International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Investigation of Vehicular Traffic on Public Health in Selected Junctions in Bonny, Rivers State, Nigeria.

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ABSTRACT

This study employed field monitoring research surveys in data collection and acquisition. Suitable multi-gas and noise monitoring instruments were used to obtained air pollutants and noise data at selected junctions, also questionnaires were distributed to drivers, traffic wardens, petty traders and individuals residing near junctions and the hypotheses analyze with a non-parametric tool known as chi square. Result from the analysis of research questions and hypotheses indicates that, factors that affect vehicle traffic on junction are; traffic light, broken down vehicles on the road, wrong parking, driving against traffic, road works and surface. Nature of traffic control in most junctions are traffic warden, traffic light, lane parking and park restriction. The period of the day when vehicular traffic is more visible at the junction are between 8:00am- 10:00am; 12:00noon – 2:00pm; 2:00pm – 4:00pm and 4:00pm – 8:00pm. The conditions of vehicles that fly most junction are smoky and non- smoky vehicles. Effect of vehicular traffic on public health includes climate change, air pollution, noise pollution, disease, congestion and vibration. The protection of the human health should therefore be a major issue of concern to the transportation industry today and the State and Local governments should enforce existing laws on vehicle inspection.

Keywords: Vehicular Traffic, Pollutions, Public Health, Traffic Flow, Congestions.

1.1 Introduction

Transportation has always played a vital role in the development of any nation, as the wheel which propels every human, community towards economic, social and political progress. The primary function of transportation is to move passengers or goods from a place to lesser value to a place of higher value or utility. The demand for transport especially in cities of developing countries has been on the increase following the rapid socio-economic growth and development of these countries. For instance the rate of motor vehicle ownership in Bonny and use is growing faster than population in many places, with the vehicle ownership growth rates rising between 15 to 20 percent per year. Bonny as an industrialize Local Government Area continue to experienced increasing urbanization, human activities, resultant heavy dependence on road of interest, difficulty of vehicular movements, on intercity roads, intersection and commercial areas in the town. The problem of traffic flow is due largely to obstruction such as traffic crashes, broken down vehicles, road rage or certain land use activities located along the condors or sheer traffic volume exceeding the road network capacity during festive seasons, peak periods in the day and other activities.

The dependency of urban population on motor vehicles for transportation, particularly those that use fossil fuels to propel their engines is quite high. The increase automobiles or cars on the road intersection or road junctions in Bonny local government area is generating, huge traffic congestion. Traffic congestion contributes to the deterioration of the environment and increases public health problems of the commuters and inhabitants of the area. In the last few years, the ambient-air quality degradation in Bonny local government area has been affected by these motor vehicle activities which positively impact economic activities and negatively generate decreasing ambient air quality and poor public health quality. It has long been noticed that poor ambient air quality has advance effect on public-health within the last decade. Data and methods have become available which allow for the qualification of advance health effects associated with air pollution. Lawrence, (2015).

World Bank (1994) predicted that air pollution in some cities in Nigeria in 2000 would be as bad as in 1990 and nine times worse in 2020. There is increase in population together with increase in the number of vehicles on the Bonny roads. Vehicular emission has significantly polluted the air and requires control (Karlsson, 2004).

One of the leading concerns is the advance effect on health from polluted air caused by motor vehicle activities. With increasing concerns for air toxics and climate modification caused by exhaust emissions, the need for tighter control increases in importance. There is therefore a great need for studies involving emission factors and impact. In cities such as Bonny, air pollution has contributed to the problem of public health. Johnson and Hyeladi, (2013) indicated that though there are a lot industrial activities taking place in Bonny local government area, vehicular population increase, ill-maintained vehicle, outdated engine design, defective road network and erratic driving pattern and congestion are all adding to air pollution. Further, noise emission, hazardous waste (used oils, batteries, tires etc.) and accidents trail spills (oil and chemical) produced by vehicles affect environment. Most of the vehicle today use internal combustion engines that burn gasoline or other fossil fuels (Prather, 1995). In the process of combustion, a number of gaseous materials and impurities are generated. These combustion by-products (unburnt petrol, carbon monoxide, and hydrocarbon, oxides of nitrogen, lead compounds and carbon particles-smoke) are emitted into the environment as exhaust gases. Previous studies have linked traffic-related air pollution to asthma exacerbation and respiratory out comes. Janel (2013).

In the U.S.A and Europe, children living or attending school near truck routes and high ways show increase asthma and average symptoms, hospitalization, allergic rhinitis and reduced lung function (Braver, 2002).

