

Unplanned urbanization, poor transportation network development, a growth in motor cars, pervasive technology, and mechanized advancement all contribute to noise pollution concerns in densely populated residential areas. Noise pollution in cities is mostly triggered by traffic, industry, construction, and other activities [8, 21]. Numerous studies have found that chronic noise exposure is known to impair human ear impairment and raise blood pressure, heart illness, nervousness, and sleeplessness [7, 24]. Thus, noise contact had led to an increase in drug usage and a constant visitation of people that are affected to hospitals [10,14].

According to World Health Organization estimates from 2018, an estimated 360 million individuals throughout the universe grieve from severe deafness as an outcome of noise pollution, with an estimated one billion young people aged 12 to 35 years old experiencing deafness as a result of noise exposure. According to [1, 3, 6, 11, 29], 8.5 million Nigerians suffer from earshot, while 466 million people are suffering from hearing loss globally. In a country of nearly 200 million people, 23.7 percent of Nigerians have hearing loss, according to [3, 18]. (total deafness, hearing loss, or any hearing-related impairment). An international organization like the World Health Organization (WHO), Environmental Protection Agency (EPA), National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), etc., had all agreed that constant noise exposure of 80 and 90 dB for 8 hours' time-weighted average is harmful to human health [10, 15, 16,24].

2.5 billion people are expected to have hearing loss due to noise pollution by 2050, 30 million American are exposed to noise above healthy levels, 100millions or 20% of Europeans are affected, USA, UK, Italy, India are the loudest country in the world and Dhaka in Bangladesh is the nosiest in the world [20, 29, 38]. Twelve thousand (12,000) Europeans die prematurely yearly due to noise; traffic is the most common source of noise pollution. 5% of the global population and 40% of Americans are living in dangerous, loud areas [5, 24, 25, 34]. Environmental Protection Agencies (EPA), in their pursuit to make the environment safe to live in, had encouraged that researchers study the level of noise exposure within their locality to document the noise pollution level in their territories and justify their result with the permissible noise level limit [40].

It becomes difficult to quantify the impact of noise on those that are perceptible to it, primarily because noise can only be measured at an exact moment as it does not leave any residue once the source is dispersed [33]. Furthermore, there is poor or unavailable information about the health impact of noise pollution, which made it a concern that there's little or no research had been done on noise pollution levels in Omu-Aran Township. Although the noise level of many cities in Nigeria has been documented, the health risk associated with noise pollution in many cities has not been done, of which Omu-Aran in Kwara State is one of them. Therefore, this study is ready to document, map, and evaluate the health risk associated with noise pollution above healthy levels with respect to different age brackets. The implication of the study is to bring the entire residents and communities of Omu-Aran Township to the awareness of noise levels within the town and its health implications and also help the government to have records on noise pollution levels, which will guide the decision-makers in policy formulation to mitigate the health and environmental effects of noise pollution.

II. MATERIALS AND METHODS

A. *Description of Study Area*

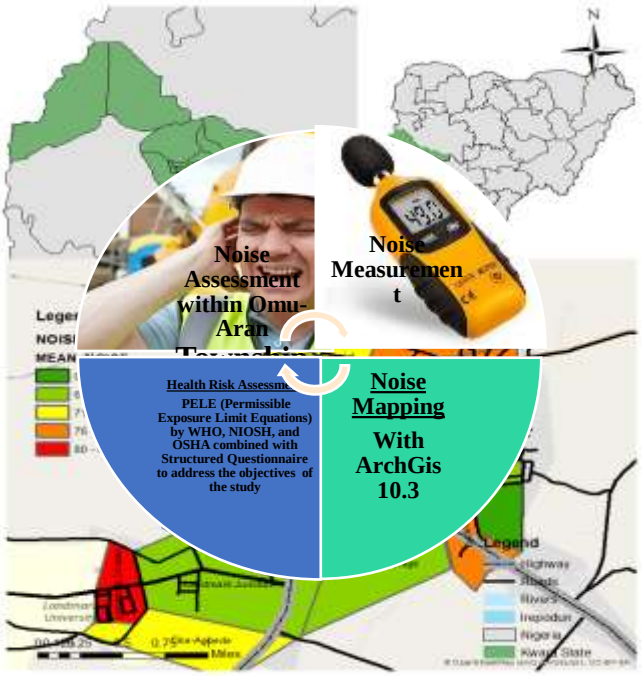

Fig 1: Abstract Methodology

Omu-Aran is a city in Irepodun local government in the southern part of Kwara State, Nigeria. Omu-Aran is situated at latitude 8.13º North and longitude 5.1º East, at an elevation of 495 m above sea level. Omu-Aran had a population of 148,610 according to the 2006 census across the land area of 73.7 km² [2, 13, 27, 28, 29]. Average weather conditions of 26º C, wind at 13 km/h, and humidity of 74%. Omu-Aran has one general hospital and more than three private hospitals.

Furthermore, aside from that, Omu-Aran has two commercial markets and a lot of supermarkets. It's a city that also has five public secondary and primary schools with a lot of private secondary and primary schools. Omu-Aran is a city with one private university (Landmark University). Fig. 1 shows the full details of the methodology.

B. Noise Documentation

This study made use of a sound level meter of model SL4010.

