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Environmental-Impacts of Urban Road Transportation in South-Western States of Nigeria

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Abstract: A study of the impacts of urban road transportation on the ambient air and the health of residents of some heavily trafficked locations-eight in Lagos metropolis, four in Ibadan and four in Ado-Ekiti-were carried out. Also, two locations in Lagos, one in Ibadan and one in Ado-Ekiti were used as control. Air quality indicators namely carbon-monoxide (CO), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and total suspended particulates were estimated using automatic air monitors. The noise levels at these locations were also determined with a noise meter. The highest levels obtained for the air pollution indicators in Lagos were CO-232 ppm at Idumota; SO_2-2.9 ppm at Idumota; NO_2-1.5 ppm at Iyana-Ipaja bus stop; total suspended particulates 852 cpm at Oshodi bus stop. At Ibadan, the CO and SO_2 levels at 271 and 1.4 ppm were, respectively highest at Mokola round about while NO_2 at 1.0 ppm was highest at Bere round about. In Ado-Ekiti, the highest levels obtained were CO-317 at Oke Isha, NO_2-0.6 ppm at Ijigbo junction and SO_2-0.8 ppm at Old Garage junction. The recorded noise levels were 112.8 dB at Oshodi bus stop in Lagos, 120 dB at Iwo road in Ibadan and 115 dB at Old Garage junction, Ado-Ekiti. The blood samples of people at these high trafficked locations such as the commercial drivers, conductors, street traders and road traffic wardens were also analysed for lead content with a resultant high Pb concentration. Responses to interviews indicate that these people suffer from air pollution related diseases such as headaches, loss of vision, anaemia, forgetfulness and fatigue than those from the control locations.

Key words: Urban transportation, gaseous air pollutants, particulates, noise levels, blood lead levels, blood pressure

INTRODUCTION

In cities and urban areas, air may be severely polluted from a variety of sources such as transportation and by burning of fossil fuels (oil and coal in power generating stations, factories, office buildings, homes) and by incineration of garbage. The combustion of gasoline and other hydrocarbon fuels in automobiles, trucks and jet airplanes produce several primary pollutants, nitrogen oxides, sulphur dioxides, carbon monoxide as well as large quantities of particulates containing elements such as lead (Lvovsky and Hughes, 1999). In the presence of sunlight, nitrogen oxides combine with hydrocarbons to form a secondary class of pollutants, the photochemical oxidants among them ozone and eye-stinging peroxyacetyl nitrate (Swertsen, 2000, 2002) and atmospheric oxidation of many hydrocarbons and other volatile organic compounds form carbonyls which play important roles in atmospheric chemistry and urban air quality (Grosiean *et al*., 2001).

Vehicular emissions are in a very close tie with industrial process emission as the leading source of air pollution in Lagos-the commercial capital of Nigeria. The emission rate of dust per vehicle kilometer for paved and unpaved roads in all parts of Nigeria is reported to be rather high when compared with 0.1 g per vehicle kilometer for roads in London, England. Quantification of national emissions resulting from transportation showed that sulphur dioxide is 11,600 tons Nitrogen oxides, 80,900 tons; carbon monoxide, 103,300 tons; particulate matter, 817,200 ton and lead 2,500 ton (Obioh *et al*., 1994).

The major sources of airborne lead are leaded gasoline, inceration of solid wastes and industrial emissions. Young children and foetus are most sensitive to lead exposure. Lead can damage the kidneys, impair haemoglobin synthesis (hence cause anaemia) and alter the nervous system. The new behavioural impairment of children intellectual development is a major concern from lead exposure and can lead to death.

Extensive measurements exist to indicate that many Nigerians may be occupationally exposed to very high degrees of air and other forms of pollution (Obioh *et al*., 1994; Ogunsola *et al*., 1993; Anonymous, 2002).

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Noise pollution in Nigeria's big cities such as Lagos, Abuja and Port-Harcourt is a serious problem where motorcycles, old cars and trailers crowd the roads. Indiscriminate and non-emergency horning by drivers on our roads is a common practice and this has serious health effects. Since transportation contributes about forty percent of the total air pollution (Odubel and Obioh, 2002), this study was thus carried out to quantify the gaseous and particulate pollutants due to road transportation and their health effect on road workers.

