ORIGINAL RESEARCH PAPER

Geography

SPATIAL DISTRIBUTION AND LEVELS OF AIR QUALITY PARAMETERS WITHIN ASABA AND ENVIRONS, DELTA STATE, NIGERIA

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ABSTRACT

This study investigated the levels and spatial distribution of key air quality parameters within Asaba and environs. Five locations were sampled to assess the concentration of Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), hydrogen sulphide (H_2S), carbon monoxide (CO) and volatile organic compounds (VOCs). Measurement of Air pollutants methods approved by ASTM was adopted for each specific parameter. All equipment and meters were properly pre-calibrated before each usage for quality assurance. Findings of the study showed that measured levels of CO (0.08-0.20 ppm), H_2S (0.01-0.10 ppm) and VOCs (13-20 ppm) in all sampling areas were below World Health Organization (WHO) and National Air Quality (NAQ) Guidelines and Standards for ambient conditions. However, NO_2 (0.11-0.25 ppm) in all sampling areas was quite high and above regulatory limits. SO_2 (0.15-0.25 ppm) was within the acceptable limit in Okwe and Ibusa but above regulatory limits in Asaba, Anwai and Okpanam. The results suggest Routine measurements should be made on a continuous basis to ascertain the volume of gaseous pollutants in the urban and rural environments

1. INTRODUCTION

Air pollution is a major environmental health problem affecting everybody, both in developed and developing countries which has a serious significant impact on the ecosystem and the health of humans. This type of pollution can be defined as the presence of pollutants concentration, such as particle substances (PM), sulphur dioxide (SO_2), nitrogen oxides (NOX) and ozone (O_3) in the air that is inhaled at levels which can create some negative environmental and human health (Yelda & Mustafa, 2011) as well as major environmental risk factor in the incidence and progression of some diseases such as respiratory diseases, asthma, pneumonia, asthma, lung cancer, ventricular hypertrophy, psychological complications, autism, retinopathy, fetal growth, tuberculosis, meningitis and measles and low birth weight (Ghorani-Azam, Riahi-Zanjani & Balali-Mood, 2016). There are both natural and human-based sources of air pollution. However, humans contribute significantly more to the problem of air pollution in the environment.

Human health is endangered with diseases associated with this nature of pollution particularly in developing economies facing industrialization and urbanization rapidly resulting in early mortality. However, by reducing the levels of this air pollution, countries can reduce the burden of diseases from respiratory diseases, asthma, pneumonia, tuberculosis, Meningitis to measles (WHO, 2014). The reduction in outdoor air pollution caused by emissions from vehicles, electricity generators and industries, road and building construction activities, as well as mining etc reduces Carbon dioxide (CO_2) emissions and this short-lived climate pollutants such as the particles of a black carbon and methane, consequently contributing to near and long term mitigation of climate change in the environment (WHO, 2014).

Globally, air pollution poses a serious threat to human health and the ecosystem generally. (Adejoke, Andile & Murembiwa, 2019). Economic growth, urbanization, energy generation and consumption, transportation services and rapid population growth are major energetic forces of air pollution resulting in various health consequences that affect children the most, as they are the most vulnerable (Colbeck & Lazaridis, 2010). Due to this effect, air pollution has become one of the most significant environmental and public health issues.

Air contamination is a leading environmental toxin (Landrigan, Fuller, Acosta, Adeyi, Arnold, Basu, Zhong, 2017) attributed to diseases responsible for an estimated 16% of premature deaths in the world. In recent years, several epidemiological studies in both developed and developing countries (Nwachukwu & Ugwuanyi, 2010; Yelda & Mustafa, 2011; Nwachukwu, Chukwuocha & Igbudu, 2012; Lelieveld, Klingmuller, Pozzer, Poschl, Fnais, Daiber & Munzel, 2019) have occurred, showing short-term and long-term exposure to air pollutants and its adverse associated health effects. Similarly, time series studies conducted in Asian cities also showed effects of exposure to particulate matter such as NO_2, SO_2, O_3 on mortality to those explored in Europe, South America and Africa (Vlatka, Elvira & Josip, 2011; William, 2012; Menezes, Viana & Paes, 2012; Ibe, Opera, Njoku & Alinno, 2017; Lelieveld et al., 2019).