TABLE 1. ZONING OF STUDY LOCATION

ZONES	*STREET*	*CO-ORDINATE*	*ELEVATION(M)*
A	Oke-Agbede	8º07ʾ06.7ʾʾN 5º05ʾ37.9ʾʾE	559
	Landmark junction	8º07ʾ27.6ʾʾN 5º05ʾ42.7ʾʾE	547
	High Court junction	8º07ʾ44.9ʾʾN 5º05ʾ50.1ʾʾE	546
	Latinwo Market	8º08ʾ05.9ʾʾN 5º05ʾ49.1ʾʾE	550
	Ile-Nla	8º08ʾ12.9ʾʾN 5º05ʾ57.8ʾʾE	554
	Falaye	8º07ʾ55.8ʾʾN 5º05ʾ41.8ʾʾE	549
	Landmark Chapel	8º07ʾ22.1ʾʾN 5º04ʾ59.2ʾʾE	548
B	Central Market	8º08ʾ20.1ʾʾN 5º06ʾ11.0ʾʾE	556
	Central Roundabout	8º08ʾ09.8ʾʾN 5º06ʾ02.9ʾʾE	539
	Iganngu/Okeki	8º08ʾ27.9ʾʾN 5º06ʾ20.1ʾʾE	546
	Ile-Olupo/Ile-Adee	8º08ʾ20.1ʾʾN 5º06ʾ11.0ʾʾE	539
	Odo-Areyin	8º08ʾ02.1ʾʾN 5º06ʾ11.8ʾʾE	534
	Egbe Garage	8º07ʾ39.1ʾʾN 5º06ʾ27.1ʾʾE	524
	Otolorin/Federal Hospital Junction	8º07ʾ35.9ʾʾN 5º06ʾ48.8ʾʾE	521
C	GRA	8º08ʾ10.2ʾʾN 5º06ʾ40.5ʾʾE	531
	Agamo	8º08ʾ24.0ʾʾN 5º06ʾ26.8ʾʾE	521
	Taissa Junction	8º08ʾ45.6ʾʾN 5º06ʾ36.3ʾʾE	529
	Bovas	8º08ʾ52.6ʾʾN 5º06ʾ25.0ʾʾE	525
	Orolodo/Olomu Palace	8º08ʾ52.6ʾʾN 5º06ʾ25.0ʾʾE	548
	Secretariate/Eco Bank	8º08ʾ40.5ʾʾN 5º05ʾ54.2ʾʾE	549
	Taiwo	8º08ʾ37.0ʾʾN 5º05ʾ50.5ʾʾE	557

The sound meter has the following features: a measurement-quality microphone, a mic preamp, frequency weighting networks, an RMS detector circuit, averaging circuits, a meter display, AC and DC outputs used to feed other measurement devices or for recording, and it is calibrated with a low sound level between 30-100 dB and a high noise level of 60-130 dB. The sound level meter was comfortably held at hand with the microphone pointed towards the noise source at a distance of not less than 1.6m above ground level. The average distance between each of the selected locations within 0mu-Aran township is 200m, and the average distance is 1 km between each zone. Omu-Aran city was divided into three zones, each of the zones consisting of six to seven locations, with a total of 20 locations in all. Data was collected between the hours of 7am-9am, 12pm-2pm, and 4pm-6pm daily in the morning, afternoon, and evening respectively, for six working days within the duration of 3 weeks, as shown in Table 1, which shows the zoning of the study location.

C. Mapping of Noise Level

The noise level gathered from all the selected locations and zones was mapped using ArcGIS 10.3 as one of the most efficient geographical information systems (GIS) as used by [1, 21].

D. Data Processing

Statistical Package for Social Science (SPSS) through Harmonic means sample size of Waller Duncan[a.b] at a significant difference ($p < 0.05$) was used to address the variation in noise exposure at each of the selected locations

E. Formulae for Leq , Lex , Time and Noise Dose

$$L_{EX,\ 8\text{-}h} = 10 \times \log 10 \times \left[\frac{t \times 10^{\left(\frac{LAeq\ avg}{10}\right)}}{8}\right] \quad (1)$$

$$t = \left[\frac{(Durational\ sampling\ time\ in\ hrs)}{Total\ sampling\ \ duration\ in\ a\ day\ in\ hrs}\right] = \left[\frac{(2hrs)}{12\ hrs}\right] \quad (2)$$

$$L_{Aeq\ avg} = 10 \times \log 10 \times \left[\frac{\sum_{i=1}^{n} 10^{\left(\frac{wi}{10}\right)}}{n}\right] \quad (3)$$

$$L_{Total} = 10_{\log}\left[10^{\wedge}\frac{L1}{10} + 10^{\wedge}\frac{L2}{10} + 10^{\wedge}\frac{L3}{10} + \cdots + 10^{\wedge}\frac{LN}{10}\right] \quad (4)$$

$$T = \left[\frac{(8)}{2^{\wedge}\left[\frac{L-90}{5}\right]}\right] \quad \leq 1 \quad (5)$$

$$D = \left[\frac{C1}{T1}\right] + \left[\frac{C2}{T2}\right] + - - - - + \left[\frac{Cn}{Tn}\right] \quad (6)$$

$$TWA = 90 + 16.61 \log D \leq 90 \quad (7)$$

Where $L_{EX,\ 8\text{-}h}$ is the average noise exposure value in decibels, above which leads to a risk of hearing loss, it estimated based on 8 hours of time-weighted exposure; t is the total sample time of exposure in hours; $L_{Aeq\ avg}$ is the logarithm average of noise levels per location during the day; *wi* is the equivalent sound level average in decibels; and n is the number of measurements per location during the day; T is the permissible exposure (hrs), L is the sound pressure level (dB) and C is the actual time of exposure in hours, which is 8 hours working per day.

F. *Health risk evaluation*

The survey was carried out within the three nosiest locations in Omu-aran Township according to Fig. 4. 100 structured questionnaires (opinion questions) were distributed within the selected locations; on average, 80 respondents were reviewed. WHO, NIOSH, and EPA PELE (Permissible Exposure Limit Equations) for the 8-hr noise exposure limit was also used to evaluate the health risk associated with noise pollution within each of the selected locations by comparing their average noise exposure level with this standard organization permissible exposure limit.