Traffic-related pollution have also been associated with asthma development (Gordian 2006). Incorporating vehicle traffic related air pollution, noise pollution and hazardous waste produced by the vehicle into large-scale epidemiological studies requires model linking traffic and ambient concentrations. Vehicle traffic health relationships have been examined using a number of different traffic indicators with non-consensus on which indicators best capture variability in vehicle Traffic-related pollution or health outcomes in different setting. It is worthy to note that vehicular traffic pollution cannot be avoided as the emissions occur at the near ground level where human breathes. It will continue to remain a threat to environmental health as vehicle ownership level increase in the world. The 21st centuries is the worst affected because it experiences high vehicular concentrations. It is clear that for any nation to enjoy clean ambient air, avoid noise pollution, clean environment free from hazardous waste and accidental spill produced by the vehicle air quality, noise, vehicle spill and hazardous waste control measures must be put in place.

Despite all these conscious efforts made by government at all levels to improve on the pollution produced by automobiles, problems of vehicular emissions and the associated health. The thrust of this research is on the impact of vehicular traffic on public health in Bonny.

The automobile is doubtless one of the outstanding inventions of man. It has become an inalienable part of modern life and one can well imagine what life would be in the present times without this great inventions. Business, commerce and industry, social life of the people and their need to travel are all served by the motor vehicle. The movement of vehicles to and fro in a round junction or intersection creates a lot of problems to the inhabitants of the area as well as those that often spend time around the area.

In a study by Braver (2002), on the impact of vehicular traffic on children living or attending school near truck routes and high ways, shows increased attack of asthma disease, allergy symptoms, allergic rhinitis and reduced lung function. Also Brugge, et al, (2007) in their study on 'near-highway pollutants in motor vehicle exhaust' indicates that the inhabitant are exposed to air pollution and elevated levels of ultrafine particulates black carbon (BC), oxides of nitrogen(nox) and carbon monoxide (CO). People living or otherwise spending plenty of time within about 200m of highways more so than persons living at a greater distance, even compared to living on busy urban streets, evidence of the health hazards of these pollutants arises from studies that assess nearer to highways, actual exposure to the pollutants or both.

The pollutions created by vehicular traffic on road junction or intersection is a result of traffic congestion. Road congestion is caused by obstacles or obstruction on the road such as accident breakdown vehicle, volume of vehicle on the road, driving against traffic, indiscriminate parking that slows down the free flow of traffic which result to an increase emission of gases from the vehicle exhaust as well as generation of noise from the vehicle chassis.

Experience has shown that, some of the vehicles that ply the roads in Bonny town are not road worthy, they are old and no adequate maintenance program. When a vehicle grow older and their mechanical condition deteriorates, the noise generated becomes more, thereby increase the rate of emission of carbon monoxide harmful to public health that leads to climate change which is experience in Bonny and its environs.

Also, there are deposits of black particles on roads and on vehicle in Bonny these days which may be caused by increase emission from the exhaust of vehicle and harmful to humans.

In realization of these problems created by vehicular traffic as a result of road congestion and its health challenges posed to inhabitant, it's necessary to investigate and find out the impact of vehicular traffic on public health of inhabitants residing in road junction, the factors that cause a vehicle to generate pollutants that are harmful to public health and the problems it create to the inhabitants.

The aim of this research is to assess the impact of vehicular traffic on public health in selected junctions in Bonny. In line with the aim, the objectives of the research are to:

1. determine the period of the day when vehicular traffic is more visible at the major junctions.
2. evaluate the factors that affect vehicle traffic flow at a road junction.
3. ascertain the effect of vehicular traffic on public health.
4. access the type(s) of pollutants emitted by vehicular traffic to the environment.
5. determine the nature of traffic control at junction

It is believed that the outcome of this research will add to the existing stock of knowledge and improve understanding on the subject matter. The study also will benefit Bonny Kingdom, Rivers State, and the Society at large.

First, this study allows the researcher to assess the present condition of vehicular traffic and its impact on public health in selected junctions in Bonny, thereby build academic knowledge and provide base for further career improvement.

Second, it accelerate national development ‘through provisions of problem solving research output to the policy and decision makers. Moreover, Bonny Local Government can use the finding of this research for policy formulation and make right decision on road designs that will enhance traffic flow and ultimately reduce health impacts of vehicular movement in Bonny metropolis.