In Africa and Nigeria in particular, Ibe et al., (2017) monitored ambient air quality of industrial areas of Southeastern Nigeria for criteria pollutants which included Particulate matter (PM10), sulfure (SO_2), Nitrogen dioxide (NO_2) as well as Carbon monoxide (CO) and all the pollutants monitored were found to be very high as compared to the World Health Organization Air Quality Guideline. This means that these pollutants are already of a high risk to the teeming Nigerian population. Yelda and Mustafa (2011) examined air pollutants and its possible health effects. The results of the study showed an increase in respiratory tract diseases of an Antigen-Presenting Cells (APCs). Nine-year data analysis results obtained showed a significant relationship between the APCs and respiratory tract diseases. That is, as the APCs (SO_2 and PM) increases, so does the morbidity and number of respiratory tract diseases. According to the findings, respiratory tract infections are significantly related to SO_2 and PM concentrations.

Despite putting considerable air pollution prevention and control measures in recent years into practice, outdoor air pollution remains one of the most significant threat to humans (Sun & Zhu, 2019) which is regarded as one of the greatest public health threats worldwide. Depending on sizes and nature, all constituents appearing in excess quantities in the atmosphere, such as particulate matter, sulphur oxides as well as nitrogen oxides may be its ingredients. People's exposure to these pollutants may cause greater risk of acute cardiovascular diseases, respiratory tract diseases, and increased mortality. Also, the

penetration of smaller particles may act as brain's blood obstruction and thus affect the central nervous system (G adka, Rymaszewska & Zato ski, 2018).

However, much attention has not been given to environmental air pollution but few scholars have been looking at only oil producing communities (Ogbija, 2014, Atubi, 2015a, Atubi, 2015b), for example Ogbija (2014) looked at the effects of environmental degradation on human health in oil producing communities in Delta State while Atubi (2015 a & b) looked at the factors of environmental degradation in oil producing communities in Delta State and the effects of oil spillage on human health in oil producing communities in Delta State. Hence, the emphasis on only oil producing communities restricted the purview of the study. This is because researches by (Hathout, 2002; Gruzieva, 2013; Baumgartner, 2014) have shown that the vertical and lateral movement of air leaves unpolluted source communities vulnerable to air pollution problems. Therefore, this research is set to examine the prevalence of pollutant gases and the occurrence of associated diseases in Asaba Metropolis, Delta State since air quality research in this area is scarcely available or very scanty.

2. Research Methods

Epidemiological data of all the reported cases treated for air-pollution related diseases from 2008 to 2017 reported by place of diagnoses was obtained from the Federal Medical Centre (FMC) in Asaba and it is important to note that the data collected from the FMC represent the sum of the incidences from all the hospitals within both local government areas. The Air-pollution related diseases were extracted from medical records from 2008 to 2017 based on reliability, consistency, continuity in records and long range of data as seen in Nwachukwu et al., (2012), Atubi (2015 a and b). The major diseases associated with air pollution that was investigated are respiratory diseases, Asthma, Pneumonia, Tuberculosis, Meningitis and Measles. These diseases are well defined in literature (Ugwuanyi & Obi, 2002; Brooks, Carrol, Butel, & Morse, 2007; Willy, Sherwood & Woolverton, 2008).