III. RESULTS

A. Documentation of Noise Level in Omu-Aran Township

A total of 378 data were collected in the morning, afternoon, and evening across all selected locations. Figures 2, 3, and 4 show the mean noise level in the morning, afternoon, and evening. The average mean noise level in the morning was found to be 67.82 dB. Landmark University Chapel is the noisiest with 82.5 dB, Central Roundabout and Central Market are exposed to 79.11 dB and 78.24 dB, respectively, and all other locations are exposed to a noise pollution below the mean average with 67.82 ± 6.24 dB in the morning. The average mean noise level in all locations in the afternoon was found to be 68.7 dB. Central Market, Central Roundabout, and Otolorin are the noisiest within this period, with 84.42 dB, 81.92 dB, and 72.87 dB, respectively. Otolorin, Landmark Chapel, Ile-nla, and Taissa Junction are slightly above the average with a value of ± 4.62 dB, while other locations are below the average. The average mean noise level in all locations in the evening was found to be 69.53 dB. Central roundabout, central market, and Latinwo market are nosiest within this period with 84.72 dB, 81.28 dB, and 76.14 dB, respectively. Otolorin, High Court Junction, Igangu/Okeki, Ile-nla, Taissa Junction, and Bovas all exceed the average value slightly with a value of ± 3.44 dB, while other locations are still below the average.

i. Variation in Noise Exposure During the Period of the Day

A total of 1134 data was collected within three weeks across the 21-location selected in Omu-Aran Township. Statistical Package for Social Science (SPSS) through Harmonic means sample size of Waller Duncan[a.b] at a significant difference ($p < 0.05$) gives different variation in noise exposure at each of the selected locations. Table 2 shows the average means results with the different (superscripts) significant difference (P-value ≤ 0.05).

ii. Noise Mapping Of Omu-Aran Township

Figure 4 shows the mapped locations in Omu-Aran with respect to the level of noise they are exposed to. Different colors (red, green, yellow, and orange) are used to differentiate the noise levels at each location. The red zone was calibrated between 80-90 dB, the light green was calibrated between 60-70 dB, yellow between 71-75 dB, and orange between 76-80 dB. It was observed that only three of the twenty-one (21) locations were within the red zone, which is the highest level of noise exposure in the town: Central Market, Central Roundabout, and Landmark Chapel, with 87.78 dB, 87.24 dB, and 83.16 dB, respectively.

Falaye, Odo-Areyin, Egbe-garage, GRA, Orolodo, and Ile-Ade are in the green zone with the mean noise level of 59.56 ± 4.40, 61.40 ± 6.61 dBA, 61.34 ± 5.56 dBA, 62.10 ± 5.95 dBA, 62.64 ± 5.37 dBA, and 64.41 ± 5.63 dBA, respectively. Oke-Agbede, Ile-Nla, Iganngu/Okeki, Agamo, Taiwo, and Secretariate are all in the yellow zone with a noise level of 72.40 ± 0.91 dB, 70.43 ± 0.82 dB, 74.42 ± 0.96 dB, 73.70 ± 0.58 dB, 71.80 ± 0.32 dB, and 71.10 ± 1.11 dB. Landmark Junction, High Court Junction, Otolorin, and Taissa Junction are in the orange zone with mean noise levels of 76.16 ± 2.09 dB, 77.13 ± 0.12 dB, 77.19 ± 1.56 dB, and 76.86 ± 1.42 dB, respectively.

iii. Health Risk: Exposure Limit and Permissible Exposure Limit Equation Approach

The recommended exposure limit and permissible exposure limit equation (REL and PELE) for 8 working hours given by NIOSH, OSHA, and also as a standard for both EPA and WHO, was used. This REL & PEL are calculated for each location.

Using equations (5) and (6), while the noise dose was calculated using equation (7) [15, 25, 39]. Fig. 6a and 6b show the results of noise dose and time-weighted average (TWA) with respect to OSHA and NIOSH. Using equation (3), the result calculated was used to categorize the noise levels at all selected locations, and their consequences were categorized based on level 1-7 as researched [13, 26]. Table 3 shows the different consequences of noise exposure at all the selected locations.

iv. Health Risk: Structured Questionnaire Approach.

The survey was carried out within the noisiest locations in Omu-aran Township according to Fig. 5. 100 structured questionnaires were distributed within the selected locations; on average, 80 feedbacks were gotten and evaluated. Tables 4, 5, 6, and 7 show the report, and Fig. 6 shows the health challenges faced by the respondents.

