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Influence of environmental factors and its associated health risks of noise pollution in Owerri Metropolis, Imo State, Nigeria

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Abstract

Noise pollution contributes to environmental degradation and poses a threat to human and terrestrial lives. Noise pollution can be regarded as environmental noise and the propagation of noise may develop a harmful impact on the activity of human or animal life. This study was conducted to determine the influence of environmental factors and its associated health risks of noise pollution in Owerri Metropolis, Nigeria. The study employed a cross sectional descriptive research design. Measurement of noise levels was carried out at 24 different locations. The sampling technique used in this study was a cluster sampling technique. The average reading for each location and each ward were calculated. Also, 900 respondents comprising adults who live and/or operate in the areas were interviewed on the health risks associated with noise, using structured and standardized questionnaire. The results obtained showed that the computed average noise level at the 24 different locations ranged from 79.4 – 95.8dB, and all of which were significantly ($P<0.05$) above the acceptable standard ranges of <80dB, thereby rating the noise level not acceptable because they can be capable of causing discomfort and pains in man. Influence of environmental factors on noise pollution; 29(3.2%) reported heavy vehicular traffic plying residential areas contributed to noise generation, 33(3.7%) said indiscriminate blowing of siren. Perceived health risks were reported as 47(5.2%) disturbs sleep, 24(2.7%) causes annoyance, 41(4.61%) causes headache and 21(2.3%) interference with conversation. In conclusion, environmental factors, poor education and lack of enforcement of the laws influence noise generation and there is need to check the level of noise pollution in Owerri Metropolis.

Keywords: Decibel (dB); Environmental factors; Health Risks; Noise; Pollution; Metropolis; Sound Meter

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1. Introduction

One of the major properties of noise is loudness and loudness is used to determine whether a sound is noise or not**.** Loudness depends upon the amplitude of the vibration which initiated the noise. The loudness of the noise is measured in decibels (dB). When sound is 60dB, it means that it is 60dB more intense than the smallest distinguishable noise or the reference sound pressure, which is understood to be 0.0002 microbar or dynes/cm^2. A dyne is 1/1,000, 000th of atmospheric pressure [1].

Normal whispering produces noise of 10dB-20dB, quiet library produces a normal noise of 30dB-40dB and a normal conversation is expected to produce noise of 60dB-65dB. Normal heavy street traffic and printing press should produce noises of 65dB-70dB and 75dB-80dB respectively. Furthermore, train passing station and motor car horn or boiler factories should produce noise of 110dB-120dB. At noise level of 140dB, there is usually, threshold of pains and mechanical damage is observed as from 150dB. A daily exposure of noise up to 85dB is about the limit people can tolerate without substantial damage to their hearing [2].

The effects of noise pollution exposure are of two types; auditory and non-auditory. Auditory effects of noise pollution include auditory fatigue, hearing impairment, deafness and pains. Auditory fatigue appears between 85dB and 90dB region and greatest at 4000Hz. It may be associated with signs such as whistling and buzzing in the ear [1].

Uslu [3] reported aural pains in children that are induced when the tympanic membranes are stretched by large amplitude sound pressure and this may rupture the membranes. At noise level of 80dB, children with healthy ears experience physical discomfort and pains at noise level range of 110dB -130dB including adults while those with inflamed ears experience physical discomfort and pains at 80dB-90dB. And pains are felt in the ear without eardrum at 170dB [4].

The direct effect of noise pollution is hearing impairment from an increase in threshold of sound in higher frequencies of 3000Hz and 6000Hz. With increasing levels and exposure time, impairment occurs at frequencies as low as 2000Hz resulting in loss of clarity rather than loudness. Morata [5] noted that in developing countries both occupational and environmental noises constitute increasing risk factor for hearing impairment. Casey et al [6] reported that hearing loss occurs gradually, beginning with loss of occasional words in general conversation and difficulty understanding speech heard on the telephone. Sound is generally distorted and may be associated with tinnitus [7].

This is the most serious pathological auditory effect of noise pollution. The patient is generally unaware of it in early stages. This may be temporary or permanent. Temporary deafness or hearing loss results from a specific exposure to noise. This inability disappears after a period of time up to 24 hours following noise pollution withdrawal. Temporary hearing loss occurs in frequency range between 4000Hz and 6000Hz [1]. Ezekiel [8] opined that repeated exposure to noise pollution of about 100dB may lead to permanent hearing loss/deafness and exposure to noise above 160dB may rupture the tympanic membrane causing permanent deafness or hearing loss.