The study adopted the stratified random sampling technique and it was applied based on the division of the study area. Study sites were selected with a view to giving a holistic representation of air quality status of the area. The study area was stratified into two LGAs based on presence of main roads, dump sites, industries, and residence and 3 sampled sites were delineated for Oshimili South and 2 for Oshimili North which make up Asaba Metropolis. The three communities sampled in Oshimili South are Asaba, Anwai while Okwe, Ibusa and

Okpanam were sampled in Oshimili North LGA (See figure 1). The air quality data was generated from measurement of NO2, SO2, H2S, CO and VOC in the five locations. The National Ambient Air Quality Standard (NAAQS) data and the summary of the Updated World Health Organization Air Quality Guideline (WHOAQG) data were also collected for the purpose of comparison as secondary data.
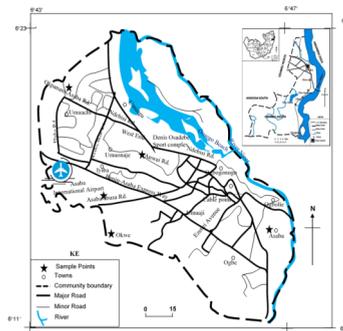

Fig. 1: Map of Asaba Showing Sampled Sites
Source: Ministry of Lands, Survey and Urban Development, Asaba, 2006

The types and trend of air pollutants/pollution in the study location, ambient air quality from the respective sites in the study location were analyzed descriptively (Mean±SD) and to determine the pattern and prevalence of pollutant gases. The descriptively (Mean±SD) has been used by Nwachukwu et al. (2012) to ascertain the effect of air pollution on the people of Rivers State, Nigeria, Ogbija (2014) to examine effects of environmental degradation on human health in selected oil communities and also by Atubi (2015b) to examine effects of oil spillage on human health in producing communities of Delta State, Nigeria.

On the prevalence of air pollution associated diseases, analysis of medical record using simple percentage method, frequency distribution method and measure of central tendency/dispersion (Mean±SD) was adopted to determine the pattern and prevalence of associated diseases.

To examine the relationship between the five prevalent pollutant gases and air pollution associated diseases in Asaba, data from medical records was regressed against volumes of prevalent pollutants in the area using Multiple Regression Model. The Multiple regression models were used to examine factors of environmental degradation (see Atubi, 2015 a&b). Also, the multiple regression analysis has been applied in researches by Nkwocha, Egejuru, Pat-Mbano and Tony-Njoku (2011), Atubi (2011 and 2012), Atubi and Ogbija (2015) with significant results.

3. DISCUSSION OF RESULTS/FINDINGS
Table 1: The Distribution of Air Pollutants in Oshimili North and South LGAs of Delta State.

Morning Hours	Pollutants (ppm)	Oshimili South			Oshimili North		WHO Standard (ppm)	NAQS (ppm)
		Asaba	Okwe	Anwai	Okpanam	Ibusa		
	NO2	0.22	0.23	0.12	0.20	0.25	0.10	0.04-0.06
	SO2	0.17	0.21	0.25	0.17	0.2/	0.175	0.01-0.10
	H2S	0.09	0.1	0.05	0.01	0.1/	22.4	Nil
	CO	0.08	0.17	0.04	0.2	0.15	26	10-20
	VOC	20	15	14	16	16	30.3	Nil
Evening Hours	NO2	0.21	0.22	0.11	0.20	0.23	0.10	0.04-0.06
	SO2	0.16	0.20	0.24	0.15	0.2	0.175	0.01-0.10
	H2S	0.10	0.1	0.03	0.01	0.09	22.4	Nil
	CO	0.2	0.15	0.05	0.08	0.14	26	10-20
	VOC	20	14	13	15	15	30.3	Nil

Source: Authors field work, 2018

Table 1 shows the mean pollution load in the study areas during morning and evening hours. The result of air pollutant measured in the mornings showed that, Nitrogen Dioxide (NO2), , Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) have mean concentration of 0.22 ppm, 0.17ppm,

0.09ppm, 0.08ppm and 20 ppm respectively in Asaba while the mean concentrations are 0.23ppm, 0.21ppm, 0.1 ppm, 0.17ppm and 15 ppm for Nitrogen Dioxide (NO2), , Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) respectively in Okwe. For Anwai the mean concentrations recorded in the morning during the study period were 0.12ppm, 0.25ppm, 0.05ppm, 0.04ppm and 14 ppm for

Nitrogen Dioxide (NO2), Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) respectively.