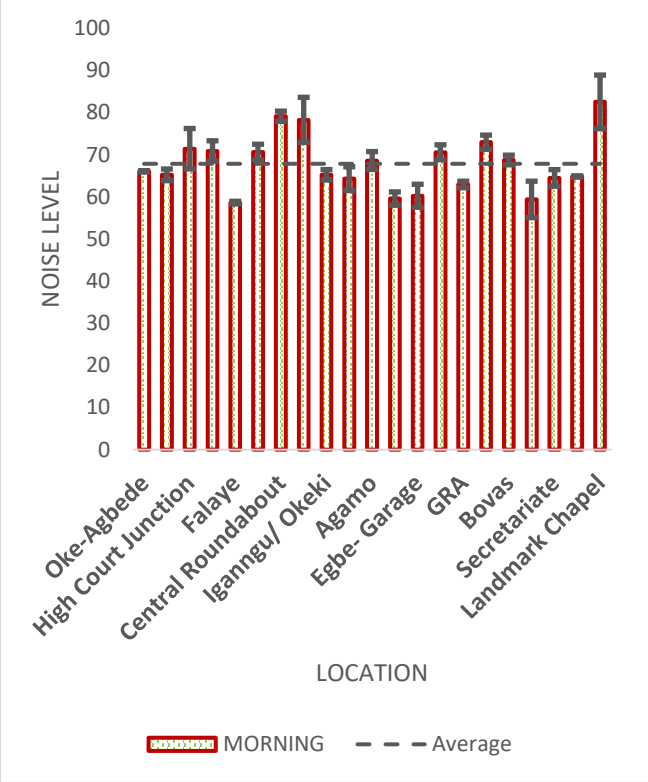

Fig 2: Mean Noise Level in the Morning

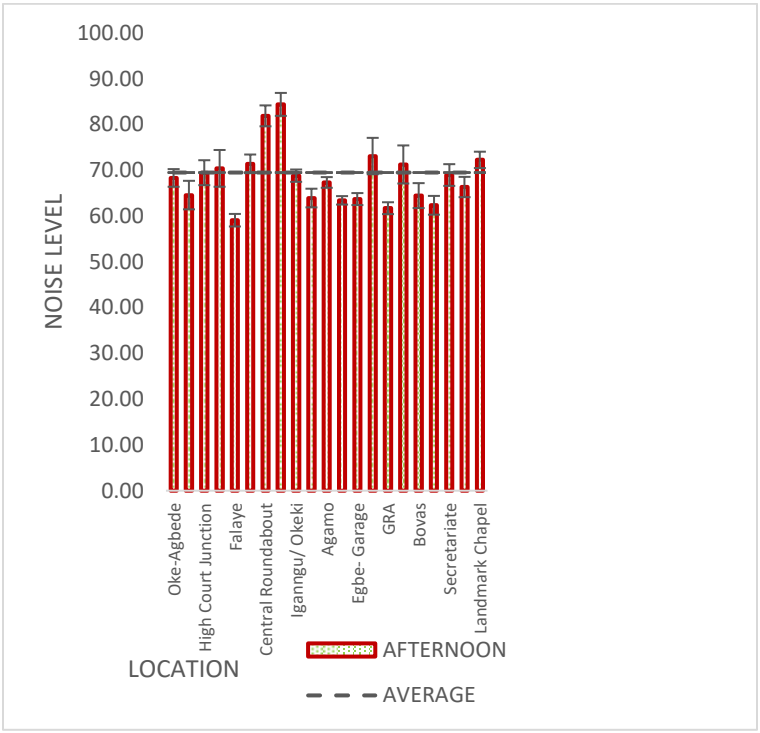

Fig 3: Mean Noise Level in the Afternoon

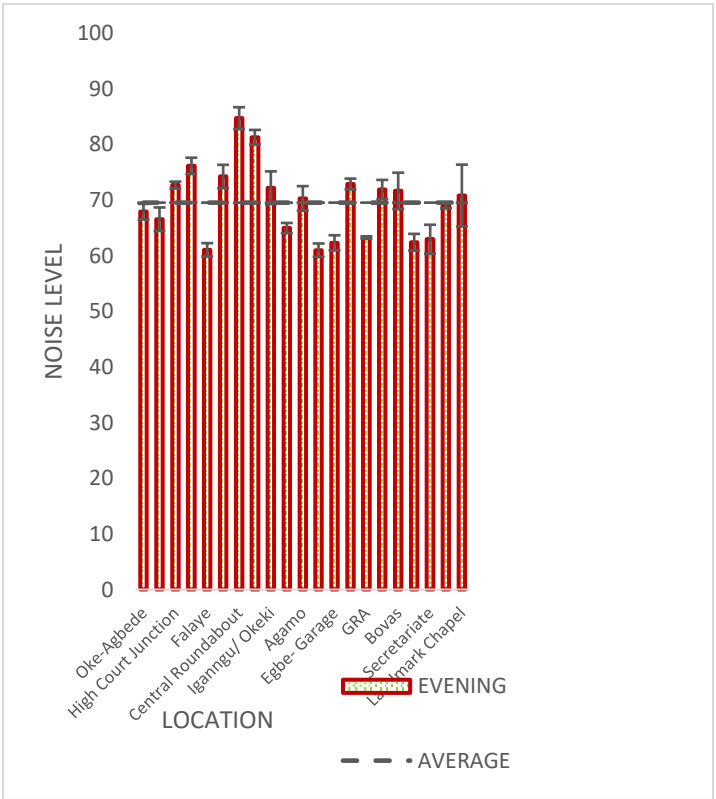

Fig 4: Mean Noise Level in the Evening

TABLE 2. VARIATION IN NOISE EXPOSURE

S/N	LOCATION	NOISE LEVEL		
		7-9am	12-2pm	4-6pm
1	Oke-Agbede	66.03 ± 7.52[a]	68.35 ± 7.31[a]	67.91 ± 7.02[a]
2	Landmark Junction	65.20 ± 10.2 [a]	64.61 ± 6.20[a]	66.55± 7.85[a]
3	High Court Junction	71.41 ± 11.22[a]	69.49 ± 6.61[a]	72.67 ± 6.25[a]
4	Latinwo Market	70.87 ± 7.27[a]	70.44 ± 6.21[a]	76.14 ± 6.37[b]
5	Falaye	58.50 ± 4.40[a]	59.12 ± 4.79[a]	61.05 ± 3.77[a]
6	Ile-Nla	70.59 ± 4.43[a]	71.44 ± 3.48[ab]	74.23 ± 5.20[b]
7	Central Roundabout	79.11 ± 10.17[a]	81.92 ± 8.12[a]	84.72 ± 7.89[a]
8	Central Market	78.24 ± 10.63[a]	84.42 ± 6.97[b]	81.28 ± 6.08[ab]
9	Iganngu/ Okeki	65.21 ± 4.67[a]	68.85 ± 5.46[b]	72.20 ± 5.72[b]
10	Ile-Ade	64.30 ± 7.04[a]	64.00 ± 5.82[a]	64.0 ± 3.84[a]
11	Agamo	69.00 ± 4.83[a]	67.37 ± 6.26 [a]	70.29 ± 5.25 [a]
12	Odo-Areyin	60.00 ± 4.29 [a]	63.46 ± 5.45 [a]	61.00 ± 6.32 [ab]
13	Egbe-Garage	60.24 ± 6.31 [a]	63.73 ± 5.29 [a]	62.32 ± 6.00 [a]
14	Otolorin	70.55± 6.24 [a]	73.13 ± 9.81 [a]	72.87 ± 5.65 [a]
15	GRA	62.91 ± 4.74 [a]	61.74 ± 4.94 [a]	63.27 ± 6.47[a]
16	Bovas	68.72 ± 6.12 [ab]	64.49 ± 10.02 [a]	71.64 ± 8.01[b]
17	Taissa Junction	72.94 ± 5.40 [a]	71.30 ± 8.45 [a]	71.91 ± 5.64 [a]
18	Orolodo	59.40 ± 6.44 [a]	62.40 ± 7.27 [a]	62.41 ± 5.94 [a]
19	Secretariate	64.50 ± 7.45[ab]	69.00 ± 9.38 [b]	63.00 ± 5.58 [a]
20	Taiwo	65.00 ± 6.30 [a]	63.00 ± 16.69 [a]	69.00 ± 6.49 [a]
21	Landmark Chapel	82.5.1 ± 11.40[ab]	68.7 ± 4.40[a]	72.1 ± 5.10[a]

