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INVESTIGATION ON THE EFFECTS OF VEHICLE EMISSIONS ON HUMAN HEALTH IN ONDO STATE, NIGERIA

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Abstract
The increasing volume of vehicular traffic in Nigeria contributes immensely to urban air pollution with its attendant degradation of air quality arising from it. Vehicular emissions generally include oxides of nitrogen, sulphur, carbon hydrocarbon, mercury and leads. The effects of vehicular emissions on human health, vegetation and environments were investigated in three locations of Ondo state (Ondo Town, Akure and Ikare) while, a fourth location (Okeagbe) was used as a control since it has low levels of pollution. The investigation was carried out with the use of questionnaires and laboratory experiments. Experiments were conducted on rainwater collected from each location to determine the level of acidity, pH and presence of dissolved substances such as NO_3, SO_4 and CO_2 in them. Physical effects on vegetation, buildings and structures were also observed. The results obtained from questionnaires show that on the average, 23 %, 18 %, 29 %, 5 % and 24 % were respectively affected by sleeplessness, running nose, heavy eyes, asthmatic attack and headache. The location (distance from the type of fuel, availability of industries, and concentration of traffic) determine the impacts of these emissions on the ecosystem.

Keywords: Vehicular Emissions, Air Pollution, Rainwater, pH level

INTRODUCTION
The increasing volume of vehicular traffic in Nigeria contributes immensely to urban air pollution with its attendant degradation of air quality arising from it. Vehicular emissions significantly pollute air and require control [18]. With increasing concern for air toxics and climate modification caused by exhaust emissions, the need for tighter control increases its importance. Therefore, there is a great need for studies involving emission factors and impact. In recent years, there has been considerable research on vehicle emissions and fumes [5, 20, 21, 1, 7-10]. Carbon monoxide causes blood clotting when it reacts with haemoglobin, which cuts the supply of oxygen in the respiration system after long exposure. This is common occurrence in urban centres with high level of commercial activity [3, 15, 16, 17]. The worst levels of pollution are seen in such urban cities as are densely populated with a low standard of living [4, 26]. Unfortunately, vehicle emissions present an important environmental hazard that needs to be investigated, since it may shorten the lifespan of exposed people. Research has also indicated that the depletion of ozone layer is largely due to pollution from industries and the use of automobiles,
A case concerns the experimental measurement of unregulated emission for vehicles operated under low speed conditions [24]. Four other studies relate to emission of Nitrous oxide from vehicle[11, 6] and emissions of ammonia from light-duty vehicles [12] and emission sates of ammonia and other toxic and low-level compound using FTIR [13]. Experiment investigation has also been conducted on the detection of excess ammonia emission from in-use vehicles [14]. Furthermore, another study on ammonia emissions relates to on-road measurement of ammonia and other motor vehicle exhaust emissions [19]. Automobile invention has brought more positive and negative impact than any other means throughout transportation history. It is possible that no invention has had as profound effect on society as the passenger automobile. Vehicular

emission in Nigeria, like any other developing economy in the world is intensified by congested roads, increasing number of motor vehicle, poor vehicle maintenance and inferior fuels among others (Abbaspour *et al*, 2004). It did not take long after its introduction in the early part of this century for the automobile to quickly become the primary means of transportation in Nigeria. In urban centres generally, human-generated air pollution sources can be divided into mobile and stationary sources. While the former includes automobiles, buses, trains, airplanes and other powdered modes of transportation sources, the latter have to do with factories through gas flaring,[22] incinerators, and other kinds of non-mobile sources. All motor vehicles release pollutants into the air [2], mostly through the exhaust fumes that come out of the tailpipe when the engine operates. Tailpipe emissions are products of burning fuel in the vehicle's engine, emitted from the vehicle's exhaust system. Automobile transports emission have been identified as key factors in the deterioration of the urban air environment constituting up to 90 % of urban air pollution [25]. Pollution due to traffic constitute up to 90 % of the ambient CO levels, 80-90 % of NO_2, and high levels of hydrocarbon and particulate matter in the world, posing a serious threat to human health [23]. The worst thing about vehicular pollution is that it cannot be avoided as the vehicular emissions are emitted at the near-ground level where we breathe.

