HEALTH IMPACTS OF VEHICULAR EMISSIONS ON TRAFFIC WORKERS IN LAGOS METROPOLIS, NIGERIA

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ABSTRACT

Background*: Air pollution is fast becoming a major health problem in Nigeria especially in Lagos state which has the highest urban population. This study assessed the health impact of vehicular emissions on Traffic workers across three Local Government Areas in Lagos state.*

Method: *Questionnaires were administered to traffic personnel and air quality was also measured. Aerocet 531 particulate matter monitor,-Rae plus and V-Rae PGM 7840 gas monitors were used to measure the particulate matter (PM), Carbon monoxide (CO), Nitrogen dioxide (NO_2) and Sulphur dioxide (SO_2) respectively.*

Results: *The concentration of CO, SO_2, NO_2,$PM_{2.5}$ and $PM_{10.0}$ in Lagos at peak periods (8.00 and 9.30 am) varied between 4.0 and 13.0ppm, 0.1 and 0.3ppm, 0.2 and 0.5, 0.010 and 0.046 mg/m^3, 0.063and 0.572 mg/m^3 respectively while at off peak period ((1.00 and 2.30 pm)it varied between 1.0 and 10.0 ppm, 0.1 and 0.3, 0.1 and 0.2 ppm,0.006 and 0.039 mg/m^3 and 0.040 to 0.205 mg/m^3. WHO limits are 10.0ppm, 0.01ppm, 0.04 ppm, 0.025 and 0.050 mg//$m^3$for CO, SO_2, NO_2,$PM_{2.5}$ and $PM_{10.0}$ respectively. The questionnaires also showed that 56%, 53% and 49% of the sampled population (90) suffered from frequent headaches fatigue and frequent cough respectively.*

Conclusion: *This study showed vehicular emissions impact negatively on the air quality and health of traffic personnel. Thus, measures such should be put in place to reduce the hours of exposures of traffic workers to vehicular emissions.*

Key Words*: Lagos state, Vehicular emission, Traffic workers, Air pollution.*

INTRODUCTION

Air pollution is defined by the World Health Organization as the alteration of the characteristics of the atmosphere due to biological and chemical contaminants which may pose health risk such as respiratory and heart conditions, and in some cases cancers1.

One of the major contributors to air pollution is the emission from cars especially in developing countries[2]. The engines of these cars combust the fuel to generate energy required to move the car while releasing primarily carbon-di-oxide (CO_2) and water along with many other gases and metals[3].

Other gases and components of vehicular exhaust release include carbon monoxide (CO), Sulphur oxides (SO_x), Nitrogen Oxides (NO_x), particulates and lead (when leaded fuels are used) among others.

Carbon monoxide an air pollutant, is known to react with haemoglobin responsible for oxygen transportation in the body for in the blood to produce carboxy-heamoglobin which cannot transport oxygen in the body and thus leads to dizziness, fatigues and may finally lead to death[4].NO_x are major components of smog along with SO_x and can lead to acid rain and can complicate asthma conditions[5].

Lagos State, though the smallest state in Nigeria, by land mass has the highest urban population in the West African region. It is 0.4% of the Nigerian land mass of which one third of this percentage is made up of rivers and Lagoons[6]. About 10% of the population of the country, (which translates to over 18 million people) stay in Lagos making it a densely populated state, and the fastest growing City in Africa[7]. Its transportation system consist of an under developed and under utilized rail and water ways thus, making its populace heavily dependent on buses and cars for transportation. According to Itua[8], 40% of all new vehicle registration in Nigeria takes place in Lagos. Lagos is made up of many frequently congested roads with over one million cars plying it roads daily and emitting harmful exhaust fumes thus making vehicular emission a major contributor to air pollution in the state. This is made worse, by the prevalence of old and "secondhand" cars which are made up of gasoline and diesel engines imported into the country from developed countries. These engines have been known to emit more pollutants than new cars and cars with newer technologies such hybrid engines among others[9].

Prioetti *et al*[10],in their study of allergy and respiratory symptoms among traffic police found that they showed more respiratory symptoms and allergic reaction compared with the control/ non-exposed group. In Tokyo, Japan, Sekine *et al*[11],who investigated the long-term effects of the exposure to automobile exhaust on the pulmonary functions of female adults, observed high prevalence of respiratory symptoms in the exposed group. Pal *et al*[12],carried out pulmonary function tests on traffic police personnel in Pondicherry, India. They observed restrictions in lung expansion, obstructions and narrowing of the airways in the traffic personnel compared to the general police personnel. They attributed it to the exposure to vehicular pollution to which the traffic police were exposed to over the years. Other studies in Mozambique and Kenya revealed higher prevalence of asthma, in urban school children exposed to more traffic pollution compared to rural children[13].

