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Ambient Air Quality Monitoring in Metropolitan City of Lagos, Nigeria

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ABSTRACT: Twenty one sampling locations were assessed for carbon monoxide (CO), carbondioxide (CO_2), oxygen (O_2), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), nitrogen oxide (NO), suspended particulate matter (SPM) and noise level using air pollutants measurement methods approved by ASTM for each specific parameter. All equipments and meters were all properly pre-calibrated before each usage for quality assurance. Findings of the study showed that measured levels of noise (61.4 - 101.4 dBA), NO (0.0 - 3.0 ppm), NO_2 (0.0 - 3.0 ppm), CO (1.0 – 42.0 ppm) and SPM (0.14 – 4.82 ppm) in all sampling areas were quite high and above regulatory limits however there was no significant difference except in SPM (at all the sampling points), and noise, NO_2 and NO (only in major traffic intersection). Air quality index (AQI) indicates that the ambient air can be described as poor for SPM, varied from good to very poor for CO, while NO and NO_2 are very good except at major traffic intersection where they were both poor and very poor (D-E). The results suggest that strict and appropriate vehicle emission management, industrial air pollution control coupled with close burning management of wastes should be considered in the study area to reduce the risks associated with these pollutants.© JASEM

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KEY WORDS: Air, pollutants, Air quality index, carbon-monoxide, sulphur-dioxide

Introduction

The atmosphere is the gaseous envelope that surrounds the earth and constitutes the transition between its surface and the vacuum of space (Bhatia, 2009). The atmosphere is composed primarily of nitrogen (N_2) and oxygen (O_2) and is made up of many layers of air, in each one which is identified by their thermal characteristics or temperature changes, chemical composition, movement and density (Narayanan, 2009). Life on earth is supported by the layers of air, solar energy and our planet's magnetic fields, and the quality of air is very essential to its sustenance (Oxlade, 1994; Ojo and Awokola, 2012). Air pollution is the introduction of chemicals, particulate matter or biological materials that cause harm and discomfort to humans and other living organisms (Bhatia, 2009). The most common air pollutants in the urban environment include: sulphur dioxide (SO_2); oxides of nitrogen (NOx), such as nitrogen oxide, (NO) and nitrogen dioxide (NO_2); carbon monoxide (CO);volatile organic compounds (VOCs); ozone (O_3); suspended particulate matter (SPM) also called particulates; and lead (Pb) (Lutgens and Edward, 2000). Air pollutant can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made (USEPA, 2006; Narayanan, 2009). Sources of air pollution include traffic (vehicle exhaust), industrial sectors (from brick making to oil and gas production), power plants and generating sets, cooking and heating with solid fuels (e.g. coal, wood, crop waste), forest fires and open burning of municipal waste and agricultural residues (Akanni, 2010; Komolafe *et al.*, 2014).

Air pollution is becoming a topic of intense researches at all levels because of the increased level of anthropogenic activities and climatic changes. Air pollution in the urban centre has increased rapidly due to high population density, increased numbers of motor vehicles, use of fuels with poor environmental performance, poorly maintained transportation systems and above all, ineffective environmental regulations and policies (Komolafe *et al*., 2014). Air pollution is believed to kill more people worldwide than AIDS, malaria, breast cancer, or tuberculosis (WHO, 2014). Airborne particulate matter (PM) is especially detrimental to health (Beelen *et al*., 2013), and has previously been estimated to cause between 3 and 7 million deaths every year, primarily by creating or worsening cardio-respiratory disease (Hoek *et al*., 2013). Particulate sources include electric power plants, industrial facilities, automobiles, biomass burning, and fossil fuels used in homes and factories for heating. In China, air pollution was previously estimated to contribute to 1.2 to 2 million deaths annually (WHO, 2014; Yang *et al*., 2013).

This study is focused on one of the most populous, but visibly polluted Nigerian urban environments. Lagos metropolis have been experiencing air pollution problems in all its severity over the past decades which are associated with high density of industries, transport networks and open waste

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burning. Several research works have been carried out in assessing air quality in traffic dense area and industrial zones in selected part of Lagos, but there seems to be a paucity of information on full scale monitoring considering the contribution of pollutants from vehicular traffic, residential area, industrial zones and dumpsite areas. Hence, the objective of this study is to present the air quality monitoring data of selected gaseous pollutants (SO_2, NO, NO_x, CO, CO_2, noise) and suspended particulate matter (SPM) in Lagos taking into cognizance the residential, industrial, open burning dumpsites and major high traffic road intersection, and to highlight the ecological and health associated problems. It is equally hoped that the AQI rating for ambient air quality study will generate data for further research on air quality control and management.