Descriptions of Study Area

Ondo Sate lies between latitudes $5^0 45'$ and $7^0 52'$ and longitudes $4^0 20'$ and $6^0 5'$ east. Its land area is about 15,500 square kilometres. Edo and Delta states bound Ondo state on the east, on the west by Ogun and Osun states, on the north by Ekiti and Kogi states and to the south by the Bright of Benin and the Atlantic Ocean as shown in Fig. 1

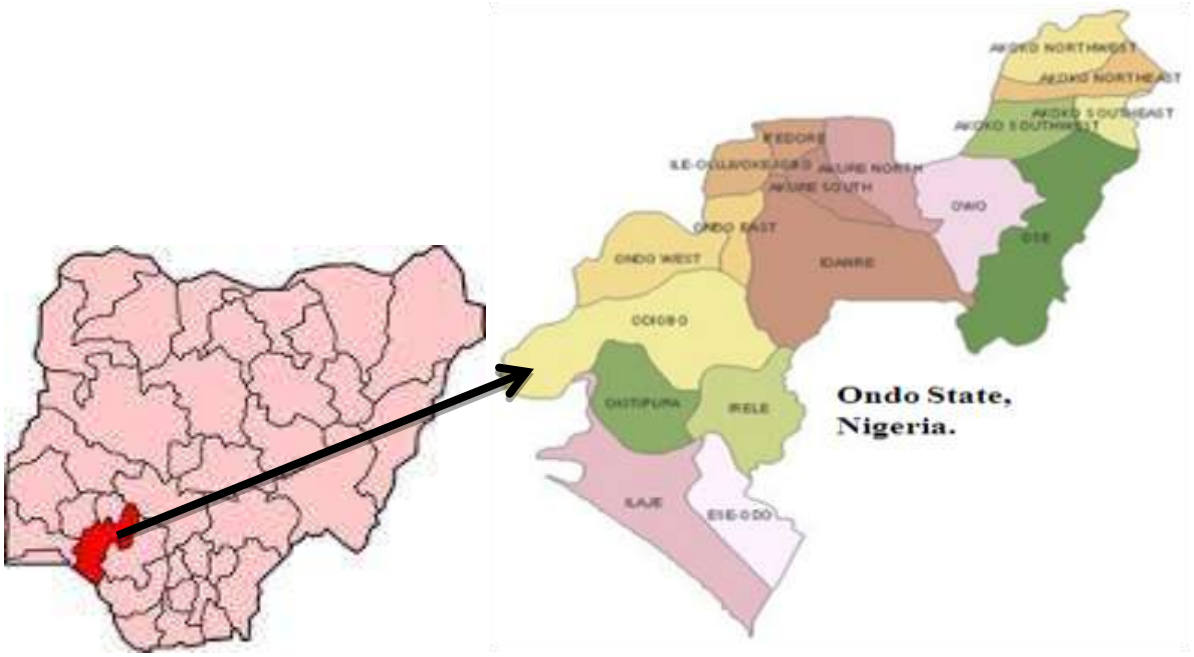

Fig 1: Map of Nigeria showing Enlargement of Ondo Sate, Nigeria

MATERIALS AND METHODS

The research focused on congested area of three major towns in Ondo state, Nigeria, where heavy vehicular emissions are common. The sample areas are densely populated. They were observed both in the day and night. A common feature of these areas is the presence of heavy

flow of transportation where the heavy combustion of fossil fuel from the internal combustion chambers exists. The sample areas are Ondo Town, Akure and Ikare, while Okeagbe-Akoko was used as a control location since it has low levels of pollution. In these study areas, concentration of pollutions such as carbon monoxide, sulphur oxide, nitrogen oxide, organic acids and hydrocarbons (obtained mostly from exhaust gases) in the atmosphere is high. However, vehicular emissions account for more than 60 % of the total pollutants emitted when compared to other sources.

In this study however, the effect and impact of vehicular emission were considered on:

- The health of the people living in the sampled location
- Buildings and structures
- Vegetation in the sample location and
- Analysis of the rainwater samples located in the study location

The effect of Emission on Health: In determining the health effects in the samples location, questionnaires and personal contact were prepared and administered on 100 selected individuals each who live or work in the study areas. The data obtained from the questionnaires were analysed based on the information obtained from them. The questionnaire also sampled the opinions of the people on what they think should be done to reduce these harmful exhausts.

The effect of Emission on Buildings and Structures: Ten (10) building and structures were observed closely in the sampled locations. Those affected by emissions were then photographed.

Effect of Emissions on Plants: The investigation carried out in the work entails observing vegetation in the sampled area to determine samples showing the effects of emissions. The symptoms are usually stunted growth, yellowing effect (chlorosis), flecks (tiny light and irregular spots), stipples (small darkly pigment), boozing and reddening of the plants. Such affected plants were photographed.