1.2 Impact of Vehicular Traffic and Public Health

The movement of vehicle ‘to and fro’ in a road junction creates a lots of problems, one of the major effect is congestion. Traffic congestion is when vehicles travel at lower speeds because there are more vehicles than the road can handle. This makes trip times longer, and increases queuing. Congestion may result from a decrease in capacity for instance accidents on the road layouts can also restrict capacity. The increase in vehicular traffic on a road junction leads to increase in vehicular emission according to Ojolo (2007) Vehicular emission includes oxides of nitrogen, Sulphur, carbon hydrocarbon, mercury and leads. Karlsson (2004) states that vehicle emission which is as a result of vehicular traffic on road junction pollutes air and require control. Carbon monoxide emission from vehicle causes blood clothing when its reacts with hemoglobin which cuts the supply of oxygen in the respiration system for long exposure. (Ackerman, 2002). Vehicle emissions are a major source of ambient air pollution that must be controlled if air quality is going to be maintained. According to studies undertaken by Schwela, (2000) nitrogen oxides and sulfur oxides are associated with immune system impairment, exacerbation of asthmas and chronic respiratory disease, reduced lung function and cardiovascular disease. Also exposure to carbon monoxide can result in fatigue, headaches, dizziness, loss of consciousness and even death at a very high concentration.

Bonny is one of the commercial town in Rivers State which is one of the Nigeria’s largest cities and is quickly growing putting its resident on high risk for exposure to transport-related pollution. The daily increase of the city in motorization and rapid urbanization, puts Bonny at risk of high levels vehicle emission. Moreover, the fuel composition makes it likely that the vehicles in use in bonny will release high levels of pollutions. Vehicle emissions are affected by fuel type, especially sulfur content. As sulfur content increases, the fuel efficiency decreases and emission of sulfur oxides particulate matter and volatile organic compounds increase (World Bank 2003).In U.S, gasoline has a standard of 15ppm of sulfur, and in the EU, it has a standard of 50ppm. The concentrations of sulfur in fuels in Nigeria most often range from 500 – 2,000ppm, with a maximum allowable sulfur level at 5,000ppm (UNEP, 2007). Thus, it can be expected that vehicles will release more pollution especially sulfur oxides and particulates.

Vehicle noise affects public health especially resident close to a road where vehicles ply. According to the World Health Organization (WHO) 2003, noise is second only to air pollution in the impact it has on health. It is a major cause not only of hearing loss, but also of heart disease, learning problems in children and sleep disturbance. Yet traffic noise could easily be halved with existing technology if more stringent limits were adopted. Vehicular traffic is the main source of noise pollution in road junctions in cities. Noise health effects are the health consequences of regular exposure, to consistent elevated sound levels, elevated workplace or environmental noise can cause hearing impairment, hypertension, heart disease, annoyance and sleep disturbance. WHO (2003).

According to Dr. William H. Stewart former U.S. Surgeon General ’calling noise a nuisance is like calling smog an inconvenience’. Noise must be considered a hazard to the health of people everywhere. Jonathan (1988) states that vehicle noise pollution is a major cause of stress. Stress reactions include the release of several stress hormones, changes in heart rate and rhythm, rise in blood cholesterol levels and digestive upsets. Barber (1992) stipulates that vehicles traffic affect public health in the following ways via safety noise, air pollution, vibration, visual intrusion and degrading the aesthetics and severance.

The safety of road users has been seriously endangered by motors vehicles based on recklessness of drivers that causes accident and inflicting pains to pedestrians, passengers and other road users.

Vehicle noise is unwanted sound generate by vehicular traffic as the vehicle ply the road, the sounds of noise from the vehicle are noise generated by different parts of the vehicle such as engine, inlet, exhaust brakes, horns, chassis, load in the vehicle, door slamming etc., other sounds of noise are those contributed by the interaction between the vehicle and the road surfaces and noise dependent on the speed, flow and density of traffic. Noise from the vehicle affects health of people living near a major road, junction in form of annoyance, sleep disturbance, cardio vascular disease adverse effects on mental health etc. Janel (2013).

Pollution of the atmosphere by fumes and smell emitted by the motor vehicles makes the urban streets extremely unpleasant. The major source of the pollution is the exhaust gas emitted by internal combustion engine although evaporative hoses from the fuel tank and the carburetor and hoses’ from the crank case account for some proportion of the hydrocarbons. The major components of the exhaust gas are carbon dioxide, water vapors, un-burnt petrol, carbon monoxide, oxide of nitrogen; lead compounds carbon particles (Smoke) etc.