MATERIALS AND METHODS

Study location: This study was carried out in three state capitals of South Western Nigeria (Lagos, Ibadan and Ado-Ekiti) during the dry season between February and April 2006. Ten locations in Lagos, the commercial capital of Nigeria, comprising eight spots along heavily trafficked road charcterised by over 400 vehicles per hour and two spots along lowly trafficked roads, having less than 200 vehicles per hour were chosen. The low trafficked spots were mainly residential areas. Five locations each in Ibadan and Ado-Ekiti (four heavily trafficked and one low trafficked) were also sampled.

Air pollution monitoring and measurements: The air pollution measurements were carried out using direct reading, automatic *in situ* gas monitors. The gas monitors used were Toxic RAE II-Reusable Personal Toxic gas monitors for CO, SO_2 and NO_2 in ppm. The noise level was measured using Digital sound level meter-Smart Sensor AR824 with sensitivity range of 30-130 dB. The particulate meter used was dusts counter with sensitivity range of 0-2500 counts per minute (cpm). When the monitor was switched on, the alarm timer came on indicating that it was properly functioning. At the end of the booting, the alarm sounded and the readings automatically showed. The noise level meter also booted for 30 sec when put on and displayed the readings which vary with sound/noise level. The particulate was however a continuous reading device in addition to being automatic direct reading and *in situ* measuring meter. The readings were taken in each location over a period of 1 h during peak periods 8-10 am and 4-7 pm The particulate counter was used in Lagos only.

Lead metal in blood of workers in high traffic density areas: The lead analyses in blood was carried out at four locations in Lagos-Dopemu garage, Ojota motor park, Oshodi bus stop and Apapa wharf which served as the control location. Five blood samples were taken from different persons made up of road side workers such as drivers, traffic wardens and food vendors at each location. A highly qualified and experienced nurse was employed for the blood sampling. In addition to taking the blood of the workers, the blood pressures were also measured. The blood sample was collected using a new sterile plastic syringe and put in an anticoagulant container. The blood samples were digested by ashing in the furnace at 550°C for about 6 h, followed by dissolution in conc. nitric acid. The digests were then analysed for lead in an Atomic Absorption Spectrophotometer Perker Elmer Model AAnalyst 200 against standards.

Questionnaires: The pollution impact on person's questionnaire was used to gather information about personal data of respondents and their impact experiences. The age range of the respondents was between 30 and 60 years comprising of 17 men and 3 women.

RESULTS AND DISCUSSION

From Table 1, Idumota Tower Clock junction which is a very busy commercial area, had the highest level of both gaseous and particulate air pollutants followed by the Obalende motor park. The least level of these pollutants were observed at the Ikeja Government Reservation Area (GRA) where the traffic density was very low, less than 100 vehicles per hour.

The noise level was highest at the Iyana Iba bus stop which services Iba town, a high density settlement and lowest at The Ikeja GRA.

From Table 2, the level of gaseous air pollutant was highest at the Mokola junction which had the highest traffic flow of about 600 vehicles per hour and the lowest value was from the Bodija residential area with a traffic flow of less than 100 per hour.

From Table 3, Oke-Isha had the highest level of gaseous air pollutants because of the presence of many old motorcycles and the lowest was at the GRA as a result of low traffic of about 10 vehicles per hour.

From the results obtained, it can be observed that Idumota a very busy commercial area in Lagos emitted averagely the greatest pollutants (Table 1), this is because of the very high traffic and lots of old commercial buses dominance. Although, there were some locations where the traffic density was higher than that of Idumota, the much higher CO and SO_2 can be accounted for from the fact that the area where the readings were recorded is rather enclosed and so the pollutants could not blow freely unlike in Oshodi and Lagos, Ojo-trailer motor park and even in Ibadan (Table 2), where the pollutants were free to blow around. That was why Ojo, Lagos and Oshodi motor parks emitted higher dust