In Okpanam, the mean concentration of 0.20ppm, 0.17 ppm, 0.01ppm, 0.2ppm and 16ppm for Nitrogen Dioxide (NO2), Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO) and Volatile organic compounds (VOC) respectively while the mean concentrations for Ibusa were 0.25ppm, 0,2ppm, 0,1ppm, 0.15ppm and 16 ppm were recorded for Nitrogen Dioxide (NO2), Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) respectively.

In the evening hours, the mean concentration of 0.21ppm, 0.16ppm, 0.10ppm, 0.2ppm and 20 ppm for Nitrogen Dioxide (NO2), , Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) were recorded in Asaba. In Okwe, the mean concentration of 0.22ppm, 0.20ppm, 0.1ppm, 0.15ppm and 14ppm were recorded for Nitrogen Dioxide (NO2), Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) respectively. At Anwai, the mean concentration recorded were 0.11 ppm, 0.24ppm, 0.03 ppm, 0.05ppm and 13ppm for Nitrogen Dioxide (NO2), , Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) respectively. Similarly at Okpanam, the mean concentration of 0.20ppm, 0.15ppm, 0.01ppm, 0.05ppm and 15ppm were recorded for Nitrogen Dioxide (NO2),Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) respectively while the mean concentration of 0.23ppm, 0.2ppm, 0.09ppm, 0.14ppm and 15ppm for Nitrogen Dioxide (NO2), Sulfur dioxide (SO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and Volatile and organic compounds (VOC) respectively were recorded in Ibusa.

It could be deduced from the Table 1 that higher concentration of the Nitrogen Dioxide (NO2) in Ibusa was recorded in the morning hour and least in the evening hour. However, Anwai had the least concentration of the Nitrogen Dioxide (NO2), closely followed by Okpanam, Asaba and then Okwe. It should therefore be noted that combustion of fossil fuel is the primary source of NO2 emissions (Olajire, Azeez & Oluyemi, 2011) in the study areas. The outcome of the finding showed that there is a high rate of combustion of fossil fuel taking place in Ibusa than any other study areas. Major sources of fossil fuel include transportation (including personal and heavy-duty vehicles), generation of electricity, industrial processes, residential and commercial activities. In additional to the finding, sources of biomass, coal smoke emissions and industries have been informed to emit many health-damaging pollutants, including nitrogen oxides (Akpoghelie, Irerhievwie, Agbaire & Orisaremi, 2016). Studies have revealed that Nitrogen dioxide has the ability to irritate the lungs and lower resistance to respiratory infections such as influenza (Akpoghelieet al., 2016). Also, the outcome of the finding revealed that burning of fossil fuels such as coal, oil and natural gas was the main source of sulphur dioxide concentration in the areas sampled. General survey also showed that the exposure to sulphur dioxide occurs primarily through direct breathing of contaminated air (Akpoghelieet al., 2016). The Agency for Toxic Substance and Disease Registry (2016) reported a long-term study surveying large numbers of children and the finding revealed possible associations between SO2pollutant and symptoms of respiration or reduced ability of breathing. SO2 pollution may result in corneal haze, breathing difficulty, airway inflammation, eye irritation, psychic alterations, pulmonary oedema, heart failure and circulatory collapse.

From the result obtained from H2S in the five sampled locations, it could be seen that all values obtained for hydrogen sulphide (H2S) at different sampling locations were below the WHO Guidelines and Standards for Ambient Air Quality which stipulates a range of 22.4 ppm. This implies that there are low anthropogenic activities in the study areas emitting H2S to the atmosphere. Short-term exposure to H2S causes throat irritation, nose, eyes, tiredness, headaches, and breathing difficulties in asthmatic patients while long-term exposure may affectnervous system and respiratory tract (ATSDR, 2016).