MATERIALS AND METHODS

S*tudy Area***:** Lagos was the former capital of Nigeria (1914 to 1991), it lies in the southwestern part of the Federal Republic of Nigeria within the latitudes 6º 23´ N and 6º 41´ N and longitudes 2º 42´ E and 3º 42´ E (Figure 1). Fifty percent of Nigeria's industrial activities including 300 industries in 12 industrial Estates are located in the Lagos area (Oresanya, 2000). The high urbanization and industrial growth rate in Lagos has made it one of the most densely populated regions on the earth with a population of about 9.3 millions according to 2006 Census (Adesuyi *et al*., 2015). The city has a tropical climate with an average relative humidity of 79%. Mean monthly temperature ranges from 23 – 32^{o}C. Being located in a coastal area and influenced by strong sea-based disturbances, Lagos experiences an average wind speed of 4.3 km/h (Komolafe *et al*., 2014)

Fig 1: Showing map of Nigeria and Lagos.

*Description of Sampling Points and locations***:** The sampling points were randomly selected to cover the core heart of Lagos metropolis, considering vehicular, dump sites, industries, and residence in each of the selected zones. The following Local government areas were sampled: Kosofe, Ikorodu, Ikeja, Oshodi, Apapa, and Lagos Island. Figure 2 shows the metropolitan map of Lagos state and the sampled locations.

Fig 2: Map of Lagos showing sampling locations

Sampling: Twenty one points were sampled, and they included the following; major road intersections (for vehicular emissions), dumpsites (open burning emissions), industrial areas and residential sites. Analysis of ambient air and air pollutants measurement methods were those approved by ASTM (2001) for specific parameters. All equipments and meters were all properly pre-calibrated before each usage for quality assurance.
Temperature was measured using pen monitor with the average readings over a period of ten to fifteen minutes record. Relative humidity was measured using a logger fitted with relative humidity probe (Testo 450) (Hygrometer). The logger measures and stores the values. Noise levels at each point were measured with a pre-calibrated digital readout noise meter (Extech instruments 407730). The sensor of the noise meter was directed towards the source of noise and the average readings over a period of one hour were taken to be the noise-level at each point (Aery, 2010). CO, CO_2, O_2, SO_2, NO_X and NO were determined using ITX multi-gas monitor for one hour exposure time. Suspended Particulate Matter was measured using Personal data RAM-1200 (Park Davis) over a range of one hour to trap in the suspended particulate matter and the reading recorded as the SPM for that location. Sampling points co-ordinates were obtained with hand-held automated GPS

Air Quality Index (AQI): Air Quality Index (AQI) is used for describing ambient air quality. The indices for each of the pollutants were derived using the mathematical formula below:

$$AQI_{pollutant} = \frac{\text{pollutant data reading}}{\text{Standard}} \times 100$$

The air quality index (AQI) is a rating scale for outdoor air. The lower the AQI value the better the air quality. AQI rating A stand for Very good (0 -15), B for Good (16 -31), C for Moderate (32 – 49), D for

Poor (50 – 99) and E for Very poor (100 and over) (USEPA, 2000)

Statistical Analyses: The statistical analysis employed was the descriptive statistics such as mean, standard deviation, analysis of variance (ANOVA) and Tukey's multiple comparisons test using Graph pad prism 6.0 software.

RESULTS AND DISCUSSION

Noise level, Temperature and Relative humidity: The noise level in all the sampling locations is shown in Table 1. The noise level at major road traffic intersection range between 80.5 and 101.4 dBA with the highest recorded around Ojota (Kosofe zone) while the least around Oshodi under bridge (Oshodi/Isolo zone). The highest noise level across all the sampled dumpsites was recorded at Agric (Ikorodu zone) and the least in dumpsite at Apapa zone. In the industrial areas, the highest was recorded in industries around Ojota (95.0 dBA) followed by Ikeja industrial estate (94.5 dBA) while the least was recorded around Chivita (69.6 dBA) in Isolo. Across the residential estates and homes the noise level range between 67.2 dBA and 92.0 dBA, the highest was recorded Tinubu estate (Ikorodu) and the least in VGC (Lagos Island). Generally, across all the zones the highest noise level was recorded at vehicular traffic intersections while the least was at the residential areas. The noise level is quite very high at major traffic intersection; this may be due to the time of sampling which was the peak periods of traffic volume, long waiting time of vehicles at intersection of traffic and also uncontrolled noise from sound speakers as observed in Ojota and Oshodi. The acceptable standard of Noise level by NAAQS of 90dB was quite exceeded in this study. The findings of this study is related to the findings of Abam and Unachukwu (2009) who concluded that the vehicular noise level in major cities in Nigeria is quite alarming and disturbing.