In Nigeria, especially in Lagos, motorization has been largely unchecked leading to higher levels of air pollution. Researchers have found that traffic contributes about 40-80% of the ambient air NOx and CO concentration in developing countries[14]. According to Fu *et al*[14],this has been attributed to the fact that the cars used are quite old also poorly maintained and this is due to the importation of old and banned vehicles from developed countries, leading to an automobile fleet of cars dominated by **'super emitters'** which releases higher concentration of air pollutants compared to newer and well

maintained vehicles[15]. Importation of this type of cars may probably be because of poverty and the economy of the country. The Lagos State Government has established some extra ministerial departments and agencies such as; Lagos State Traffic Management Authority (LASTMA), Vehicle Inspection Office (VIO), State traffic Police, Highway managers (HM) among others to help implement new traffic policies that will ensure free flow of vehicular traffic and ensure that only vehicles of certain quality ply the Lagos roads[16]. For effective performance, these agencies deploy personnel to traffic congested locations. The personnel who work in this busy traffic daily for years are exposed to the risk associated with being exposed to traffic pollution with lifelong consequences. The aim of this study therefore, is to assess the level of air pollution caused by vehicular emissions at various traffic congested areas of Lagos metropolis and to evaluate the health impact of the vehicular emission on traffic workers at those locations.

METHODOLOGY

Study Locations

Lagos is divided into Local Government Areas (LGAs). Three LGAs were selected for this study and three different locations per local government area were monitored. The locations sampled were chosen base on the volume of traffic and presence of traffic personnel. The three LGAs studied were Ikeja, Agege and Lagos-Island as shown in Figure 1.

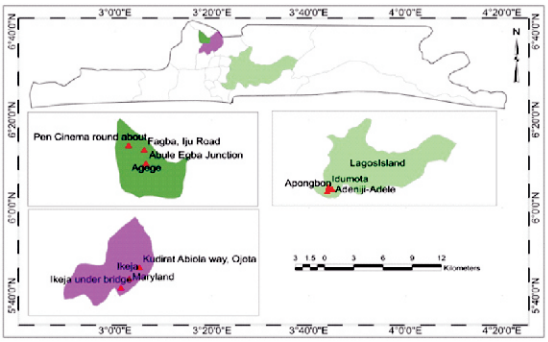

Figure 1: Map of Lagos showing the study locations

Study Design

The study was conducted using both experimental and a descriptive cross-sectional survey involving questionnaires between 18th and 21st November 2013.

Study population and size

The study population (110) was made up of both sex-the male and the female. Questionnaires were administered to all the traffic personnel found at the locations however, only 100 were willing to participate in the survey at the sampling locations.

Study instrument

Questionnaires in English were designed and had two sections. The first section was about their personal information such as experience, age, sex, years of experience on the job. The second section was about their health conditions and exposures to pollution with respect to their time on the job. The questions comprised of both open and close ended questions. The questions were few to encourage even the busy personnel to fill them.

Data collection method and analysis

Questionnaires were administered only after

educating the traffic personnel. Participations of the traffic personnel were voluntary. A total of 90 questionnaires were collected and they were analysed using excel spread sheet.

Ethical considerations

Consent was sought before administering the questionnaires. To ensure anonymity, limited personal questions were asked in the questionnaire and the data analysis of the questionnaire were not segregated into locations since there were an average of 10 (few) traffic personnel at each location comprising of Traffic police, LASTMA officials, NURTW officials. Their identities were kept confidential.

Air Sampling and Analysis

Between 18 November and 1st of December 2013, the air quality of three LGAs in Lagos namely, Ikeja, Agege and Lagos-Island(as shown in Figure 1) were monitored at 9roadjunctions with traffic congestions, heavy flow of traffic and the presence of traffic personnel. Badagery was used as a control since it has lower volume of traffic generally. At the various junctions, carbon monoxide (CO), were monitored using Muti RAE plus monitor while nitrogen (IV) oxide and sulphur dioxide (SO_2) was monitored using V-RAE gas monitor PGM 7840. Particulate matters were measured using handheld laser particle counter (Aerocet 531 particulate matter monitor). The monitors were calibrated before sampling. Air monitoring of the locations were carried out at peak (8.00-9.30 am) and off-peak period (1-2pm) for two weeks. Three days were spent on each location. Readings were taken at the closest position to where the traffic personnel control traffic and at a height of 1.5 to 2.m from ground level. For every sampling, three readings were taken, and the average was recorded.