Other impacts of vehicular traffic are vibration. A vehicle moving on a road surface induces vibrations in the soundings. These are of the following types via, vibrations generated in the contained air, surface vibrations and underground vibration. On narrow streets, flanked by buildings, the air contained between the buildings is vibrated when vehicles, move on the streets such vibrations rarely cause structural damages, but may be annoying to the people. Surface vibrations are those set up on structures above the ground whereas underground vibrations are set up in the soil mass and the foundations resting there on. Barber (19192)

Janel (2013) postulates that exposure to noise is continuing challenge to individual and community health and states that some of the excess noise include vehicular traffic and the potential health impacts associated with exposure include annoyance, sleep, disturbance, interference with communication, decreased school performance, increased levels of stress and modification of social behavior. Chronic exposure to vehicle noise leads to increase noise of hearing impairment hypertension and ischemic heart disease.

Climate change is another impact of vehicular traffic on the public health. Climate change is a long term change in the earth's climate especially a change due to an increase in the average atmospheric carbon dioxide produced by the use of fossil fuels. Jonathan and Barry (2016)

Climate change has impact on global public health. Around the world harsh weather events increased temperatures, drought and rising sea levels are all affecting ability to grow food, access clean water and work safely out doors. The health risks with climate change are hypothermia in cold weather; heat Stress on hotter days, and injuries or less of life from severe weather (e.g. flood) it can also indirectly impact on public health through for instance water contamination after intense rainfall, cardio-respiratory problems from smog and increased noise from food –borne and vector-born disease during hot weather.

1.3 Summary of effect of Air Pollution

Evaporative losses from the fuel tank and vehicle- car bettor, together with pollutants emitted from exhaust gas, are the major factors causing air pollution. If oxidation were complete, water and carbon dioxide would be the only products produced from the combustion of petrol in an internal combustion engine. Either of these products is considered as a pollutant, although there is great anxiety about the build-up of carbon dioxide in the atmosphere and its effect on global climate. In practice, it is difficult to achieve complete oxidation so that carbon monoxide is formed in great quantities, some of the fuel remains unchanged and some is turn into other organic compounds. Therefore, the major components of air pollution due to vehicular traffic are carbon monoxide (CO), oxides of nitrogen (N08), hydrocarbon (Hc), lead, and particulate matter, as shown in Table 1.1.

Table 1.1: By products of the burning of vehicle fuel

S/N	**By Products Of Engine's Fuel/ Combustion**	**REMARKS**
I	Carbon dioxide(co2)	Not consider to be Pollutant
Ii	Water vapors	
Iii	Unburnt petrol	Pollutants
Iv	Carbon monoxide	
V	Hydrocarbon(Hc)	
Vi	Oxides of nitrogen(No8)	
Vii	Lead compounds	
Viii	Carbon particles(smoke)	

i. Carbon Monoxide

Carbon Monoxide will combine with hemoglobin in the blood to produce carboxyhemoglobin (COHb). Carbon monoxide has a greater affinity for hemoglobin than oxygen and it is preferentially absorbed, even when the concentration of carbon monoxide is very low. High percentage of carboxyhemoglobin in the blood leads to health hazards. Death will result when more than 70% of the blood hemoglobin has been converted to CO Hb. After a subject cease to be exposed to non-lethal doses of carbon monoxide, the carboxyhemoglobin content of the blood gradually declines as carbon monoxide is breathed out (reversible effect).

ii. Oxides of Nitrogen and Hydrocarbon

Oxides of nitrogen or NO x are produced by the combination of atmospheric nitrogen with oxygen under conditions of high temperature and pressure, such as are produced in an internal combustion engine. They are a significant health hazard, especially nitrogen dioxide. In the atmosphere, the oxides of nitrogen resulting from the combustion of petrol can react with hydrocarbon (HC) in the presence of sunlight, particularly under anticyclonic weather conditions, to produce ozone. This is a known precursor for the formation of photochemical smog. Thus, the products of vehicle fuel combustion can react with each other to produce undesirable secondary products which are all hazardous to human health.

iii. Lead Compounds

The major sources of lead in urban areas are from vehicle exhaust gases. The lead compounds in the exhaust gas originate from the "anti-knock' agents added to leaded fuel. Lead emitted through vehicles' exhaust gases will eventually enter plants or will drain to watercourse s. Lead enters human bodies through the consumption of food containing lead from either of the two sources. In the long-term, lead will cause health hazards in term of lead poisoning.

iv. Smoke

The smoke emitted by vehicles consists mainly of very fine particles of carbon, which result from incomplete combustion of fuel. Smoke is usually related to vehicles with diesel engines. It consists of fine particulates, including those with aerodynamic diameter less than 10 micrometers, which can penetrate deep into the air exchange region of the human lung, thus causing a health hazard. In addition, carbon particles may act as nuclei both for haze formation and the absorption of gases such as sulfur dioxide and nitrogen oxides which are likely to cause damage to the lung.