Table 1: Noise level (dBA) recorded in Lagos city during the study peroid

Zones	Vehicular Intersection	Dumpsite Area	Industrial Area	Residential Area
Kosofe	101.4	79.0	95.0	67.2
Ikorodu	93.0	88.2	90.5	92.0
Oshodi/Isolo	80.0	94.4	69.6	70.5
Apapa	82.5	71.2	75.5	76.0
Lagos Island	93.6	71.0	NS	61.4
Ikeja	90.2	NS	94.5	NS
Mean	90.12±3.205	80.76±4.643	85.02±5.234	73.42±5.213
Std. Deviation	7.850	10.38	11.70	11.66

NS-not sampled

The sampled ambient air temperature (°C) is shown in Table 2. The ambient air temperature at major road traffic intersection range between 30.5 °C and 34.8 °C with the highest recorded around Ikorodu roundabout while the least around Lagos Island. The highest temperature recorded in dumpsite areas was 35.3 °C at Ikorodu (Agric dumping ground) and the least was 30.1 at Lagos Island dumping ground. Across all the industrial zones sampled, the highest ambient temperature was recorded Odogunyan Industrial estate (36.1 °C) while the least was recorded at industries in Lagos Island (32.3 °C). Residential temperature ranged between 27.8 °C (VGC Estate, Lagos Island) and 34.0 °C (Tinubu Estate, Ikorodu). Generally the highest mean temperature was recorded at industrial zone and the least at the residential area .

Table 2: Ambient air temperature (°C) received in the study area

Zones	Vehicular Intersection	Dumpsite Area	Industrial Area	Residential Area
Kosofe	32.4	33.4	33.6	30.2
Ikorodu	34.8	35.3	36.1	34.0
Oshodi/Isolo	34.1	30.2	33.9	30.1
Apapa	32.0	30.3	32.3	33.4
Lagos Island	30.5	30.1	NS	27.8
Ikeja	32.2	NS	33.2	NS
Mean	32.67±0.6333	31.86±1.060	33.82±0.6304	34.00±1.149
Std. Deviation	1.551	2.371	1.410	2.569

NS-not sampled

The relative humidity (%) of the study area is shown in Table 3. The mean relative humidity at major road vehicular intersection ranged between 49 to 57 % with the highest measured around Ojota (Kosofe LGA) and the least in Ikeja under-bridge. The relative humidity obtained across all the dumpsites, the highest (55 %) was measured around Oke afa dumpsite (Oshodi/Isolo LGA) and the least (48 %) at Lagos Island dump site. Across industrial zones the relative humidity ranged between 63 % (Ojota, Kosofe LGA) to 39 % (Odogunyan, Ikorodu LGA), however, despite the difference there is no significant difference (P>0.05) across the Industrial areas. In residential areas, the highest relative humidity was 58 % at Ogudu GRA (Kosofe LGA) and the least at VGC (Lagos Island). There was no significant difference at (P>0.05) in relative humidity from the different locations.

Table 3: Mean relative humidity (%) of the study area

Zones	Vehicular Intersection	Dumpsite Area	Industrial Area	Residential Area
Kosofe	57	53	63	58
Ikorodu	56	54	39	55
Oshodi/Isolo	50	55	47	51
Apapa	55	54	57	53
Lagos Island	54	48	NS	50
Ikeja	49	NS	47	NS
Mean	53.50±1.335	52.80±1.241	50.60±4.241	49.42±1.435
Std. Deviation	3.271	2.775	9.423	3.209