The non-auditory effects include speech interference, annoyance, and language development in children, speech intelligibility and physiological, psychological and behavioral effects. In everyday life, frequencies from noise pollution interfere with speech communication thereby causing most disturbances to speech communication lie in the 300Hz-500Hz range. For good speech intelligibility, it is considered that the speech sound level must exceed the speech interference level (SIL) by approximately 12dB.

Sisman and Unver [9] reported that noise annoyance is the feeling of displeasure evoked by noise and such depends on many non-acoustic factors of social, psychological or economic nature. However, as noise pollution increases to 40dB, people increasingly complain about it.

In the year 2000, in the USA, the residents complained mostly of industrial or commercial noise (12%) aircraft engine (10%), highway traffic (10%), amplified music (9%, race crowd (4%) [10]. Amadi [11] affirmed that noise pollution causes annoyance by interfering with conversation, mental concentration, rest and recreation. In respect to Amadi's affirmation, annoyance reaction depends on the level of its spectral and temporal and impulse characteristics, information conveyed by the noise, sex, age and occupation of the respondent and attitudes towards the source of the noise [12].

Noise is like chronic stress adversely affects general health and well-being of a man [10,13]. WHO emphasizes that noise pollution control management helps to prevent serious annoyances and disruption of sleep, recommending 55dB

during the day and 45dB for night time for residential, institutional and educational areas, and 70dB for general industrial and commercial projects, including foundries, iron and steel manufacturing and thermal power plants.

Indoor speech perception is affected by the reverberation characteristic of the room. Reverberation time over one second produces less speech discrimination and makes speech perception more difficult. Strained speech perception will be completely lost in a listener with normal hearing ability to differentiate between the speech level and sound level of the interfering noise is 15dB or more [14].

Community noise pollution is the type of noise pollution can also be called environmental/residential noise pollution. The majority of the population is exposed to or tormented by noise from diverse sources outside the industrial workplace either indoor or outdoor which Nadakavukarem [15], altogether called community, environmental, residential or domestic noise pollution. Residential noise pollution is any noise from house apartment, commonly neighbors' stereos, radio and air conditioner. Noise pollution exists when the said items can be heard in habitable room of a neighboring house during a prohibited time whether or not the windows and doors are open, if it goes on for a protracted time [16]. Residential noise pollution could be indoor noise pollution or outdoor noise pollution.

Ozer and Irmak [17], stated that use of loudspeakers at various occasions like festivals, election campaigns/rallies, religious worships in temples, churches, mosques, and during advertisements, mining operations, bulldozing of buildings, drilling and breaking of rocks are all sources of noise. Furthermore, household gadgets like vacuum cleaners, television, radio, stereo, grinder, mixer, etc., generate noise.

According to WHO [18] 360 million people worldwide live with disabling hearing loss. This is approximately 5.3% of the world population. Thirty-two (32) million of these are children less than 15 years of age. This represents 9% of the world population. Adults had 328 million patients representing 91% of those affected. And out of the population, 183 million (56%) are males while 145 million (44%) are females, signifying that male suffer from hearing loss more than females worldwide. The report also noted that 40,000 people in Nigeria live with hearing loss.

Looking at the conditions of living and working environment, man cannot completely avoid noise. Therefore, Alam, et.al, [19], had presented a table showing the acceptable noise levels (dB) as seen in previous publication. And the general acceptable standard to minimize hearing risk is based on an exposure of 90dB for a maximum limit of eight hours per day, followed by at least ten hours of recovery time.

2. Material and methods

This study employed a cross sectional descriptive research design to determine the influence of environmental factors on generation of noise pollution and associated health risks on residents of Owerri Metropolis, Imo State. The study was carried out at Owerri Metropolis which is the capital city of Imo State. The sampling technique used in this study was a cluster sampling technique and the average mean reading for each location were calculated. For population size, sixty residents were randomly selected from each of the 15 political wards; given a total of nine hundred (900) residents which was serve as the representative of the entire population of Owerri Metropolis. The study used well-structured questionnaire to collect primary data from the adult residents and operators in Owerri Metropolis.

Reference table Noise Quality Description for daytime

Noise level (dB)	Noise Quality Description
0-20	Excellent quality
21-40	Very good quality
41-60	Good quality
61-80	Satisfactory quality
81-100	Unsatisfactory (painful)
101-120	Hazardous quality
> 120	Not allowed

Source: Anomohanran and Osemeikhian, [13]; Koenigsberger, [20] And Alam, et. al [19].