1.4 Summary of effect of Noise Pollution

Noise causes annoyance, sleep disturbance, disturbed cognitive functioning, cardio vascular disease, and causes adverse effects on mental health; Babisch (2006) states that to control vehicle noise, which affects the health of people living near road the following techniques should be adopted such as changes in the design of vehicles; changes in tires or road surface, elimination of nosier vehicles on the road; building of noise barriers at the road; redesigning of the building in the area; smoothing of road surface; change of operating time of vehicle movement, modification in traffic operation; designing streets, buildings and areas for producing less noise etc.

Table 1.2: The acceptable noise levels recommended by the European Economic Committee.

(UK, 1970)

S/No	Class Of Vehicles	Acceptable noise levels (measured at a distance of 7.5m) db (A)
i.	Passenger vehicles with seating capacity for not more than a persons including driver	82
ii.	Passenger vehicles with seating capacity for more than a persons including driver and a maximum permissible weight not exceeding 3.5 tons	84
iii.	Goods vehicles with a maximum permissible weight not exceeding 3.5 tons	84
iv.	Passenger vehicle with seating capacity for more than a persons including the driver, and a maximum permissible weight of more than 3.5 tons	89
v.	Goods vehicle with a maximum permissible weight of more than 3.5 tons	89
vi.	Passenger vehicles with seating capacity for more than a persons including the driver and powered by an engine of 200 HP or over DIN	91
vii.	Goods vehicle powered by an engine of 200 HP.DIN or over and having a maximum permissible weight of over 2tons	91

2.1 Methodology

The descriptive survey research design is used to carry out in this study. This is a kind of research design aim at gathering information after the incident has occurred. The focus is on why the situation behaves the way it does. The research design utilizes both qualitative and quantitative approaches. The qualitative approach includes the use of interview, field study, and observation techniques while the quantitative approach involves the use of description statistics generated with frequency tables.

The study area includes major roads junctions in Bonny where vehicular traffic is more visible and densely. This includes the following junctions; Bonny Town, Lion gate, Bonny round about, Shell gate, Berger junction, LGA junction, Macaulay Junction, SDP junction, Akiama junction, Semidia Junction, Abalamabie junction, Wilbros Junction, NLNG round about, Finima Junction etc.

The population includes; vehicle drivers, traffic wardens, individuals' resident within the selected road junction in bonny, passengers, medical doctors etc.

To determine the entire numbers of road junctions in Bonny that falls into the sample, number of commuters plying the road junction as well as number of people living within the road junction environment, the sample size determination formula known as Yaro Yamen is used. The sample size determination formula is known as.

$$n = \frac{N}{1 + N(e)^2} \qquad (3.1)$$

Where

n = Sample sought N = Total population

e = Level of significant.

However, the population of study includes the entire commuters, traffic wardens, passengers, individuals residing within the road junctions and medical doctors. Since we cannot ascertain the number of junctions, drivers, traffic warden, passengers and medical doctors, the cluster sampling techniques of probability sampling method is adopted by zoning the population in terms of location with each zone representing the entire population and having an equal chance of being selected. The statistical tool used for the analysis of the two hypotheses is chi-square a non-para-metric variable. The chi-square is defined as a 'goodness of fit test'. It is used to determine whether a significant relationship exist between and observed or actual number of objects in each category and an expected number based on the null hypotheses. The chi-square is symbolized mathematically by:

$$X^2 = \frac{(F_o - F_e)^2}{F_e} \quad (3.2)$$

$$where:$$

$$F_o = F(PR)$$

$$F_e = \frac{TR \times TC}{GT} \quad (3.3)$$

Where:

X^2	=	Chi-square	TR	=	Total Row
TC	=	Total Column	GT	=	Grand Total
F_O	=	Observed frequency	F_e	=	Expected frequency
F	=	Function	PR	=	Population response

Degree of freedom

This is the probability that the true value statistics will fall within the interim created by adding and subtracting the desire level of freedom and is calculated as;

$$DF = (R-1)(C-1) \quad (3.4)$$

Where

DF = Degree of freedom R = Number of row

C = Number of column

Level of significance

The level of significance is the range or error which the researcher envisages or the probability of the researcher being in error, hence the level of significance for this study is 90 percent or 0.0l

Critical region

The critical region is the criteria or bases for acceptance or rejection of the hypotheses stated, the critical region is derived by checking from the chi-square table, the vehicle of degree of freedom upon the level of significance.