From the results, it could be seen that Carbon monoxide (CO) measured at all the sampling locations was between the ranges of 0.08 to 0.20 ppm. This implies that the concentration of CO measured in all the sampling stations was below the WHO and NAQ standards tolerance limit for air quality, which stipulates a range of 26 ppm and 10 to 20 ppm for an 8–hourly average time respectively and therefore may not pose immediate hazard to the exposed population. It can also be deduced from the finding that Asaba and Okpanam had the highest joint CO concentrations value of 0.20 ppm recorded in the evening and morning sampling sessions respectively. Anwai had the lowest concentration value ranging from 0.04 to 0.05 ppm. This low concentration of CO is due to the fact that CO is certainly oxidized by oxygen to carbon dioxide in the atmosphere. Carbon monoxide levels in urban and semi-urban areas closely reflect traffic density (in combination with weather conditions) and also open incineration of wastes (Njoku et al., 2016). In this study, the two highest CO concentrations were recorded at two major traffic intersection areas (Asaba and Okpanam), thisis mainly because of the high presence of vehicular activities and road construction along Federal Medical Center during the sampling period. The CO concentration in this study is quite different from those reported by Olajire et al. (2011) and Akpoghelie et al. (2016) in a study of air pollutants along Oba Akran road, Ikeja Lagos State and sub-urban cities in Isoko, Delta State.

The results of the study also revealed that the values of data for VOC concentrations in this study ranges from 13.00 to 20.00 ppm which falls below the maximum WHO standard (30.3 ppm) in fresh air which is safe for healthy adults for an 8-hour work day (WHO, 2016). It could be seen that Asaba had the highest VOC concentration with value of 0.20 ppm showing a high traffic density and other anthropogenic activities taking place in Asaba main town than any of the sampled location. Anwai had the least concentration of the VOC, closely followed by Ibusa and Okpanam which had similar concentrations for both sampling periods and then Okwe. The World Health Organization (2018) reported that people are at highest risk of prolonged exposure to VOC from heavy motor vehicle traffic.

3.1: The Prevalence of Air Pollution and Associated Diseases 2007-2017.

Table 2: Patients care information statistics on Air Pollution Related Diseases Reported for the period of ten years (2008 – 2017)

Year	Respiratory Disease	Asthma	Pneumonia	Tuberculosis	Meningitis	Measles
2008	1386	99	91	148	3	21
2009	2726	135	355	227	27	33
2010	1402	84	122	2448	4	27
2011	1902	241	310	274	12	35
2012	2292	291	277	3197	9	23
2013	2882	312	69	3716	3	19
2014	1878	162	65	833	6	6
2015	1635	100	82	749	5	8
2016	1252	81	69	1029	21	13
2017	1534	68	50	876	43	7
Total	18889	1573	1490	13497	133	192

Source: Department of Health Information Management, Federal Medical Centre, Asaba (2018)

Table 2 shows data on air pollution related diseases reported at the Federal Medical Centre, Asaba, a central medical facility covering the study areas. The result showed that for the immediate past decade, respiratory diseases had the highest prevalence with total reported cases of 18,889. This is closely followed by Tuberculosis with a ten year record of 13,497, Asthma recorded 1,573 cases, Pneumonia cases were 1,490, Measles cases were 192 while the least reported disease was Meningitis with a ten year record of 133 cases.

The result further showed cases of respiratory diseases were on the increase from 1,386 in 2008 to 1,534 cases in 2017. Similarly, cases of Tuberculosis were on the increase from 148 cases in 2008 to about 876 cases in 2017. Same trend was observed for Meningitis, only 3 cases were recorded in 2008 but by 2017, the incidence had increased to 43 cases. However, it appeared to be a good decline in reported Measles cases from 21 cases in 2008 to 7 in 2017. This drift was also observed in Pneumonia which had 91 reported cases in 2008 but reduced to 50 in 2017. There was also a marginal drop in the reported cases of Asthma for the period from 99 cases in 2008 to 68 in 2017.