Experimental Analysis

A collection of samples of rainwater was made in clean bottles that were fitted with a funnel covered with cloth and placed on top of buildings in the sampled locations. The reason of this was to avoid adulteration of the water samples since if it comes in contact with anything (i.e. roofs, walls etc.), therefore, results of the tests carried out in the laboratory could be affected. Efforts were also made to determine the acidity level of the rainwater collected, the presence of nitrate in the samples, the sulphate and carbon dioxide levels, and the pH of samples. The procedures are stated in the subsections that follow here.

Test of the Presence of Nitrates

The description hereunder shows the reagents used for the test and the procedure followed. Reagents used were: 0.25 M NaOH, Hydrazine sulphate + copper sulphate (reduction mixture), 0.1 M hydrochloride acid (HCL) EDTA, Sulphannilic acid, Naphthylamic and sodium acetate.

Procedure:

1. 25ml of sample was pipette into 250 ml baker:
2. 4ml of 0.25 M NaOH was then added to the mixture and stirred gently, after a while.

3. 12.5 ml of reduction mixture was added.
4. The mixture was shaken vigorously and allow to stand for 45 minutes,
5. 6 ml each of 0.1M of HCL, 1 ml of mixed thoroughly
6. It was then allowed to stand for 5 minutes after which 1 ml sodium acetate was added.
7. The mixture was allowed to stand for 10 minutes.
8. The absorbance of the mixture was read on a spectrophotometer at 520 mm: and the concentration of nitrate in the sample test for the presence of carbon dioxide.

Test of the Presence of Sulphate (Gravimetric Method)

By using the gravimetric method, the following procedures were carried out.
Procedure:

1. Filter the water sample
2. Pour 200 ml of the filtrate into 400 ml baker, and add 5 ml diluted (2 M) acid to the filtrate.
3. Raise the temperature of the liquid to boiling point and add 10 ml of 10 % BaCl to it.
4. After waiting for 30 minutes or alternatively, wait overnight, filter the solution.
5. Wash the filter paper until it is free of excess barium chloride.
6. The precipitation is then shed and weighed as BaS04.
7. Calculate the part per million of sulphate

Test of the Presence of Carbon Dioxide

The following reagents and procedure are used for testing carbon dioxide from the sample. Reagents used were: Phenolphthalein and Sodium carbonate.
Procedure:

1. Collect 10 ml of sampled water in a measuring cylinder
2. Add 4 drops of phenolphthalein.
3. The colourless solution is then titrated with 0.045 M of sodium carbonate solution.
4. Stir gently with iron rod.
5. Add sodium carbonate in bits
6. A faint pink colour that remains for at 30 seconds is observed. This indicates the presence of carbon dioxide.

Calculation of carbon dioxide in the sample

The following formula shows how the calculation is made

CO_2 in mgl litres = $\frac{Mg/gNaCo_2 \ x\ N\ x\ 22\ x\ 100}{Volume\ of\ sample}$

Determination of Level of Acidity

For this scheme, the methyl orange titration method is used as follows.
Procedure:

1. 0.1ml of methyl orange was added to 50 ml of the sample in a conical flask over a white surface.
2. The mixture is then titrated with standard 0.02 M NaOH until the colour changed to faint orange, which is the characteristic of pH of 4.5.

Calculation of Carbon Dioxide Quantity in the Sample

The following formula shows how the acidity as mild as $CaCO_3$ is calculated.

$$\text{Acidity as mild as } CaCO_3 = \frac{\text{A x N x 50000 x D}}{\text{Volume of sample}}$$

Where A= ml of titrated sample, N= normality of NaOH and D = diluted factor (if any).

Determination of pH Values

This was done with the use of pH meter (PW 9504 Philips pH meter). Electronic pH meter was standardised with butter solutions of pH 4, pH 9.2, and pH 7 before the water was tested.

Questionnaire

Questionnaires were administered in four major towns of Ondo State: Ondo Town, Akure, Ikare, and Okeagbe. The fourth town, Okeagbe, was used as a control site with which comparison of results were made. Okeagbe is a relatively low- emission area of the four sites. Questionnaires were administered on a total of 310 respondents to determine the effects of emissions on their health, particularly in congested areas where heavy vehicular emissions are common. Preliminary observations were done for 2 months in many areas before selecting the sampled areas. These are the areas where there are heavy flows of transportation. A total of 100 respondents were carefully selected each from the three locations, while 10 respondents were chosen from the control area. Questionnaires were administered on them over a period of 12 months. The selected respondent included office workers, market women, street hawkers, drivers, conductors, traders and residents. Those that had difficulty in responding to the questionnaire were assisted. The questionnaire were analysed based on factors/symptoms that constitute health problem. The procedure carried out in achieving the objectives of the current work could be classified into two: (i) Procedure related to questionnaires administration and analysis; and (ii) Procedure related to testing of substances.