Table 1: Ambient air measurement in Lagos

Location	GPS	Mean CO (ppm)	Mean SO_2 (ppm)	Mean NO_2 (ppm)	Mean Particulate (cpm)	Noise (dB)
Idumota	N06°27.680[1] E 003°.23.231[1]	219.00	2.90	0.50	821.0	94.0
Tower clock junction						
Wharf opposite the port	N06°24.486[1] E 003° 22.669[1]	42.00	0.00	0.15	339.5	92.5
Ojota motor park	N06°35.298[1] E 003° 22.759[1]	46.30	0.20	0.15	325.0	106.3
Ojuelegba under bridge	N06°30601[1] E 003° 11.691[1]	103.00	0.10	0.75	605.5	100.0
Iyana-ipaja bus stop	N06°37.169[1] E 003° 18.165[1]	69.00	0.70	0.60	405.0	102.0
Under the bridge						
Oshodi bus stop	N06°33.576[1] E 003° 21.086[1]	92.00	0.45	0.80	803.5	98.0
Obalende motor park	N06°26.954[1] E 003° 24.597[1]	131.00	0.75	0.15	809.0	99.0
Iyana iba bus stop	N06°27.614[1] E 003° 12.243[1]	90.50	1.55	0.80	439.0	110.0
Fed. Sec. rad						
Lekki Phase I*	N06°26.761[1] E 003° 27.550[1]	4.00	0.00	0.00	138.0	88.0
Admirality road						
Ikeja GPA*	N06°34.736[1] E 003° 21.175[1]	0.00	0.00	0.00	159.0	77.0
Adeyemo Alakija						

*: Control location; GPS: Global Positioning Satellite

Table 2: Ambient air measurement in Ibadan

Location	GPS	Mean CO (ppm)	Mean SO_2 (ppm)	Mean NO_2 (ppm)	Noise (dB)
Iwo-Road near overhead bridge	N07°24.239[1] E 003° 56.659[1]	86.0	0.70	0.05	107.0
Ojo-Trailer prk	N07.28.088[1] E003° 54.796[1]	32.5	0.00	0.43	105.0
Mokola junction opposite Wema Bank	N07° 25.319[1] E003°.54530[1]	135.0	0.65	0.25	101.5
Bere round about	N07° 22.774[1] E003. 53.947[1]	35.0	0.00	0.90	100.2
Oba Olagbegi Pd Bodija Estate*	N07°.25.319[1] E003° 54.530[1]	3.3	0.00	0.00	67.5

*: Control location

Table 3: Ambient air measurement in Ado-Ekiti

Location	GPS	Mean CO (ppm)	Mean SO_2 (ppm)	Mean NO_2 (ppm)	Noise (dB)
Ijigbo junction Fed. Polythenic road	N07°37.045[1] E 005° 13.336[1]	67.80	0.200	0.45	96.3
Oke-Isha Governor's office junction	N07° 37.605[1] E005° 13.094[1]	153.20	0.360	0.05	105.0
Iworoko juncton fajuyi road	N07° 37.772[1] E005° 12.869[1]	55.50	0.020	0.10	95.0
Old garage junction	N07° 37.274[1] E005° 12.869[1]	101.80	0.500	0.13	103.0
GRA opposite FERMA office*	N07° 37.397[1] E005° 12.561[1]	14.25	0.025	0.20	105.0

*: Control location

counts per minute. At Ado Ekiti (Table 3), the traffic volume was not as high as those at Lagos and Ibadan but the mean concentration of the pollutants were found to be comparatively high because the vehicles were generally older than ten years and there were many motor cycles where these readings were taken. The mean concentrations of the pollutants; carbon monoxide, sulphur dioxide, nitrogen dioxide and the particulate counts per minute were found to be much higher than the Federal Ministry of Environment (FMEN) limits and also higher than earlier results of 49.32 ppm CO obtained for heavy traffic points in Lagos (Osuntogun, 1999). Limit set by the Nigerian Federal Minisrty of Environment are Carbon monoxide 10 ppm, sulphur dioxide 0.01 ppm, Nitrogen dioxide 0.04-0.6 ppm (Anonymous, 1991). These pollutants have adverse effects on human health particularly the respiratory organs. Carbon monoxide binds strongly on haemoglobin and therefore prevents haemoglobin from carrying oxygen, its normal function and deprives the body tissue of the necessary oxygen. The symptoms of oxygen deprivation are severe headache, nausea dizziness, coma and even death. Sulphur dioxide effects include coughing chest pains shortness of breath and on the long-run, it causes emphysema and bronchitis. Nitrogen dioxide is highly toxic and corrosive. It is an irritant to eyes and the respiratory tract (Boubel *et al*., 1994).