It is pertinent to observe that phenomenal increases in the hospital cases of respiratory diseases were in 2009 where the figure rose to 2726. In 2013, the figure rose to 2882. From 2013 to 2017, the figures showed a downward trend. In a similar pattern, Tuberculosis had a peak in 2010 with reported hospital cases of 2448 which further rose to 3197 in 2012 and 3716 in 2013. The rest of the diseases didn't show these sharp increases and drop like respiratory diseases and Tuberculosis. There were fluctuations in the numbers of reported cases within the years but there were not very pronounced like that of the respiratory diseases and Tuberculosis in the area.

One could possible comment that most of the declines seen in reported cases could be attributed to availability and accessibility of drugs and medical care. Also, there have been massive awareness campaigns by Government and other health related ministries and agencies that people should seek early medical care for especially cases of Tuberculosis noting that early diagnosis is key to survival of patients.

3.2 Relationship between Prevalence of Pollutants and Occurrence of Associated Diseases
Table 3: Summarized Multiple Regression Model Result

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
NO2	.727a	.529	.413	.05560
SO2	.790a	.624	.129	.03516
H2S	.654a	.428	.716	.05084
CO	.977a	.954	.862	.02204
VOC	.803a	.645	.064	2.46948
a. Predictors: (Constant), Measles, Tuberculosis, Meningitis, Respiratory Disease , Asthma, Pneumonia					

Table 3 presents the summarized R, R2, adjusted R2, and the standard error of the estimate, which was used to determine how well a regression model fits the air pollution and disease data.

The values of 0.727 for NO2, 0.790 for SO2, 0.654 for H2S, 0.977 for CO and 0.803 for VOC indicate a very high level of prediction of the relationship between air pollution and prevalence of associated diseases in Oshimili South and North LGAs as represented by Asaba and Okanam and other locations.

The R2 value (also called the coefficient of determination) is

the proportion of variance in the dependent variable that can be explained by the independent variables. From the model result, values of 0.529 for NO2, 0.624 for SO2, 0.428 for H2S, 0.954 for CO and 0.645 for VOC means that NO2 explains or account for 53% of the prevalence of Measles, Tuberculosis, Meningitis, Asthma, Pneumonia and respiratory diseases in the study area. SO2 accounts for 62%, H2S accounts for 43%, CO accounts for 95% and VOC accounts for 65% of the prevalence of Measles, Tuberculosis, Meningitis, Asthma, Pneumonia and respiratory diseases in the study areas. The result evidently shows that CO is the largest culprit in the atmospheric pollutants that contributes to diseases. This is followed closely by VOC. This result is congruent with the hospital data collected.

Table 4: Summarized ANOVAa

Model	Sum of Squares		df	Mean Square	F	Sig.
NO2	Regression	.010	6	.002	.562	.749b
	Residual	.009	3	.003		
	Total	.020	9			
SO2	Regression	.006	6	.001	.828	.615b
	Residual	.004	3	.001		
	Total	.010	9			
H2S	Regression	.006	6	.001	.374	.859b
	Residual	.008	3	.003		
	Total	.014	9			
CO	Regression	.030	6	.005	10.353	.041b
	Residual	.001	3	.000		
	Total	.032	9			
VOC	Regression	33.305	6	5.551	.910	.580b
	Residual	18.295	3	6.098		
	Total	51.600	9			
a. Dependent Variable: NO2, SO2, H2S, CO, VOC						
b. Predictors: (Constant), Measles, Tuberculosis, Meningitis, Respiratory Disease , Asthma, Pneumonia						

Table 4 show the summarized ANOVA generated from the multiple regression analysis. The F statistic of 0.562 for NO2 with p-value (sig. of 0.749), 0.828 for SO2 with p-value (sig. of 0.615), 0.374 for H2S and p-value (sig. of 0.859), 10.353 for CO with p-value (sig. of 0.041) and 0.910 for VOC with p-value (sig. of 0.580) means that our model is significant. This implies that the gaseous pollutants have been able to predict the prevalence of the associated diseases, therefore the null hypothesis is rejected and an alternative hypothesis accepted that there is a relationship of significant between the volume of air pollutant gases and the occurrence of associated diseases in the study areas.