Risk Assessment

The air quality of these locations were compared with the 1991 ambient air limits of the Nigerian Federal Ministry of Environment (FMENV)[17] and World Health Organization (WHO)[18]

RESULTS

Out of 110 traffic personnel found at the sampling locations 100 traffic personnel consented to participating in the study however only 90 (90%) traffic personnel returned their questionnaires. The questionnaires were collected on the same day it was administered. The ratio of male to female respondents were 58 (64%) to 32 (36%). The age of the participants varied between 20 and 60 years (seven respondents were between 20 and 30 years, 43 were between 31-40 years, 34 were between 41-50 years and 6 were between 51- 60 years). The years of experience on the job as traffic personnel varied between 1 to 26 years. Specifically, 18 personnel have spent 5 years and below 5 years on the job. 21 personnel have spent 6 to 10 years on the job, 33 personnel have spent 11-15 years, 4 personnel have spent 16 to 20 years, 6 personnel have spent 21 to 25 years and 7 personnel have spent over 26 years on the job. The question on how many hours they worked per day showed that 44 (49%) personnel worked for 6 to 10 hours a day and 24 (27%) personnel worked for 11 to 15 hours a day. Other personnel did not state how many hours they worked per day. Also 56%, 53%, and 49% of the responders reported frequent headache, body weakness

and coughing which are some common health indicators of pollution. The responses of the participants to the questions asked are as summarized in Table 1.

Table 1: Responses to the open-ended questions on health impacts of vehicular emissions on traffic Workers in Lagos Metropolis, Nigeria by 90 respondents

S/N	Questions	Responses	
		Yes (%)	No (%)
1	Have you ever smoked for as long as one year or Has anyone in your household smoke for as long as one year	6 (7)	84 (93)
2			
a.	Asthma	0 (0)	90 (100)
b.	*Cough*	44 (49)	46 (51)
c.	*Shortness of breath*	3 (3)	87 (97)
d.	*Body Weakness and Fatigue*	48 (53)	42 (47)
e.	*Itching /irritation*	17 (19)	73 (81)
f.	*Chest pain*	16 (18)	74 (82)
h.	*Running Nose and sneezing*	33 (37)	57 (63)
i.	*Sore Throat*	16 (18)	74 (72)
3	Have you missed work because of symptoms	69 (77)	22 (33)
4	Have you visited hospital because of symptoms	33 (37)	56 (62)
5	Does the symptoms worsen in the rainy season	24 (27)	64 (71)
6	Does these symptoms worsen in dry season	18 (20)	72 (80)
7	Does the symptom remain the same in dry and raining season	37 (41)	42 (47)
8	Does the symptoms Worsen at work during high traffic period (peak period)	45 (50)	34 (38)
9	Does the symptoms improve at work during low traffic period (off-peak period)	1 (1)	89 (99)
10	Does the symptom remain the same at low traffic and high traffic (peak and off peak of traffic) (no Change with traffic)	33 (37)	46 (51)

The results of the air analyses carried out at traffic peak and off-peak periods are shown in Table 2 and 3 respectively. At peak period concentrations of CO, SO_2, NO_2, in Lagos varied between4.00±0.01 and 13.00±0.05 ppm, 0.10±0.01 and 0.30±0.03 ppm, 0.20±0.02and 0.50±0.02 ppm (Table 2) while at off peak traffic period, the concentration values were between 1.00±0.10and 10.00±0.10 ppm, 0.00±0.01 and 0.30±0.02, 0.10±0.01 and 0.2±0.02 ppm respectively (Table 3). $PM_{2.5}$ and PM_{10}Concentrations at peak periods varied between 0.010±0.020 and 0.046±0.030mg/m^3, 0.063±0.020 and 0.575±0.010mg/m^3 respectively while at off peak, the concentrations varied between 0.006±0.001 and 0.039±0.020 mg/m^3, 0.038±0.010 and 0.308±0.030 respectively (Table 2 and 3).