NS- not sampled

*Sampled oxygen, carbon monoxide, carbon dioxide, nitric oxide, nitrogen dioxide, and suspended particulate matter***:** Sampled oxygen, carbon monoxide, carbon dioxide, nitric oxide, nitrogen dioxide, and suspended particulate matter level are shown in Table 4. For Oxygen level across all the sampled residential area, Apapa has the highest value (66.9 ppm) while the least is obtained in Olusosun dump site (57.6 ppm) in Kosofe. For major traffic intersection the oxygen level ranged between 60.6 ppm (Ikeja under-bridge) and 63.2 ppm (Oshodi). The average oxygen level in industrial areas is between 60.5 ppm (Kosofe LGA) and 63.1 ppm (Isolo). Across residential areas the oxygen level varied from 60.9 (Tinubu Estate, Ikorodu) to 66.9 ppm (Apapa). The concentrations of carbon-monoxide in heavy traffic stations ranged between 10 to 42 ppm with the highest measured at Oshodi and the least in Ikorodu. Across the Industrial Estates and zones, the CO concentration was found to vary from 3 ppm (Ikeja Industrial Estate) to 15 ppm (Apapa Industrial area) which was higher than that of residential areas, which varied from 1 ppm (VGC) to 4 ppm (Ikorodu). There was significant difference (P<0.05) CO concentration from all the sampling points to Local government areas considered. Ikeja industrial estate has the highest level of CO_2 (9.69 ppm) while the least was observed at Ikeja traffic intersection (3.18). There was no significant difference at (P>0.05) in carbon dioxide.

Carbon monoxide levels in urban and industrial areas closely reflect traffic density (in combination with weather conditions) and also open incineration of wastes. In this study the two highest CO concentrations were recorded at two major traffic intersections in Oshodi and Lagos Island, these may be due to the high presence of vehicles during sampling. Air Quality Index (AQI) is used for describing ambient air quality. It is an indicator of air quality based on pollution levels for the criteria air pollutants that have adverse effects on human health and the environment. In terms of air quality index (AQI), the CO variation across the sampling sites revealed that the air quality were very good (A) around all the sampled residential areas, good to very poor (B-E) in all the sampled major traffic intersection, the dumpsites across all the zones were between good to moderate (B-C) while around the industrial areas it was between Good and moderate except in Ikeja were it was observed to be very good. Carbon monoxide binds to haemoglobin in red blood cells, reducing their ability to transport and release oxygen throughout the body. Moderate exposure of CO to the occupants along the study area can aggravate cardiac ailments such as the brain and heart (Yusuf *et al*., 2013). CO also plays a role in the generation of ground-level ozone. It contributes to the formation of CO_2 and ozone (O_3), greenhouse gases that warm the atmosphere (USEPA, 2007). Comparing the concentrations of CO at different sampling sites in the study area, the CO levels in Oshodi traffic intersection (42 ppm) was higher than US national ambient air quality standard of 35 ppm at one hour exposure time. The CO concentration in this study is quite similar to those reported by Olajire *et al*. (2011) in a study of air pollutants along Oba Akran road, Ikeja Lagos and were much higher to the results obtained for heavy traffic points in Ibadan and Ado Ekiti (Koku and Osuntogun, 2007). Fossil fuel combustion is the primary source contributing to CO_2 emissions. In 2007, fossil fuel combustion contributed almost 94 percent of total CO_2 emissions in US (USEPA, 2007). Major sources of fossil fuel combustion include electricity generation, transportation (including personal and heavy-duty vehicles), industrial processes, residential, and commercial.

The value of NO recorded is between 0 ppm in several sampling points to 3 ppm in Oshodi traffic intersection. There was significant difference at ($P<0.05$) between vehicular and dump site, vehicular and industrial site, vehicular and residential site. For oxides of nitrogen the highest value of 3 ppm was also observed at Oshodi traffic intersection, followed by Lagos Island and Ikeja traffic intersection (2 ppm respectively). There was no significant difference at ($P>0.05$) for nitrogen dioxide from all the different sampling points and local government areas. The concentration of NO_2 was only recorded at traffic intersection only. Traffic congestion is everyday life in the case study city. This may be attributed to poor road infrastructure, uncontrolled automobile growth, lack of effective urban mass transit system, inadequate road networks and private car oriented traffic system because burning of fossil fuel is known to be the major contributor to total NO_2 pollutant load (Olajire *et al*., 2011). The NO_2 concentrations at all the sampling sites exceeded the US maximum national ambient air concentration of 0.313 ppm (1h exposure time average). In terms of AQI rating, the air quality for NO_2 across all the sampling locations and local government in the study area were all very good (A) except at all the major traffic intersection which was all very poor (E). Oxides of Nitrogen (NOx) are medically known to aggravate lung diseases leading to respiratory symptoms, and also increase susceptibility to respiratory infection. They also contribute to the acidification and nutrient enrichment (eutrophication, nitrogen saturation) of soil and surface water which leads to biodiversity losses. NOx also impacts levels of ozone, suspended particles, and methane with associated environmental and climate effects (USEPA, 2007).