There were physical measurement of noise levels at some selected places and locations in the Council, which were used to compare the universally acceptable noise levels/ranges. In recording the noise level, Digital Sound Level Meter of 30dB-130dB was switched on for two minutes and the maximum value that stabilized within the two minutes was recorded for that period as the noise level for the location. The measurement was done at three different periods in a day at each location. For each measurement to be concluded readings were taken at each minute for three consecutive minutes after which the mean reading was calculated and recorded as the reading of the measurement of noise per period. At the end of the physical noise level measurement, the results were compared with the standard acceptable noise levels/ranges following the description made by Koenigsberger, [20] and Alam, et.al. [19]

Analysis of data was done using Statistical Package for Social Sciences (SPSS) version 20.0 and results were presented with frequency and percentages. The chi-square test was used to establish a relationship between the variables at p-value of 0.05. The outcome enabled the researcher to accept or reject any particular hypothesis and P–value less than 0.05 was considered statistically significant of any result obtained and they are compared with standard noise level ranges.

3. Results

Table 1 presented the socio-demographic characteristics of people assessed in Owerri Metropolis; 349(38.8%) were males and 551(61.2%) females. Fifty-five (6.1%) were aged between 18-27 years, 64(7.1%), 28-37 years, 200(22.2%) between 38-47 years, 301(33.4%) were aged 48-57 years, 165(18.3%) were aged 58-67 years, while 115(12.8%) were 68 and above years of age. Marital status of the respondents shows that 300(33.3%) were single, 572(63.6%) were married, 25(2.8%) were widows/ widowers, 1(0.1%) was a divorcee and 2(0.2%) were separated. Monthly income, 403(44.8%) earned between N10, 000 – N20, 000, 205(22.8%), N21, 00 –N30, 000, 100 (11.1%) earned N31, 000 – N40, 000 while 192 (21.3%) earned N41, 000 and above. Their employment status showed that 200 (22.2%) were students, 29 (3.2%) were unemployed, 226 (25.1%) were traders/ hawkers, 410 (45.6%) were civil/ public servants, 10 (1.1%) were farmers while 25 (2.8%) were artisans. Educational qualification; 11(1.2%) had no formal education, 251(27.9%) had primary education, 437(48.6%) had secondary while 201(22.3%) had tertiary education.

Table 1 Socio-Demographic Characteristics of the 900 Interviewees in Owerri Metropolis

Variables	Frequency (%)
Age	
18-27	55 (6.1)
28-37	64 (7.1)
38-47	200 (22.2)
48-57	301 (33.4)
58-67	165 (18.3)
68 and above	115 (12.8)
Gender/Sex	
Male	349 (38.8)
Female	551 (61.2)
Marital Status	
Single	300 (33.3)
Married	572 (63.6)
Widow/Widower	25 92.8)
Divorced	1 (0.1)
Separated	2 (0.2)

Monthly income (N)	
10,000-20,000	403 (44.8)
21,000-30,000	205 (22.8)
31,000-40,000	100 (11.1)
41,000 and above	192 (21.3)
Employment Status	
Students	200(22.2)
Unemployed	29 (3.2)
Traders/Hawkers	226 (25.1)
Civil/public Servants	410 (45.6)
Farmers	10 (1.1)
Artisans	25 (2.8)
Educational Qualification	
No Formal Education	11 (1.2)
Primary	251 (27.9)
Secondary	437 (48.6)
Tertiary	201 (22.3)

3.1. Noise Level Measurement in Owerri Metropolis

Table 2 showed the results of noise level measurements in 24 locations. In GRA, the highest noise level (94.8dB) was got at Imo State University (IMSU) Round about while the least noise level (85.7dB) was recorded at AIvan Federal College of Education (AIFCE).

In New Oweri I; the highest noise level (91.3dB) was got at Concord Hotel Junction while the least noise level (89.1dB) was recorded at Imo Specialist Hospital/Port Harcourt Road Junction (Imo Sp. Hos./PH.Rd).

In Ikenegbu II; the noise measurements recorded as follows; the highest noise level (93.4dB) was got at Federal Housing Estate Junction while the least noise level (79.4dB) was recorded at Ikenebgu Extension.

In Ekeukwu location; the highest noise level (94.5dB) was got at AmaJk R/about while the least noise level (87.8dB) was recorded at Sch, Rd/Douglas Rd.

In Azuzi I location; the highest noise level (90.6dB) was got at Orlu Rd / Bank Rd while the least noise level (90.1dB) was recorded at Control R/ about.