The noise level in all the locations except in the control locations were found to be higher than the FMEnv. limit of 90 dB and the WHO limit of 70-75 dB (WHO, 2000). Research has proved that noise may produce high blood pressure, contribute to heart and circulatory diseases, cause abnormal foetal development and cause extreme emotions and behaviour (Horsfall and Spiff, 1998).

The results of the concentration of lead in the blood of traffic workers gave highest mean value of 152.42 μg dL^{-1} for Oshodi workers (Table 4) followed by

Table 4: Concentration of lead in blood of high density traffic workers

Location	Age/Sex	Blood pressure	Occupation	Pb (μg dL^{-1})	Mean Conc. (μg dL^{-1})
Dopemu garage	37 M	145/100	Motorcycle driver	121.6	148.56
	57 M	140/110	Driver	213.6	
	52 M	150/120	Driver	118.5	
	43 M	150/100	Transporter	181.6	
	32 M	150/90	Driver	107.5	
Ojota bus stop	35 M	140/100	Bus river	76.6	122.6
	55 M	130/90	Bus river	92.3	
	55 M	170/100	Traffic warder	274.9	
	42 M	190/100	Bus driver	91.8	
	46 M	170/90	Bus driver	78.4	
Oshodi bus stop	52 M	150/90	Transporter	192.7	152.42
	47 M	120/110	Driver	149.4	
	35 M	190/100	Driver	127.9	
	49 M	160/120	Traffic warder	144.8	
	42 M	180/90	Transporter	147.8	
Apapa Wharf*	49 F	150/85	Accounts clerk	ND	11.02
	34 M	130/80	Driver	ND	
	40 M	130/80	Butcher	30.2	
	50 F	180/110	Charcoal trader	24.9	
	40 F	170/100	Food vendor	ND	

*: Control location; M: Male; F: Female; ND: Not Determined

148.56 μg dL^{-1} for Dopemu garage and those of Ojota was 122.6 μg dL^{-1} which are much higher than WHO limits but that of the control location at Apapa Wharf was 11.02 μg dL^{-1}. The current WHO recommendation for acceptable blood Pb is that no more than 2% of the population should have blood lead about 20 μg dL^{-1} (Wixson and Davies, 1994). Studies of human exposure to lead in Nigeria using human tissues have reported high levels of lead in urine (Ogunfowokan *et al*., 2002) and blood samples (Nriagu *et al*., 1994; Ogunsola *et al*., 1994; Adeniyi and Anetor, 1999; Ademoroti, 1992). The result obtained from this study is much higher than an earlier study on Lagos Wardens in which the mean blood levels was 18.1 μg dL^{-1} (Ogunsola *et al*., 1997). The level of lead in Nigerian petrol has been estimated as 600-800 mg L^{-1} which is much higher than permissible levels in some pollution conscious countries (Osibanjo and Ajayi, 1989; Awofolu, 2004). The very high lead levels recorded in Nigeria may be attributed deposition and inhalation lead particulates from exhaust fumes into human tissues.

The results of the blood pressures of the workers are moderately to severely hypertensive. The normal blood pressure is less than 140/90. From the questionnaires, it was found that these workers complained about the following health problems; headache, body pains, tiredness/weakness, cough, cold and sleeplessness.

RECOMMENDATIONS

The following recommendations are important for the abatement of ambient air quality in Nigeria:

- Public enlightenment programmes on air quality.
- Government should provide mass transit transportation such as good train system, big buses and even good ferries for places like Lagos and Port-Harcourt where a lot of people reside.
- Enforcement of laws banning old second-hand cars over eight years and also the reduction of the use of two stroke engines (Motorcycles).
- The government should urgently stop the importation of leaded petrol and Establishment of national air pollution monitoring network.

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