Ikorodu (industry) has the highest level of suspended particulate matter of 4.818ppm while the lowest value of 0.144ppm was obtained at Kosofe residential area (Ogudu GRA). SPM at major traffic intersection ranged between 0.243 ppm to 0.612 ppm; for dump sites it varied between 0.225 ppm (Olusosun dump site in Ojota) to 0.693 ppm (Apapa); for industrial areas it varied between 0.027 ppm (Ikeja) to 4.818 ppm (Ikorodu) while for the residential areas it varied between 0.144 ppm (Ogudu GRA in Kosofe) to 0.915 ppm (Apapa). There was significant difference at ($P<0.05$) in Ikorodu between vehicular and industrial sites, dumpsite and industrial sites, industrial and residential sites. The suspended particulate matter in all the sampling location is noted to be very high especially in the industrial locations of Ikorodu and Apapa along with the residential area in Apapa. Researches has confirmed that the level of suspended particulate matter in cities especially in their industrial zones are high due to wind-blown dust from the roads, emissions from machineries in the industry, industrial vehicles etc. (Akuro, 2012; Ukpebor and Okolo, 2002), as also confirmed in this study. In terms of AQI rating, the air quality for suspended particulate matter across all the sampling locations and zones in the study area were all between poor to very poor (D - E). The result obtained in this study is similar to those recorded by Oyediran et al. (2013) during the characterization and source identification of airborne particulate loadings at receptor site classes of Lagos Mega-City. Particulate matter impairs visibility, adversely affects ecosystem processes, and damages and/or soils structures and property. It causes variable climate impacts depending on particle type. Most particles are reflective and lead to net cooling, while some (especially black carbon) absorb energy and lead to warming. Other impacts include changing the timing and location of traditional rainfall patterns (USEPA, 2007). Most cities around the world like Lagos are experiencing high levels of visibility degradation due to high emission intensity and adverse meteorology (Jimoda, 2012).

Table 4: Levels of CO, CO_2, NO, NO_x, O_2 and SPM (ppm) in the study area

Zones	Sampling points	CO	CO_2	SO_2	NO	NO_2	O_2	SPM
Kosofe	Veh. Intersection	12.0	7.20	0.0	0.0	0.0	62.7	0.225
	Dumpsite Area	12.0	9.24	0.0	0.0	0.0	57.6	0.225
	Industrial Area	9.0	5.61	0.0	0.0	0.0	60.5	0.591
	Residential Area	3.0	6.50	0.0	0.0	0.0	63.0	0.144
	Mean	9.0±2.12	7.14±0.77	0.0	0.0	0.0	61.0+1.25	0.30+0.10
	Std. Deviation	4.24	1.55	0.0	0.0	0.0	2.50	0.20
Ikorodu	Veh. Intersection	10.0	7.32	0.0	0.0	0.0	62.9	0.279
	Dumpsite Area	6.0	7.50	0.0	0.0	0.0	62.2	0.252
	Industrial Area	5.0	10.5	0.0	2.0	0.0	61.5	4.818
	Residential Area	4.0	6.81	0.0	0.0	0.0	60.9	0.243
	Mean	6.25±1.32	8.03±0.84	0.0	0.5±0.5	0.0	61.88±0.43	1.40±1.14
	Std. Deviation	2.63	1.67	0.0	1.0	0.0	0.87	2.28