In Azuzi I1 location; the highest noise level (91.6dB) was got at Lobour Street while the least noise level (89.4dB) was recorded at Fire Service R/about.

In Aladinma I location; the highest noise level (95.8dB) was got at WACE Rd, Junction while the least noise level (88.3dB) was recorded at Aladinma Housing Estate.

In Ikenegbu IV; the noise measurements recorded as follows; the highest noise level (90.7dB) was got at Wetheral/Oki.Rd while the least noise level (87.0dB) was recorded at Cherubim Junction.

Table 2 Noise Level Measurement in Owerri Metropolis

S/N	Wards	Location	Noise Level (dB)	Acceptable Range (dB)	Remark
1	GRA	AIFCE	85.7	30-40	Not Accepted
		FMC	92.8	20-35	Not Accepted
		IMSU Round about	94.8	61-35	Not Accepted
		World Bank Market	90.8	65-70	Not Accepted
2	New Owerri I	Concord Hotel Junction	91.3	40-60	Not Accepted
		Imo Sp. Hos./PH. Rd. Junction	89.1	65-70	Not Accepted
3	Ikenegbu II	Ikenegbu Layout	88.3	25-40	Not Accepted
		Ikenebgu Extension	79.4	25-40	Not Accepted
		Fed. Housing Estate Junction	93.4	25-40	Not Accepted
4	Ekeukwu	AmaJk R/about	94.5	61-75	Not Accepted
		Sch, Rd/Douglas Rd	87.8	61-75	Not Accepted
		Mbaise Rd./Douglas Rd	88.0	61-75	Not Accepted
5	Azuzi I	Control R/ about	90.1	61-75	Not Accepted
		Orlu Rd / Bank Rd	90.6	25-40	Not Accepted
		Bank Rd	88.1	20-35	Not Accepted
6	Azuzi I1	Fire Service R/about	89.4	61-75	Not Accepted
		Lobour Street	91.6	25-40	Not Accepted
		St, Lk Hos/Mbaise Rd	91.2	20-35	Not Accepted
7	Aladinma I	Aladinma Housing Estate	88.3	25-40	Not Accepted
		Aladinma, Hospital Junction	89.4	20-35	Not Accepted
		WACE Rd, Junction	95.8	35-45	Not Accepted
8	Ikenegbu IV	Wetheral / Oki. Rd	90.7	61-75	Not Accepted
		Cherubim Junction	87.0	65-70	Not Accepted
		MCC.Rd./Wetheral Rd.	89.9	35-45	Not Accepted

3.2. Influence of Environmental Factors on Noise Pollution in Owerri Metropolis

Table 3 shows the influence of environmental factors on noise pollution in Owerri Metropolis; 29(3.2%) said heavy vehicular traffic plying residential areas contributed to noise generation, 33(3.7%) blamed it on indiscriminate blowing of siren, while 25(2.9%) said, it resulted from too much use of horns. Twenty one (2.3%) said, there were many noisy engine vehicles and 792 (88.0%) claimed that all the factors contributed. There is statistically significant difference between the knowledge of gender on noise pollution and vehicular movement. The calculated Chi-square value (X^2Cal) of 2601.444; df = 4 is greater than the table Chi-square value (t-Cal) of 9.488 at P< 0.05. Therefore, significantly, null hypothesis was rejected.

From the acoustic standpoint, 43(4.9%) said single large buildings contributed to noise generation, 101(11.2%) blamed installations that produce noise, 11(1.2%) said sound- prone buildings/batchers, while 745(82.9%) said all the listed factors contributed. The calculated Chi-square value (X^2Cal) of 1620.871, df =3 is greater than the table Chi-square value (t-Cal) of 7.815at P< 0.05. Therefore, significantly hypothesis was rejected.

Again, on careful plan of the city helps to minimize noise level, 380(42.2%) said the city was well planned, 481(53.4%) answered no while 39(4.3%) were undecided. The calculated Chi-square value (X^2Cal) of 357.607, df = 2is greater than the table Chi-square value (t-Cal) of 5.991 at P< 0.05. Therefore, significantly hypothesis was rejected.