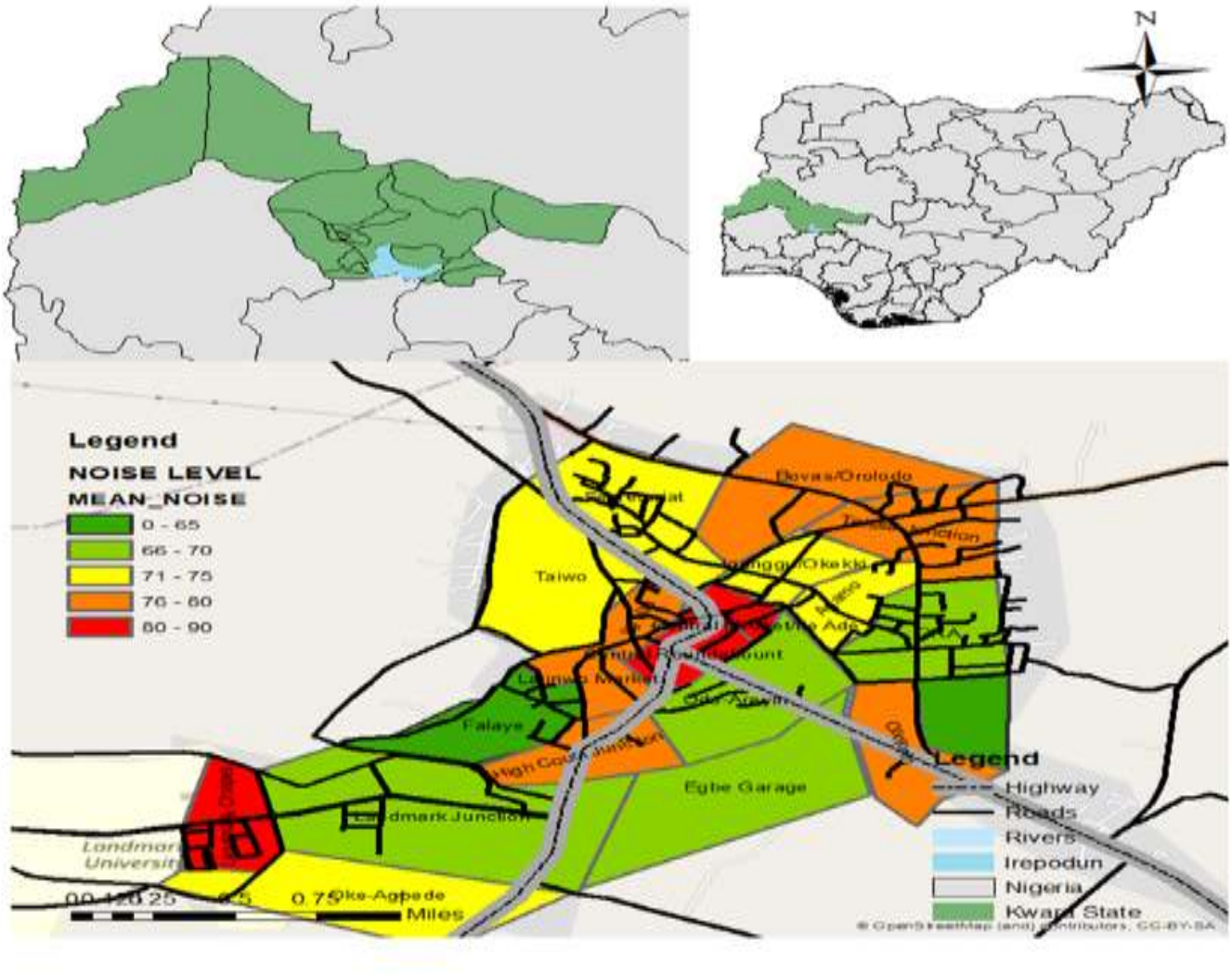

Figure 5. Map of Noise Levels in Selected Areas of Omu-Aran Township

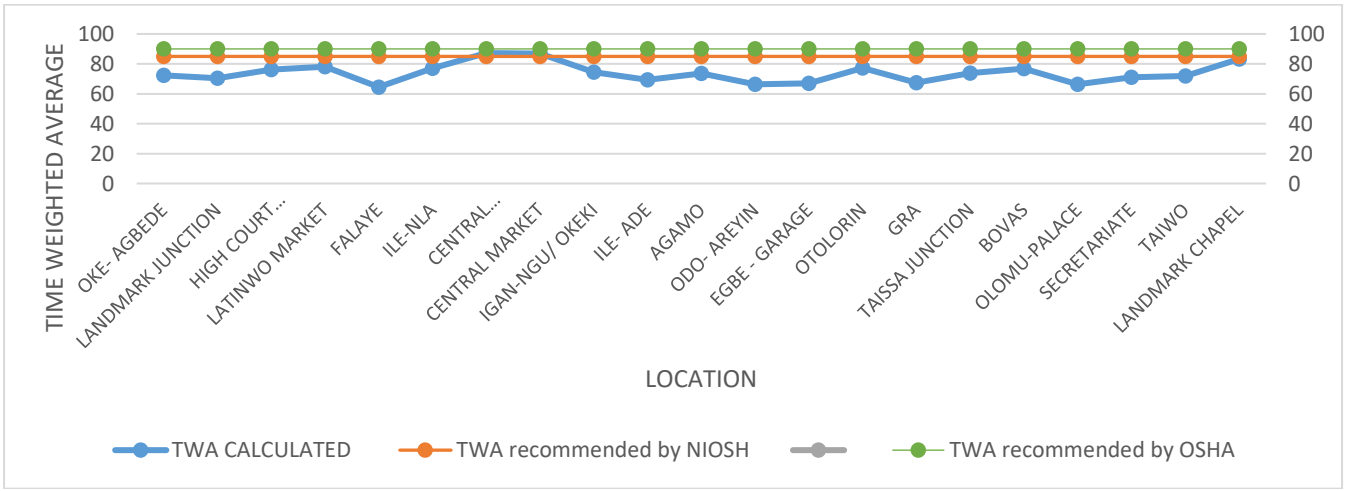

Fig 6a: TWA Vs OSHA & NIOSH Recommendation

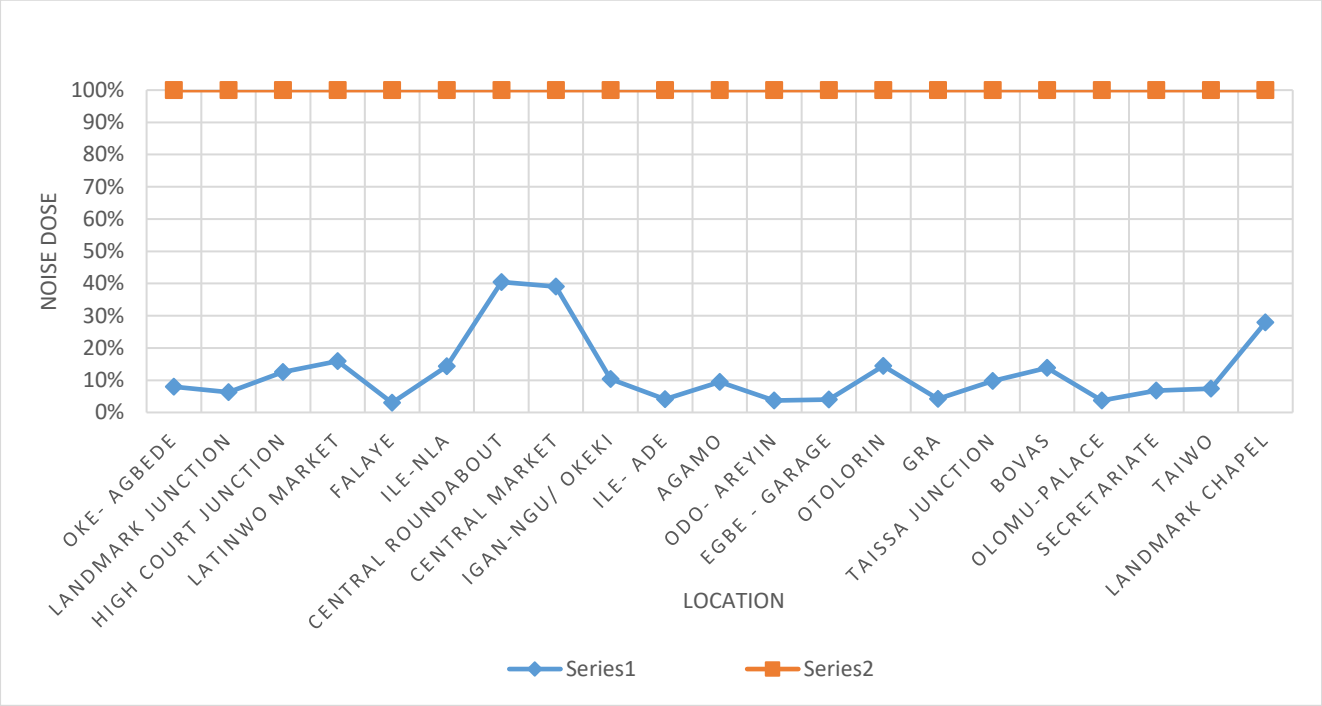

Fig 6b: Dose Vs OSHA &NIOSH Recommendation

Table 3: Categories of Noise Levels and their Consequences Within Omu-Aran Township

Location	Categories in Levels	Noise Levels (Db)	Consequence	Source
-	1	30-60	Confusion, discomfort, anger, sleep, etc., disorders	[7, 17]
OROLODO, ILE-ADE, EGBE-GARAGE, ODO-AREYIN, GRA & FALAYE	2	60-75	annoyance, stress, slight headache, discomfort	[26, 32, 34]
OKE-AGBEDE, LANDMARK JUNCTION, HIGH COURT JUNCTION, LATINWO MARKET, ILE-NLA, IGANGU/OKEKI, AGAMO, OTOLORIN, BOVAS, TAISSA JUNCTION, TAIWO & SECRETARIATE	3	75-85	stress, annoyance, headache, Damage to the ear started or noise-induced hearing loss, ineffective communication	[5, 3, 1, 4, 7]
LANDMARK CHAPEL,	4	85-90	blood pressure, headache, coronary artery disease	[6, 16, 17, 21, 37]
CENTRAL ROUNDABOUT, CENTRAL MARKET	5	90-120	cardiovascular effect and increase in physiological responses	[6, 24, 14]
-	6	>120	Permanent damage to internal ear and balance deterioration	[9, 19, 20, 18]
-	7	>140	Serious brain destruction	[5, 36, 23 16]