Table 2: Concentration of CO, NO_2, SO_2 and Particulate matters Study Area at High Traffic period (Peak Period)

LGAs	Ikeja			Agege			Lagos-Island			Limits
Location	Ikeja under bridge	Ikeja Maryland	Ikeja Kudirat Abiola way, Ojota	Agege Pen Cinema round about	Agege Fagba, Iju Road	Agege Abule Egba Junction	Lagos-Island Apongbon	Lagos-Island Adeniji-Adele	Lagos Island Idumota	FMENV/ WHO
CO (ppm)	13.00±0.05	8.00±0.03	12.00±0.04	12.00±0.03	9.00±0.01	12.00±0.02	4.00±0.01	13.00±0.03	13.00±0.02	10.00
SO_2(PPM)	0.20±0.01	0.20±0.02	0.20±0.01	0.10±0.01	0.10±0.02	0.20±0.02	0.30±0.03	0.20±0.01	0.30±0.01	0.01
NO_2(PPM)	0.30±0.02	0.20±0.01	0.40±0.01	0.30±0.02	0.20±0.03	0.50±0.02	0.50±0.01	0.20±0.02	0.50±0.03	0.04-0.06
$PM_{2.5}$ (mg/m^3)	0.018±0.020	0.011±0.030	0.036±0.020	0.013±0.020	0.024±0.030	0.010±0.020	0.014±0.01	0.046± 0.030	0.015±0.010	0.025
PM_{10}(mg/m^3)	0.208±0.050	0.063±0.020	0.522±0.020	0.064±0.030	0.575±0.010	0.333±0.020	0.093±0.033	0.245±0..020	0.205±0.030	0.050

Table 3: Concentration of CO, NO_2, SO_2 and Particulate matters Study Area at Low Traffic period (Off-Peak Period)

LGA	Ikeja			Agege			Lagos-Island			Limits
Location	Ikeja under bridge	Ikeja Maryland	Ikeja Kudirat Abiola way, Ojota	Agege Pen Cinema round about	Agege Fagba, Iju Road	Agege Abule Egba Junction	Lagos-Island Apongbon	Lagos-Island Adeniji-Adele	Lagos Island Idumota	FMENV/ WHO
CO (PPM)	7.00±0.05	5.00±0.10	10.00±0.10	.. ..	2.00±0.10	5.00±0.01	1.00±0.10	1.00±0.10	4.00±0.02	10.00
SO_2(PPM)	0.00±0.01	0.10±0.03	0.10±0.02	0.10±0.01	0.10±0.02	0.10±0.02	0.10±0.02	0.10±0.04	0.30±0.02	0.01
NO_2(PPM)	0.20±0.10	0.10±0.01	0.20±0.02	0.20±0.03	0.10±0.01	0.10±0.02	0.10±0.03	0.10±0.02	0.10±0.01	0.01
$PM_{2.5}$ (mg/m^3)	0.006±0.001	0.008±0.002	0.014±0.010	0.006±0.003	0.010±0.001	0.039±0.020	0.011±0.010	0.013±0.010	0.014±0.001	0.025
PM_{10} (mg/m^3)	0.308±0.030	0.038±0.010	0.205±0.010	0.129±0.030	0.080 ±0.020	0.092±0.01.	0.061±0.030	0.040±0.010	0.093±0.030	0.050

DISCUSSION

The participants consisted of both male and female traffic personnel as seen in the ratio of male to female respondents [58 (64%) to 32 (36%)]. The age of the participants varied between 20 and 60 years. This shows that only adults are employed as traffic personnel and that only adult responded to the questionnaire in this study. An adult is any human being above the age of 18 year[19].The years of experience on the job as traffic personnel varied between 1 to 26 years. Specifically, 18 personnel have spent 5 years and below 5 years on the job others personnel have spent more. This shows that 79% of the traffic workers have spent over 6 years on the job with most of the personnel working for at least 6 hours on the job per day [44 (49%) personnel worked for 6 to 10 hours a day and 24 (27%) personnel worked for 11 to 15 hours a day].