Table 3 Influence of Environmental Factors on Noise Pollution in Owerri Municipal Council

Variables	Freq (%)		Total	P –value	Calculated X^2 value
Vehicular Movement	Gender				
	M	F			
Heavy vehicular traffic ply residential streets	9 (1.0)	20 (2.2)	28(3.2)	P < 0.05	2601.444
There is indiscriminate blowing of siren	14(1.6)	19(2.1)	33(3.7)		
There is much use of horns	5(0.6)	20(2.2)	25(2.9)		
There are many noisy engine vehicles	9(1.0)	12(1.3)	21(2.3)		
All of the above	198 (22.0)	594 (66.0)	792(88.0)		
Tabulated X^2 = 9.488; df=4					
Acoustic Stand Point				P <0.05	1620.871
Single large buildings	11(1.2)	32(3.6)	43(4.9)		
Installations that produce noise	40(4.4)	61(6.8)	101(11.2)		
Sound-prone buildings/batchers	3(0.3)	8 (0.8)	11(1.2)		
All of the above	300 (33.3)	445 (49.4)	745(82.9)		
Tabulated X^2 = 7.815, df =3					
A Carefully Planned City				P <0.05	357.607
Yes	100 (11.1)	280 (31.1)	380(42.2)		
No	100(11.1)	381 (42.3)	481(53.4)		
Undecided		20(2.2)	39(4.3)		

Tabulated X^2 = 5.991, df = 2

3.3. Associated Health Risks of Noise Pollution on the Residents of Owerri Metropolis

Table 4 Associated Health Risks with Noise Pollution on the Residents of Owerri Metropolis

Variables	Frequency (%)		Total	P-value	Chi-square calculated
Disturbs my sleep	Gender		47(5.7)		
	M	F		P < 0.05	=3499.267;
Causes annoyance	21(2.3)	26 (2.9)	24 (2.7)		
Causes headache	14 (1.6)	10 (1.1)	41(4.6)		
Interferes with my conversation	15 (1.7)	26 (2.9)	21(2.3)		
Disturbs while teaching or listening to my teachers	9 (1.0)	12(1.3)	36(4.0)		
Makes me unable to understand speech	21 (2.3)	15 (1.7)	39(4.3)		

Pains	19 (2.1)	20 (2.2)	31(3.4)		
Lack of concentration	22 (2.4)	9 (1.0)	19(2.1)		
Whistling and buzzing of the ear	10 (1.1)	9 (1.0)	13(1.4)		
Hearing impairment	12 (1.3)	1(0.01)	38(4.2)		
All of the above	30 (3.3)	8(0.9)	591 (65.7)		
Tabulated $x^2 = 18.307$; $df = 11$	*100 (11.1)*	*491 (54.6)*			
Associated Health Risk among gender dependent					
Yes	300(33.3)	377(41.9)	61(75.2)		
No	100(11.1)	106(11.8)	206 (22.9)		
Undecided	7(0.8)	10 (1.1)	17 (1.9)		

Tabulated $X^2 = 5.991$, df = 2

Table 4 presented the associated health risks of noise pollution as seen in the previous work, 47(5.2%) reported disturbs my sleep, 24(2.7%) said it causes annoyance, 41(4.61%) said it causes headache, 21(2.3%) reported interference with my conversation, 36(4.0%) it disturbs while teaching or listening to my teachers, 39(4.3%) said it makes me unable to understand speech, 31(3.4%) said pains, 19(2.1%) said lack of concentration, 13(1.4%) said whistling and buzzing of the ear, 38(4.2%) said hearing impairment while 591(65.7%) reported all of the above. The evaluation of associated health risks of noise pollution on the residents among gender, 677(75.2) said yes and 206(22.9) said no while 17(1.9) were undecided.

3.4. Education and Enforcement of Laws Prohibiting Noise Pollution in Owerri Metropolis

Table 5 Education and Enforcement of Laws Prohibiting Noise Pollution in Owerri Metropolis

Variables	**Frequency (%)**		**Total**	**P –value**	**Calculated X^2 value**
	M	**F**			
Continuous Education of the Residents on the Associated Health Risks inherent in Noise Pollution				P < 0.05	1557.247
Yes	19 (2.1)	10(1.1)	29(3.2)		
No	300 (33.3)	558(62.0)	858(95.3)		
Undecided	1(0.1)	12 (1.3)	13(1.4)		
Tabulated X_2= 5.991, df = 2				P < 0.05	
Noise pollution is due to lack of Enforcement of Laws prohibiting Noise Pollution					1636.247
Yes	300 (33.3)	572 (63.6)	872(96.7)		
No	12(1.3)	9 (1.0)	21(2.3)		
Undecided	5(0.6)	2(0.2)	7(0.8)		
Tabulated $X^2 = 5.991$, df =2				P < 0.05	

Tabulated $X^2 = 5.991$, df = 2

Table 5 shows education and enforcement of laws prohibiting noise pollution, 29(3.2%) said there were continuous education on laws prohibiting noise generation, but 858 (95.3%) said there was none, while 13(1.4%) were undecided. There is statistically significant difference between the knowledge of gender on noise pollution and education and enforcement of laws prohibiting. The calculated Chi-square value (X^2Cal) of 1557.247; df = 2 is greater than the table Chi-square value (t-Cal) of 5.991 at P< 0.05. Therefore, significantly, null hypothesis was rejected.