Table 4: **Demographic Details**

Demographic Details		
Variables	**Population Frequency**	**Percentage of Respondent (%)**
Age in years (80 Respondents)		
Less than 20 years	15	18.75
20-30	29	34.4
30-50	44	46.9
50-above	12	15.5
Gender (79 Respondents)		
Male	59	60
Female	40	40
Marital Status (79 Respondents)		
Single	44	55
Married	36	45
Occupation (77 Respondents)		
Trading/artesian	16	20.7
Civil Servant	14	18.18
Student	33	42.9
Academia/Lecturer	14	18.18
Level of education (79 Respondents)		
Non-literate	0	0
Primary Education	0	0
Secondary	5	5
Tertiary	95	95
Location during the day (80 Respondents)		
Landmark university	22	27.5
Central Market	12	15
Roundabout	18	22.5
Others	28	35

Table 5: knowledge About Noise

Knowledge About Noise (80 Respondents)			
Variables	**Yes**	**No**	**Maybe**
Noise pollution involves people and their activities	68	12	-
Noise refers only to loud sounds	38	34	8
Noise pollution does not affect well-being/comfort/reasoning	76	4	-
Exposure to noise at work has negative health effect	78	2	-
Noise has impact on children academy performance	76	4	-
Noise pollution is not as important as other types of pollution	*58*	*13*	*9*
Noise affect effective communication	*78*	*2*	-

Table 6: Societal Reactions

Societal Reaction (80 Respondent)			
VARIABLES	**AGREE**	**DISAGREE**	**NEUTRAL**
Living in noisy environment has no negative effect on comfort, concentration and reasoning	49	31	-
Exposure to noise will not increase anxiety or stress level	33	47	
Exposure to noise pollution during working hours can result to negative effect on human health?	50	28	2
In a study environment, noise is a hindrance for assimilation	52	24	4
Adopting mechanism like earplug, soundproof etc. are possible ways of deal with noise	51	18	11

Noise pollution guidelines and regulation can be effectively implemented to protect public and quality of life	41	36	3
Noise leads to hearing lost and auditory disorder	74	2	4
Noise increase stress and anxiety	77	3	
Noise pollution does not have any long-term health effects	8	58	18
Headache, heart attack, hearing loss are enhanced by exposure to noise pollution	45	35	-
People with pre-existing health issues are more vulnerable to adverse effect of noise	63	10	7

Table7: Health Survey

SURVEY ON SLEEP DISTURBANCE		
Variables	**Yes**	**No**
When noise comes from surrounding, do you find it difficult to sleep?	**72**	**7**
Do you think your once perfect sleep pattern has been negatively affected due to noise pollution?	**74**	**5**
Do you always feel refreshed after you waking in the morning?	**66**	**14**
SURVEY ON CARDIOVASCULAR EFFECTS		
Variables	**Yes**	**No**
Have you ever been diagnosed with high blood pressure or any heart disease	**12**	**67**
Do you notice any chest pain, palpitation, shortness of breath in your heart	**18**	**61**
Do you have any changes in your blood pressure levels after you leave noise exposure location?	**21**	**58**
SURVEY ON ADVERSE BIRTH/NATAL CONSEQUENCE		
Variables	**Yes**	**No**
Have you ever been pregnant or experienced and pregnancies complication?	**21**	**56**
Do you notice any changes in your stress levels or exposure to noise pollution during pregnancy?	**16**	**61**
Did your healthcare provider discuss any potential risks or precaution related to noise pollution during pregnancy?	**18**	**59**
SURVEY ON MENTAL HEALTH DISORDER		
Variables	**Yes**	**No**
Have you ever been diagnosed with depression, anxiety, or any mental issues?	**74**	**5**
Do you normally experienced mood swing, unsatisfactory, irritability after work day at a noisy surrounding	**58**	**19**
Have seek medical help on your mental health before?	**11**	**68**
SURVEY ON STRESS AND ANXIETY		
Variables	**Yes**	**No**
Do you often feel stressed or anxious in a noisy environment?	**72**	**7**
Have you notice any symptom of stress such as; headache, muscle tensions, or digestive issues when exposed to noise?	**62**	**17**
Do you feel calm, relax, comfort in a quitter surroundings?	**78**	**2**
SURVEY ON TINNITUS (79 Respondent)		
Variables	**Yes**	**No**
Have your experience ringing, buzzing without external sound?	**37**	**43**
Do you think this ringing and buzzing often come after an exposure to loud noise, such s concert, market, church or mosque	**58**	**21**
Have you ever sorted for medical advice on ear ringing and buzzing?	**14**	**66**