Since the degree of freedom upon the level of freedom for the two hypotheses i.e one, and two are the same, checking at the table of chi-square these values:

For hypothesis one

The critical region is obtain thus,
DF (3-1) (3-1) = 2 x 2= 4
That is:

Table 2.1 vehicular traffic and public health

Vehicular traffic	**Public health**
1. Fast 2. Slow 3. Dead end	1. Positive 2. Negative 3. indifferent

Source: This Study, 2024

The matrix is 3 x 3

Thus by checking at chi-square table the level of confidence as 0.01 against 4 is 13.277

For hypothesis two

The critical region is

DF = (3– 1) (3 – 1)

The critical region is DF (3 – 1) (3 – 1) = 2 x 2 = 4

That is:

Table 2.2 Condition of vehicle and pollution.

Condition of vehicle	Pollution
1. Smoky (non -road worthy) 2. Non smoky (road worthy) 3. Bad	1. Air pollution 2. Noise pollution 3. Oil spill

Source: This Study, 2024

Therefore, by checking the chi-square table these values 0.01 and 4 we have 13.277 which is the critical region.

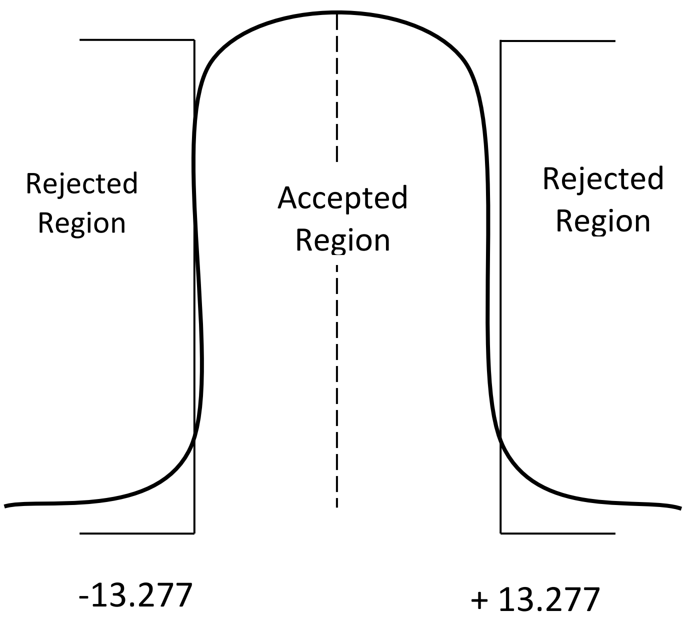


Figure 1.2: diagram of critical region

Decision Rule

The decision rule summaries the research findings on each of the hypotheses stated in chapter one, it is a guide (decision rule) to enlighten the project supervisor/examiner, the result of the research conducted.

The decision rule for chi-square test i.e. for hypothesis one and two is

i. If the calculated chi-square is less than the critical region accept null hypothesis otherwise reject it.

That is if

CAL X2 < CR (3.5)

Accept Null hypothesis (H_0)

ii. If the calculated is greater than the critical region, accept alternative hypotheses, otherwise reject.

That is If

CAL X2 > CR (3.6)

Accept alternative hypotheses (H_1)

The formula to calculate Noise level and average noise level is given below

Noise level formula

$$L_{eq} = 10Log\left(\left(\frac{1}{T}\right)\sum_{i=1}^{i=n}10^{L_i/10}(t_i)\right) \quad (3.7)$$

where :

Li = the noise level in dB(A) of the ith measurement

T = total time

n = the total number of measurements taken

t_i = fraction of total measurement time

Average noise level formula

$$L_{avg} = 20\log\frac{1}{N}\sum_{j=1}^{N}10^{\left(L_j/20\right)} \quad (3.8)$$

where

L_{avg} = average noise level (in dB ref : 20μPa)

N = number of measurements

L_j = the jth noise level (in dB ref : $20\mu Pa$)

j = 1,2,3,.........N

3.1 Result and Discussion

The analysis and interpretation of data is to give a detailed picture of the researcher's findings especially as portrayed by the respondent involved.

This research work is more of descriptive analysis (survey) and field study, thereby giving the researcher the opportunity to implore as many data collection.

A deliberate attempt is made in this section to present and analyze data gathered from the field, having in mind, the objective of our research which is "to assess the impact of vehicular traffic on public health in selected junctions in Bonny in Rivers State.

3.1.1 Testing of hypotheses

The two hypothesis stated earlier are analyze in this section. In order to avoid as much confusion as possible, a system approach consisting of the following five steps is used whenever statistical test of hypothesis are conducted.