Procedures Related to Questionnaires Administration and Analysis

1. A pre- survey is carried out by going to the field to understand what classes of respondent would be involved and answering the questionnaires, and possibly estimating the population so that sample size could be determined.
2. Based on (1), questionnaires are designed and a test-survey is carried out to refine the questions posed in the instrument and to determine its adequacy.
3. Based on the target number of respondents, the questionnaires is designed and administered on the respondents. A response rate of 100 % is the target since the questions are simple enough not to consume much of respondents time, and for economic purpose:
4. Based on the returned questionnaires. Analysis of items contained therein is then made.

Procedure related to testing of substances

1. Visit the field to collect samples (i.e. vegetation polluted by the environment)
2. Preserve such samples
3. Visit laboratories with the sample where tests are administered on the vegetation
4. Analyse the results obtained and make conclusions.

RESULTS AND DISCUSSIONS

Results

Tables I, II and III show details of the selected respondents for the survey. Table III shows the results of the responses from the questionnaires administered on the respondents while Table 4 shows the result of the chemical analysis from the rainwater collected. It should be stated that in all cases, Okeagbe is chosen as a control area in view of its relative low emission level.

Table I: Effects of Automobile Emissions on the Respondents at Ondo Town, Akure, Ikare and Okeagbe (control area).

	Number of people affected by				
Respondent	Sleeplessness (On,Ak,Ik,Ok)	Catarrh (On,Ak,Ik,Ok)	Heavy eye (On,Ak,Ik,Ok)	Asthmatic (On,Ak,Ik,Ok)	Headache (On,Ak,Ik,Ok)
Office workers	2, 2, 1, 0	4, 4, 3, 0	5, 7, 5, 2	0, 1, 0, 0	5, 6, 4. 1
Market women	2, 4, 3, 1	6, 7, 5, 2	4, 4, 4, 2	1, 0, 0, 0	2, 3, 1, 0
Street hawkers	2, 3, 2, 0	5, 6, 5, 0	4, 5, 3, 0	0, 0, 0, 0	3, 4, 3, 1
Drivers	2, 3, 2, 0	3, 4, 3, 1	3, 4, 3, 1	1, 1, 1, 0	3, 5, 3, 2
Conductors	3, 3, 2, 1	3, 5, 3, 1	2, 3, 2, 0	0, 0, 0, 0	2, 2, 2, 0
Traders	4, 4, 3, 2	4, 5, 3, 1	4, 6, 3, 1	2, 2, 1, 1	4, 4, 3, 1
Residents	5, 6, 4, 1	5, 6, 4, 2	4, 7, 4, 0	1, 2, 2, 0	3, 4, 3, 0
Totals	20, 25, 17, 5	30, 37, 26, 7	26, 36, 24, 6	5, 6, 4, 1	22, 28, 19, 5

Key: On – Ondo; Ak – Akure; Ik – Ikare; Ok – Okeagbe

Table II: Distribution of the Respondents in the Study Areas

Respondents	Ondo Town		Akure		Ikare		Okeagbe		Total
	M	F	M	F	M	F	M	F	
Office workers	3	8	9	6	9	7	-	-	42
Market women	-	12	-	10	-	14	-	-	36
Street hawkers	5	12	9	10	10	8	-	-	54
Divers	10	-	12	-	10	-	4	-	36
Conductors	9	-	10	-	9	-	3	-	31
Traders	10	9	7	10	6	12	6	6	66
Residents	6	12	8	10	10	7	-	-	53
Totals	43	53	55	46	54	48	13	6	318

M – Male; F – Female; Okeagbe (Control area area)

Table III: Effects of Automobile Emission on the Respondents in the Study Areas

Number of Respondents Affected						
Ailment	Ondo Town	Akure	Ikare	Okeagbe	Total	Percentage (%)
Sleeplessness	22	25	19	10	76	23 %
Flu	20	18	21	1	60	18 %
Heavy eye	25	31	24	17	97	29 %
Asthmatic	3	4	2	9	18	5 %
Headache	26	27	19	8	80	24 %

Table IV: Result from the Analysis on Rainwater Samples in Three Locations. World Health Organisation (WHO) Values are Presented for Comparison.