Oshodi/ Isolo	Veh. Intersection	42.0	7.62	0.0	3.0	3.0	63.2	0.243
	Dumpsite Area	13.0	6.51	0.0	0.0	0.0	65.4	0.237
	Industrial Area	6.0	7.25	0.0	0.0	0.0	63.1	0.240
	Residential Area	2.0	5.25	0.0	0.0	0.0	63.6	0.846
	Mean	15.75±9.04	6.66±0.52	0.0	0.0	0.75±0.75	63.83±0.53	0.39±0.15
	Std. Deviation	18.08	1.046	0.0	0.0	1.50	1.07	0.30
Apapa	Veh. Intersection	21.0	7.10	0.0	1.0	1.0	62.8	0.312
	Dumpsite Area	9.0	6.33	0.0	0.0	0.0	61.5	0.693
	Industrial Area	15.0	6.90	0.0	0.0	0.0	61.9	1.413
	Residential Area	2.0	7.26	0.0	0.0	0.0	66.9	0.915
	Mean	11.75±4.07	6.90±0.203	0.0	0.25±0.25	0.25±0.25	63.28±1.24	0.83±0.23
	Std. Deviation	8.14	0.41	0.0	0.05	0.50	2.48	0.46
Lagos Island	Veh. Intersection	27.0	6.43	0.0	1.0	2.0	61.6	0.612
	Dumpsite Area	6.0	6.85	0.0	0.0	0.0	59.7	0.396
	Industrial Area	NS	NS	NS	NS	NS	NS	NS
	Residential Area	1.0	6.21	0.0	0.0	0.0	66.3	0.150
	Mean	11.33±7.97	6.50±0.19	0.0	0.33±0.33	0.67±0.67	62.53±1.96	0.39±0.13
	Std. Deviation	13.80	0.33	0.0	0.58	1.16	3.40	0.23
Ikeja	Veh. Intersection	5.0	3.18	0.0	1.0	2.0	60.6	0.279
	Dumpsite Area	NS	NS	NS	NS	NS	NS	NS
	Industrial Area	3.0	9.69	0.0	0.0	0.0	62.7	0.227
	Residential Area	NS	NS	NS	NS	NS	NS	NS
	Mean	4.0±1.0	6.44±3.26	0.0	0.50±0.50	1.0±1.0	61.65±1.05	0.25±0.03
	Std. Deviation	1.41	4.60	0.0	0.71	1.41	1.49	0.04
USEPA Standard at1hr (2006)		35	-	0.425	-	0.313	-	0.250
FEPA (1991) ppm		10	-	0.01	-	0.06	-	-

NS- Not sampled

Table 5: Results of AQI rating for ambient air quality (CO, SO_2, NO_2, NO, SPM) and the National Ambient Air Quality Standard (NAAQS) for some air pollutant at one hour exposure time for USEPA and FEPA

S/n	Zones	Sampling points	AQI				
			CO	**SO_2**	**NO_2**	**NO**	**SPM**
1	Kosofe	Vehicular Intersection	C	A	A	A	D
		Dumpsite Area	C	A	A	A	D
		Industrial Area	B	A	A	A	E
		Residential Area	A	A	A	A	D
2	Ikorodu	Vehicular Intersection	C	A	A	A	E
		Dumpsite Area	B	A	A	A	D
		Industrial Area	A	A	A	E	E
		Residential Area	A	A	A	A	D
3	Oshodi/ Isolo	Vehicular Intersection	E	A	E	E	D
		Dumpsite Area	C	A	A	A	D
		Industrial Area	B	A	A	A	D
		Residential Area	A	A	A	A	D
4	Apapa	Vehicular Intersection	D	A	E	D	E
		Dumpsite Area	B	A	A	A	E
		Industrial Area	C	A	A	A	E
		Residential Area	A	A	A	A	E
5	Lagos Island	Vehicular Intersection	D	A	E	D	E
		Dumpsite Area	B	A	A	A	D
		Industrial Area	NS	NS	NS	NS	NS
		Residential Area	A	A	A	A	D
6	Ikeja	Vehicular Intersection	A	A	E	D	D
		Dumpsite Area	NS	NS	NS	NS	NS
		Industrial Area	A	A	A	A	D
		Residential Area	NS	NS	NS	NS	NS

NS-not sampled

Conclusion: Air pollution is something that we cannot really ignore now. There is great evidence linking air pollution with mortality and morbidity in the general population, damage to public health with adverse effects concentrated in urban areas both in developed and developing countries, broad range of adverse health effects affecting both the respiratory and the cardiovascular system which are observed in both short-term and long-term exposures (Brunekreef and Forsberg, 2005; WHO, 2009). However, more recently, it is clear that air pollution and climate change are inexorably linked. Air pollutants are now known to be the keen drivers of climate change. Findings of the study showed that measured levels of NO, NO_2, CO and SPM in all sampling areas were quite high and above regulatory limits however there was no significant difference except in SPM (at all the sampling points), and NO_2 and NO (only in major traffic intersection). Air quality index (AQI) indicates that the ambient air can be described as poor for SPM, varied from good to very poor in CO, NO and NO_2 are very good except at major traffic intersection where they were both poor and very poor. The sources in the four site-classes studied (traffic-related, dumpsite emission, industrial and residential) are contributory but with varying degrees of contributions, however residential sources are very low. The results suggest that strict and appropriate vehicle emission management, industrial air pollution control coupled with close burning management of wastes should be considered in the study area to reduce the risks associated with these pollutants. Also, there is need to develop monitoring mechanisms, regulations and enforcement measures by relevant regulatory bodies. National development and drive should focus more on renewable energy, clean energy and cleaner air initiatives.

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