Hence, the procedure adopted for analyzing the hypothesis is as follows:

(i) Statement of Hypothesis
(ii) Identification of test statistics
(iii) Formulation of the decision rule
(iv) Computation of the value of the test statistic
(v) Drawing, a conclusion or make a decision in terms of the result.

The calculation and testing of hypothesis one

Hypothesis One:

H_0: There is no correlation between vehicular traffic and public health

H_1: There is a correlation between vehicular traffic and public health

Table 3.1: Vehicular traffic and public health

Vehicular traffic		PUBLIC HEALTH			
		Positive	**Negative**	**none**	**Total**
I	Fast	4	13	0	17
Ii	Slow	9	14	1	24
Iii	Dead end	6	25	1	32
	Total	**19**	**52**	**2**	**73**

Source: This Study, 2024

i. Fast movement: $\frac{19 \times 17}{73} = 4.42$ $\frac{19 \times 24}{73} = 6.25$ $\frac{19 \times 32}{73} = 8.33$

ii. Slow movement: $\frac{52 \times 17}{73} = 12.11$ $\frac{52 \times 24}{73} = 17.10$ $\frac{52 \times 32}{73} = 22.79$

iii. Dead end: $\frac{2 \times 17}{73} = 0.50$ $\frac{2 \times 24}{73} = 0.66$ $\frac{2 \times 32}{73} = 1.0$

Table 3.2: Calculation of Chi-square

Vehicular traffic	Public health	FO	FE	FO-FE	$(FO-FE)^2$	$(FO-FE)^2$
Fast m	Positive	4	4.42	-0.42	0.1764	0.04
Fast m	Negative	13	6.25	6.75	45.56	7.29
Fast m	None	0	8.33	-8.33	69.39	8.33
Slow m	Positive	9	12.11	-3.11	9.67	0.79
Slow m	Negative	14	17.10	-3.1	9.61	0.56
Slow m	None	1	22.79	-22.79	579.40	22.79
Dead end	Positive	6	0.50	5.5	30.25	60.5
Dead end	Negative	25	0.66	24.34	592.43	897.62
Dead end	None	1	1.0	0	0	0
		73			0	X^2
						= 997.92

Hypothesis one was tested to ascertain the validity on the statement that "vehicular traffic does not affect public health in selected road junction in Bonny, from the result obtain through the calculation of Chi-square, it was observed that the calculated chi-square (x^2 = 997.92) was greater than the critical region (+ 13.277) and referring to the decision rule stated earlier, I accept the alternative hypothesis showing that "there is a correlation between "vehicular traffic and public health.

The calculation and testing of hypothesis two

(a) H_0: There is no correlation between condition of vehicle and pollution

(b) H_1 : There is a correlation between condition of vehicle and pollution

Table 3.3: Condition of vehicle and pollution

Condition of vehicle		Pollution		Oil spill	Total
		Air	**Noise**		
I	Smoking (non-road worthy)	10	31	2	43
Ii	Good (road worthy)	6	3	0	9
Iii	Bad (written off)	1	10	10	21
	TOTAL	**17**	**44**	**12**	**73**

Source: This Study, 2024

Computation of expected frequency:

i. Smoking Vehicle: $\frac{17 \times 43}{73} = 10.01$ $\frac{44 \times 43}{73} = 25.95$

$\frac{12 \times 43}{73} = 7.07$

ii. Good vehicle $\frac{17 \times 9}{73} = 2.10$ $\frac{44 \times 9}{73} = 5.42$

$\frac{12 \times 9}{73} = 1.50$

iii. Bad vehicle = $\frac{17 \times 21}{73} = 4.89$ $\frac{44 \times 21}{73}$ 12.66

$\frac{17 \times 21}{73} = 3.45$

Table 3.4: Calculation of Chi-square

Condition of vehicle	Pollution	FO	FE	FO-FE	$(FO-FE)^2$	$(FO-FE)^2$
Smoky V	Air	10	19.01	.0.01	0.0001	0.0001
Smoky V	Noise	31	25.92	5.08	25.81	1.00
Smoky V	Oil spill	2	7.07	5.07	25.71	3.7
Good V	Air	6	2.10	3.9	15.21	7.24
Good V	Noise	3	5.42	-2.42	5.90	1.10
Good V	Oil spill	0	1.50	-1.0	2.25	1.5
Bad V	Air	1	4.89	-3.64	1.13	3.10
Bad V	Noise	10	12.66	-2.66	7.08	0.56
Bad V	Oil spill	10	3.45	6.55	42.90	12.44
		73			0	X^2
						30.64

Hypothesis two was tested to ascertain the validity on the statement that condition of vehicle does not cause pollution in selected road junction in Bonny. From the result obtain through the calculation of Chi-square it was observed that the calculated Chi-square ($X^2 = 30.64$) was greater than the critical region (+13.277) and referring to the decision rule stated earlier, I accept the alternative hypotheses, showing that " There is a correlation between " condition of vehicle and pollution.