Pollutants	Ondo Town	Akure	Ikare	*WHO, Drinking water standard
NO_3 (mg/l)	1.10	1.20	1.00	0.47
SO_4 (mg/l)	4.35	4.67	3.98	5.21
CO_2 (mg/l)	4.30	4.40	4.00	
Acidity (mg/l)	10.00	11.52	9.21	
pH	7.40	7.70	7.1	6.8

*[27]

DISCUSSIONS

Limitations

We did no measure the emission rates of different vehicles or the volumes of traffic so our comments on the influences of vehicles types and traffic volume are purely observational. Although we did not measure rainwater pollutants in the control area, we have personally verified that the traffic there is lower in volume. Using this observational information, we can suggest that the health effects measured in the areas that experience higher levels of vehicle emissions were in fact attributable to vehicle emissions.

Ondo Town

The respondents in Ondo town were frequently affected by catarrh. This may be due to the heavy emissions from bigger buses and cars that ply the town to other parts of Nigeria and also those within the town (i.e. Taxes and motorcycles (Okada)). These vehicles are mainly powered by diesel or petrol fuel, and in most cases, they are not frequently serviced. They operate almost 16 hours a day, hence the possibility of worn rings thereby causing heavy soot from their exhaust pipes. Asthmatic attacks were rare in all areas, but traders in Okeagbe showed the highest complaints. Heavy eye, which is closely linked to sleeplessness, ranks second in Ondo town. Therefore after assimilating different kinds of emissions for a large number of hours, they suffer from heavy eye which is the cause of sleeplessness particularly people around Yaba, Oka and along Ore road in Ondo Town. The measurement of rainwater pollutant was generally high with acidity of 10.00 mg/l with pH value of 7.40 therefore; the rainwater is not drinkable when compared with WHO standard for drinkable water.

Akure

The percentage of respondents affected by headache was the highest in Akure compared with other two towns (Ondo Town and Ikare). This may be due to the fact that Akure is the state capital with highest number of vehicles and motorcycles ply the roads. These vehicles are mainly powered by diesel or petrol fuel, and in most cases, they are not frequently serviced. They operate almost 20 hours a day, hence the possibility of worn rings thereby causing heavy soot from their exhaust pipes. Asthmatic attacks were rare in all areas, but traders in Okeagbe showed the highest complaints. Heavy eye, which is closely linked to sleeplessness, ranks first in Akure. Therefore after assimilating different kinds of emissions for a large number of hours, they suffer from heavy eye which is the cause of sleeplessness particularly people around Oba-Adesida road, Ijomu and along Oke-Aro. The measurement of rainwater pollutant was the highest with acidity of 11.52 mg/l with pH value of 7.70 therefore; the rainwater is not drinkable when compared with WHO standard for drinkable water.

Ikare

Ikare-Akoko is the gateway to Abuja from south western Nigeria. Therefore, there are many types of vehicles plying this area mainly big buses which produce heavy emission, others are Lorries, trailer, and small buses (Agolo) and motorcycles (Okada), this allows for the mixture by diesel and petrol. Since these emissions are a mixture of gases from different sources, it results quickly into adverse effects on the respondents hence the greatest number of the respondents in this area (Ilepa, Ese and Okoja) suffer from catarrh. Ikare is one of the commercial towns in Ondo state. Many respondents suffer from headache and the aftermath is sleeplessness. This is due largely to the amount of gases (exhaust) that they have assimilated for a long time during the day while undergoing their business activities which is the least compared with that of Ondo Town and Akure. The measurement of rainwater pollutant was the lowest with acidity of 9.21 mg/l with pH value of 7.10 therefore; the rainwater is fairly drinkable when compared with WHO standard for drinkable water.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The study is worth considering in view of the cost savings that would result if adequate traffic controls were implemented. Therefore, the result of such a research will be useful to the vehicle manufacturers in the design of new exhaust pipes. Another fertile research area may be the study of the diffusion rate of emitted substances into the blood stream of victims.

RECOMMENDATIONS

This paper showed that vehicles remain the dominant sources of urban air pollution. Addressing this situation requires holistic understanding of causal factors related to emission. This study therefore, recommends the following:

- Adequate public awareness on the effect of vehicle emissions and the way to mitigate it should be properly addressed.
- Provision of adequate testing and repair facilities and air quality monitoring programs.
- Introduction of alternative fuel with environment friendly emissions.
- Proper legislation to regulate and control vehicle emission.

And finally, with proper implementation of this traffic control measures there is a high potential for emission reduction and related problems

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