Also 56%, 53%, and 49% of the responders reported frequent headache, body weakness and coughing which are some common health indicators of pollution. Epidemiological studies have also shown that there are associations between exposure to ambient air pollutants and respiratory symptoms or illness[20].Guowei *et al*[21], in their study found that air pollutants significantly increase the prevalence of cough and other health symptoms. However none of the respondents indicated having asthma which is a major symptom experienced by populations exposed to air pollutants[22] but Since 62% of the respondents indicated that they do not go to hospital, they may have asthma but have not been diagnosed of asthma. On inquiry on why they do not go to hospital they stated the fear of loss of job as hospital checkup may lead to the revelation of their true health status to their employers and so resort to self-medications and treatment by herbs. This is evidence in the low absenteeism from work. 77% or the respondents reported not missing work for health-related reasons in the past 1 year. However, 50% of the respondents stated that their health symptoms worsened at high traffic period and 37% stated that the symptoms experienced remained the same at both high and low traffic period. Though most of the respondents were not smokers nor were they exposed to smoking (Only 6 (7%) of the participants were smokers or had one living in their house). Thus, most of the symptoms may be attributed to or aggravated occupational exposure to air pollution while on duty.

Olajire *et al*[23] also studied exposure to hazardous air pollutants along Oba Akran Road in Ikeja, Lagos-Nigeria to evaluate pedestrian exposure. In their study, the PM_{10} and CO concentration was found to be an average of 0.275 mg/m^3 and 19.27 ppm which are within the range of concentration found in this study (0.038±0.010 to 0.575±0.010mg/m^{3}and 1.00±0.10 and 13.00±0.05 ppm. The WHO and FMENV limits for CO, SO_2, NO_2, $PM_{2.5}$ and $PM_{10.0}$ in ambient air is 10.0 ppm, 0.01 ppm, 0.04 ppm, 0.025 mg/m^3 and 0.050 mg/m^3 for respectively[17,18].

In this study, CO concentration in 6 locations out of the 9 locations studied exceeded the WHO/ FMENV limit[17,18]at traffic peak periods. This may be as a result of the traffic density at that time of the day. Ikeja under bridge, Kudirat Abiola way, Pen cinema, Abule Egba Juction, Adeniji Adele and Idumota are characterized by slow moving heavy traffic at

peak periods of the day. $SO_2$and NO_2 values at peak and off-peak period of traffic for all the sites in this study exceeded their WHO/FMENV limits (Table 2). $PM_{2.5}$ values for all the study locations were within the WHO/FMENV limit of 0.025 mg/m^3 and except in two locations where they exceeded the limit at traffic peak period. PM_{10}values at traffic peak period of for all the sites in this study exceeded their WHO/FMENV limits[17, 18](Table 2).

While at off peak period, the concentration of $PM_{2.5}$ were below the WHO/FMENV limits at off peak period. However, for PM_{10}only 2 locations out of the 9 study locations had values that were below its WHO/FMENV limit of 0.050 mg/m^3 at off peak traffic period.

Generally, the concentrations of air pollutants at peak periods were higher than at off peak periods (Table 2 and 3). This may be due to the presence of more cars on the roads than at off peak periods. This observation is similar to a previous study in Tanzania where higher levels were observed at roadside where vehicular counts are higher[24].

This study showed that at least 76% of the respondent work for at least 6 hours and 27% worked for at least 11 hours per day. These personnel were not found with nose mask or face mask to shield them from exposure to some of the pollutants such as particulate matter. 56%, 53%, and 49% of the responders reported frequent headache, body weakness and coughing which are some common health indicators of pollution and 50% reported more symptoms during high traffic usually at peak periods characterized by the presence of more pollutants in the air more. Sharma *et al*[25], in their study on health effects of air pollution on some traffic workers in India also found that they also experienced some health symptoms (such as eye irritation and sleeplessness, difficulty in concentration, headache, sneezing, and nose irritation). They found some of the symptoms to be serious but not curable. Thus, measures should be put in place to reduce the hours of exposures of traffic workers to vehicular emissions. Measures like the use of more traffic lights should be encouraged for traffic controls while the personnel enforce obedience by surveillance using cameras. More study should be done to access the effect of air pollutants in traffic on traffic personnel in Nigeria, while monitoring the health status using medical devices on personnel over a period of time.

CONCLUSION

This study showed vehicular emissions impact negatively on the air quality and health of traffic personnel. Thus, measures such should be put in place to reduce the hours of exposures of traffic workers to vehicular emissions. The use of more traffic lights should be encouraged for traffic controls. Also, studies should be done to access the effect of air pollutants in traffic on traffic personnel in Nigeria, while monitoring the health status of the respondents over a period of time.

Conflict of Interest: The authors declare that there is no conflict of interest associated with this study.

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