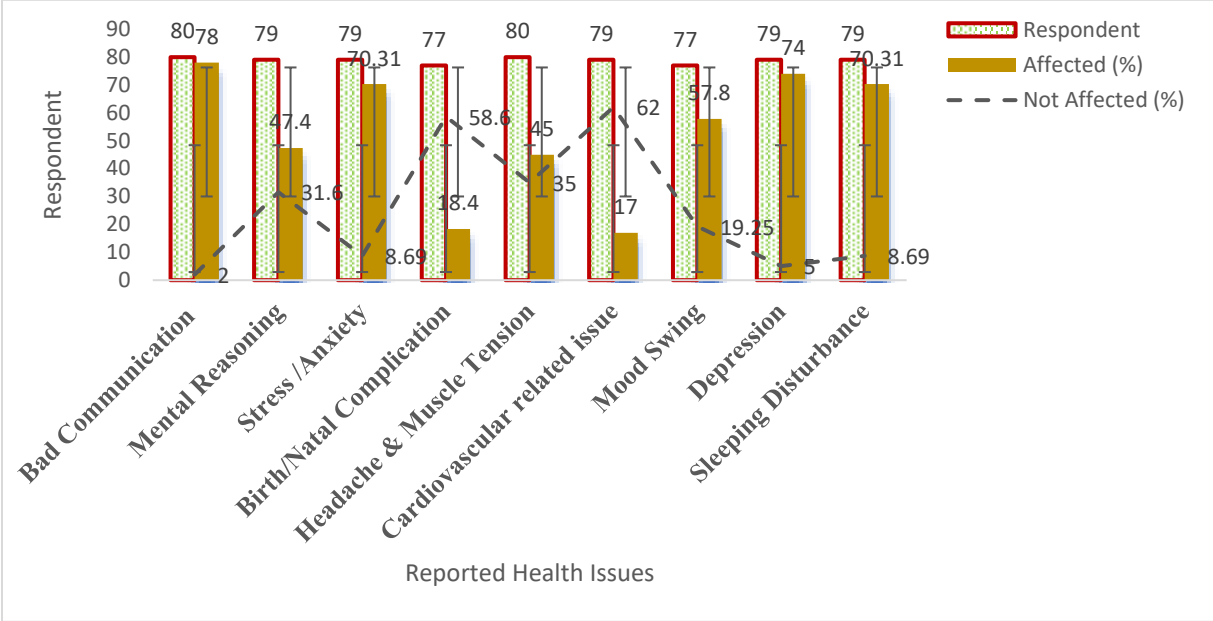

Fig 7: The Health Challenging Issues Faced by the Respondents

IV. DISCUSSION

Landmark University Chapel, Central Roundabout, and Central Market are exposed to the highest noise level in the morning due to their location beside the road, the nature of their daily vocation, and also the academic, commercial, and transportation activities that have more influence in all these locations. This agrees with [22, 31, 41], which declared location as one of the factors that influence noise pollution, and also commercial and transportation activity locations are open to more and consistent noise during the day. Most of the locations above the average are those that fall at the center of the city, where there are high concentrations of shops, markets, and traffic activities. As of the time this data was collected, it was during the festive period, and the population influenced the ceremonial activities. This agrees with [23, 30, 31, 29], which says population, major roads that pass through some of these locations, traffic noise, and commercial activities are the major sources of environmental noise pollution in the locations that fall within the center of the city.

Using Harmonic means sample size of Waller Duncana.b. it shows that Central roundabout, Oke-Agbede, Landmark Junction, High Court Junction, Falaye, Ile-Ade, agamo, Egbe-garage, Otolorin, GRA, Taissa junction, Orolodo and Taiwo has no significant differences of noise variation in each of the period (morning, afternoon, evening) irrespective of the activities and population involves (this location can be classified as a busy location all through the day). This is because most of this location are sited along the road with consistent activities, and some falls within the center of the city while some within the outskirt of the city, where less or no change in activities occurs. This agrees to what [37, 35, 30, 28, 29] discussed in their research that, most structure that are sited beside the roads are mostly affected with traffic noise pollution. Latinwo market shows that there's no significant difference in noise exposure in the morning and afternoon, but there's high exposure in the evening due to the nature of the market having it highest population in the evening period while, Central market, Igangu/Okeki has a significance difference all through the period of the day, but experienced high exposure in the afternoon due to the high population of the marketer during this period of the day and also traffic volume, conversation and advertisement garget are mostly source of noise during this period.

The result that was calculated shows that the central roundabout and central market have 87.24 dB and 86.78 dB, which exceed the NIOSH Recommended Exposure Limit (REL) of 85 decibels for an 8-hour time-weighted average but are still within the limit of the OSHA Recommended Exposure Limit (REL) of 90 dB with 8 hours of working exposure. Other locations are all within NIOSH and OSHA occupational standards for 8 hours of exposure due to their fewer populations and activities that could result in nuisances, as concluded by [18, 1, 22, 40] that the higher the activities and population of any given location, the higher the noise pollution exposure.

The survey was carried out within the three nosiest locations in Omu-aran Township according to Fig. 4, Table 3, and Fig. 6 shows that there is an adverse effect on residents from physical disorder, cardiovascular-related issues, natal complications, sleeping disturbance resulting in headache, stress and anxiety, and effective communication is greatly altered.

V. CONCLUSION

The noise levels measured at the Central Roundabout and Central Market in Omu-aran Township exceeded the NIOSH Recommended Exposure Limit (REL) of 85 decibels for an 8-hour time-weighted average, with readings of 87.24 dB and 86.78 dB, respectively. While these levels remain within the

OSHA REL limit of 90 dB for 8-hour exposure, they still pose a potential health risk to those regularly exposed. The higher noise levels in these areas can be attributed to the bustling activity and dense population, as established by previous studies [12], which show a direct correlation between increased noise pollution and higher population densities or activities. In contrast, other locations in the township are within the acceptable limits of both NIOSH and OSHA, suggesting that less crowded areas may experience less disruptive noise, leading to a safer living and working environment.

The survey results highlight the significant adverse effects of prolonged exposure to high noise levels on the residents of Omu-aran Township. These effects are not limited to physical discomforts but also extend to more severe health implications, such as cardiovascular diseases, headaches, mood swings, depression, natal complications, and sleep disturbances. Additionally, the impact on mental well-being is considerable, with residents experiencing increased stress, anxiety, and frequent headaches. Effective communication, a key aspect of daily life, is also impaired in these high-noise environments. The findings of this study underscore the need for targeted noise management interventions, especially in high-traffic areas, to mitigate these negative health outcomes and enhance the quality of life for residents.

VI. CONTRIBUTION TO KNOWLEDGE

This study had helped to: document the average noise level of selected location in Omu-Aran Township; health issues associated with the most noisiest location within the township which will all help the local authorities in decision making and create awareness for the residents.

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