Table 5: Coefficients of the Multiple Regression for NO2 Coefficientsa

	Coefficientsa					
	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.126	.081		1.566	.215
	Respiratory Disease	-9.638E-7	.000	-.012	-.018	.987
	Asthma	.000	.000	.883	1.107	.349
	Pneumonia	-5.515E-5	.000	-.138	-.149	.891
	Tuberculosis	-1.202E-5	.000	-.332	-.567	.611
	Meningitis	.002	.002	.614	1.224	.308
	Measles	-5.673E-5	.003	-.013	-.016	.988
a. Dependent Variable: NO2						

Table 5 presents the Coefficients of the Multiple Regression for NO2 and diseases recorded in Oshimili South and North Local Government Areas. From the standardized coefficient values in Table 5, the beta values are positive for Asthma and Meningitis meaning that as the emission of NO2 gases increases so also the occurrence of Asthma and Meningitis increases.

Table 6: Coefficients of the Multiple Regression for So2

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.232	.051		4.550	.020
	Respiratory Disease	1.630E-5	.000	.281	.475	.667
	Asthma	-.001	.000	-1.427	-2.002	.139
	Pneumonia	.000	.000	1.249	1.513	.227
	Tuberculosis	1.870E-5	.000	.731	1.394	.258
	Meningitis	-.001	.001	-.564	-1.258	.297
	Measles	-.002	.002	-.765	-1.096	.353
a. Dependent Variable: SO2						

Table 6 presents the Coefficients of the Multiple Regression for SO2 and diseases recorded in Oshimili South and North Local Government Areas. From the standardized coefficient values in Table 6, the beta values are positive for Respiratory diseases, Pneumonia and Tuberculosis. This implies that as the emission of SO2 gases increases so also the prevalence of Respiratory diseases, Pneumonia and Tuberculosis increases.

Table 7: Coefficients of the Multiple Regression for H2S

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant	-.004	.074		-.050	.963
	Respiratory Disease	5.779E-5	.000	.850	1.165	.328
	Asthma	.000	.000	-.348	-.396	.719
	Pneumonia	-1.681E-5	.000	-.051	-.050	.963
	Tuberculosis	4.272E-6	.000	.142	.220	.840
	Meningitis	3.877E-6	.002	.001	.002	.998
	Measles	-.001	.003	-.249	-.289	.791
a. Dependent Variable: H2S						

Table 7 presents the Coefficients of the Multiple Regression for H2S and diseases recorded in Oshimili South and North Local Government Areas. From the standardized coefficient values in Table 7, the beta values are positive for Respiratory diseases, Tuberculosis and Meningitis. This implies that as the emission of H2S gases increases so also the prevalence of Respiratory diseases, Tuberculosis and Meningitis increases.

Table 8: Coefficients of the Multiple Regression for CO

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.042	.032		-1.313	.281
	Respiratory Disease	3.148E-5	.000	.303	1.464	.239
	Asthma	.001	.000	1.121	4.495	.021
	Pneumonia	.000	.000	-.484	-1.678	.192
	Tuberculosis	-2.471E-5	.000	-.539	-2.938	.061
	Meningitis	.002	.001	.546	3.480	.040
	Measles	.002	.001	.293	1.201	.316

a. Dependent Variable: CO

Table 8 presents the Coefficients of the Multiple Regression for CO and diseases recorded in Oshimili South and North Local Government Areas. From the standardized coefficient values in Table 8, the beta values are positive for Respiratory diseases, Asthma, Meningitis and Measles. This implies that as the emission of CO gases increases so also the prevalence of for Respiratory diseases, Asthma, Meningitis and Measles increases.