And 872(96.7%) said lack of enforcement of laws prohibiting noise pollution, 21(2.3%) said it was not true while 7(0.9%) were undecided. The calculated Chi-square value (X^2Cal) of 1636.247; df = 2 is greater than the table Chi-square value (t-Cal) of 5.991 at P< 0.05. Therefore, significantly, null hypothesis was rejected.

4. Discussion

From the findings of this study, environmental factors were implicated as factors influencing noise generation in Owerri Metropolis. A good number of the residents were peasants earning an average monthly income of N10, 000-N20, 000. For this reason, there is no doubt that residents would lack the capacity to live and operate in decent, separate and noise-free environments**.** Rains et al [4] opined that illiterate women and young adult males generate noise more than their older people. And they might not be knowledgeable enough on the dangers inherent in noise pollution. Low socio-demographic status leads to neighborhood overcrowding and the associated human activities such as the indiscriminate use of loud speakers, entertainment, festivals, election campaign rallies, fireworks, and so on, all these push up the noise pollution level during the evening hours. World Health Organization [18] supported the report on the effects of environmental noise pollution which was perceived to be associated with many health risks. For instance, it disturbed sleep and it was in line with Heewagen [21] who noted that noise interferes and impairs some activities like sleeping. The result showed that noise pollution, causes annoyance to the people because as noise level increases to 40dB, people will start complaining about it. Also, Amadi [11] affirmed that noise pollution causes annoyance by interfering with conversation, mental concentration, rest and recreation.

Concerning the environmental factors, greater number of the respondents reported that environmental factors influence noise pollution due to too much use of horns/sirens and many other noisy engine vehicles on the roads. This agrees with WHO [14], which opined that the main threat of noise pollution is road transportation and Alberola [22] (2005), observed that road traffic is a major factor in noise pollution. According to Lebiedowska [23], buildings radiate generated noise. On the same note, Olayinka and Abdullahi [24] reported that road traffic is the prominent and most generating source of noise in Nigeria.

In regard to acoustic stand point, cities with many private and public students' hostels, indiscriminate use of generators and other sound systems and people live in sound-prone buildings/batchers as observed in AIvan Federal College of Education (AIFCE) campus because Owerri Municipal Council was not carefully planned. Also, indiscriminate settings of motor parks (loading bays), markets, street hawking activities, traffic jams, among other noise pollution were contributing factors. And the above was in agreed with WHO [25] stated that the major causes of noise pollution are the environmental factors.

Lack of continuous education influences generation of noise in this study and it was similar to the work done by Parks [1] and WHO [26] that high rate of illiteracy and lack of continuous education of the people is a major factor to noise pollution mostly among the developing countries. Furthermore, Anomohanran [27] discovered that lack of public awareness and ignorance of the people caused most noise pollution in major towns in Delta State, Nigeria.

5. Conclusion

In conclusion, environmental factors, poor education and lack of enforcement of the laws influence noise generation in Owerri Metropolis. The vehicular movements, acoustic factors, careless planning of the city were the perceived environmental factors influencing noise generation in Owerri Metropolis.

Another important factor was low level of education of the residents and there were inadequate of enforcement of laws prohibiting noise pollution among machine or electronic operators in Owerri Metropolis.

Recommendations

Based on the findings of this study, there is need to check the level of noise pollution in night and day time in Owerri Municipal Council. Noise pollution should be assessed with reference to vehicular movements and acoustic factors in Owerri Municipal Council. The enforcement of laws prohibiting noise pollution should be strictly adhering to.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors of this article report no conflicts of interest throughout the work.

Statement of informed consent

Approval to carry out this study was obtained from Head of Department of Public Health, Federal University of Technology, Owerri, Imo State and Director of Capital Development of Imo State. The researcher obtained a letter of introduction as an approval for the research from the Department of Public Health, School of Health Technology, before proceeding to Owerri Metropolis. Informed consent was also given by the participants.

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