Table 9: Coefficients of the Multiple Regression for VOC

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	10.902	3.586		3.040	.056
Respiratory Disease	.001	.002	.217	.378	.730
Asthma	.022	.018	.830	1.200	.316
Pneumonia	-.031	.016	-1.518	-1.895	.154
Tuberculosis	-.001	.001	-.456	-.897	.436
Meningitis	.036	.079	.200	.459	.677
Measles	.263	.153	1.161	1.713	.185

a. Dependent Variable: VOC Table 9 presents the Coefficients of the Multiple Regression for VOC and diseases recorded in Oshimili South and North Local Government Areas. From the standardized coefficient values in Table 9, the beta values are positive for Respiratory diseases, Asthma, Meningitis and Measles. This implies that as the emission of VOC gases increases so also the prevalence of for Respiratory diseases, Asthma, Meningitis and Measles increases.

4. POLICY IMPLICATIONS/RECOMMENDATIONS
Air pollution is a major environmental health problem, causing and inducing many adverse associated health effects that lead to excessive rate of annual morbidities and mortalities, especially in developing countries such as Nigeria. For this reason, air pollutions control is essential and should be a top priority of the government. Therefore, the policy makers and legislators in the country should amend all relevant laws and regulations, and also ensure there is coordination between different departments involving in air pollutions, which should be led by a powerful environmental protection organization.

The legislation and regulatory authorities should introduce an air quality framework that will require compliance monitoring, evaluation and assessment in Nigeria, and to ensure ambient air quality standards for protection of health are attain, maintain and met continually.

- Governmental institutions such as National Environmental Standards and Regulation Enforcement Agency (NESREA) or the Federal Ministry of the Environment should be enforced with statutory regulations and duties with regards to the protection of the Nigeria's environment such as the air quality. Such regulations should be adopted or re-introduced and strictly implemented which include the prohibition and other control measures restricting the pollutants from certain outdoor activities or from the vehicular emission
- The state government, as well as national agencies such as NESREA, should adopt environmental permitting system by setting out and enforcing management procedures such as regular reviews and assessments of air quality to

identify whether the objectives have been, or will be, achieved at particular geographic locations where public health is, or will be, in jeopardy, by the applicable date that were introduced since the 1980s, by the Nigerian Government as implementation of legislative requirements to attain stated air quality objectives.

• There is a need for proper air quality regulations since air quality standards and objectives are designed to protect public health, moreover, proposed legislation at the National Assembly on air pollution should incorporate the institution of regulations, which are designed with general scientific and expert consensus on the definition of the problem.

• There should be establishment of monitoring mechanisms, regulations, enforcement measures and emissions trading scheme for renewable energy, clean energy and cleaner air initiatives.

5. CONCLUSION

Air pollution exposure has devastating health effects as pollutant particles can penetrate the lungs and cardiovascular system, causing strokes, chronic obstructive pulmonary diseases and respiratory infections such as pneumonia.

It was also revealed in this study that the highest recorded gas emitted in the area was VOCs with 96.4%, CO was 0.8%, N2S was 0.4% while SO2 and NO2 were 1.2% each. NO2 exceeded the WHO and NAQS threshold. The gaseous pollutants showed high affinity with the prevalence of the associated diseases.

From the study, it was revealed that diseases related to air pollution are prevalent in the area of study, which ranges from Measles, Tuberculosis, Meningitis, Asthma, Pneumonia to respiratory diseases caused as dwellers inhaling small to large doses of NO2, SO2, H2S , CO and VOCs. These have contributed to number of hospistalisation cases and have had impacts on the livelihood of the people. Therefore, both the government and the corporate bodies should live up to the challenges of monitoring, evaluating and managing the air we breathe in the urban environment for a sustainable liveable city in the future not just for this generation but those yet unborn. Therefore, routine measurements should be made on a continuous basis to ascertain the volume of gaseous pollutants in the urban and rural environments

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