3.1.2 General Observation and Analysis on Field Study of Air Quality and Noise Level Test on Selected Road Junction.

A field study was conducted in four road junctions in Bonny - Bonny round about, SDP junction, Semidia Junction, and NLNG round about, on Air quality and noise level as to determine its impact on the inhabitant within the road junction.

The study was carried out on the 22nd to 30th April, 2024 and it's conducted on hourly bases starting from 9:00am to 6pm daily. The following instruments as stated below, were used to test and analyze the quality of air and noise pollutions exposed to inhabitants of the four road junctions. The instruments includes: Madur GA – 21 plus – Flue gas analyzer b21 752013; Noise meters (model test 135 2H); kestrel anemometer (Model kestrel 4500); Nerosmy 2600 Gps (model 2 600); Ammonia meter and HAT PM^2. 5/PM 01/TSP meter (Model CN-HAT 200). Prior to each test, the wind direction and speed is identified to determine the direction the gases on the air is blowing toward; Also the ambient temperature is taken as well as the time for each test.

3.1.3 Results of Air quality and Noise level test

This section provides information on the air quality and noise characteristics in the environment of the study area. Results of the monitoring exercise for each junction within the study area are presented in Tables 3.5 to 3.9 Variations of SO_2, NO_2, CO and H_2S with time at Bonny round about are shown in Figure 3.1; while Variation of hydrocarbon with time at Bonny round about is shown in Figure 3.1. Also, Variations of TSPM, PM_{10} and $PM_{2.5}$ with time at bonny round about are shown in Figure 3.1. Variations of SO_2, NO_2, CO and H_2S with time at SDP junction, Junction are presented in Figure 3.2; Variation of hydrocarbon with time at SDP junction, junction is presented in Figure 3.2; while Variations of TSPM, PM_{10} and$PM_{2.5}$ with time at SDP junction, Junction are shown in Figure 3.2.

Variations of SO_2, NO_2 and CO with time at Semidia Junction are shown Figure 3.3; Variation of Hydrocarbon with time at Semidia Junction is shown in Figure 3.3; while, variations of TSPM, PM_{10} and $PM_{2.5}$ with time at Semidia Junction are shown in Figure 3.3. Variations of SO_2, NO_2, CO and H_2S with time at NLNG round about are presented in Figure 3.4; while, variation of Hydrocarbon with time at NLNG round about is presented in Figure 3.4; also, variations of TSPM, PM_{10} and $PM_{2.5}$ with time at NLNG round about are presented in Figure 3.4. Mean values of temperature, wind speed and relative humidity as measured during field exercise are shown in Figures 3.1; while meteorological wind rose of the area is shown in Figures 3.2.

Table 3.5: Result of Ambient Air quality monitoring at Bonny Round About Junction

27-03-17 **N4⁰48'23.520" E7⁰00'41.976"**														
Time (hr)	**SO_2 (ppm)**	**NO_2 (ppm)**	**CO (ppm)**	**H_2S (ppm)**	**C_xH_y (ppm)**	**NH_3 (ppm)**	**TSPM (µg/m^3)**	**PM10 (µg/m^3)**	**PM 2.5 (µg/m^3)**	**Noise dB (A)**	**Wd spd (m/s)**	**Temp (^{0}C)**	**Rel. Hum (%)**	**Wind direct**
10:00	1.00	0.00	0.00	1.00	300.00	0.00	192.0	245.0	112.0	77.70	1.00	29.50	89.00	NE
11:00	1.00	0.00	3.00	0.00	200.00	0.01	604.0	520.0	260.0	85.70	1.00	30.70	81.50	NE
12:00	1.00	0.00	4.00	0.00	400.00	0.01	417.0	454.0	225.0	92.00	2.30	31.70	78.70	SE
13:00	0.00	0.00	7.00	0.00	600.00	0.00	97.0	81.0	39.0	87.40	3.20	34.00	69.60	NE
14:00	0.00	0.00	1.00	0.00	400.00	0.01	84.0	62.0	48.0	71.30	1.80	32.20	71.90	SE
15:00	0.00	1.00	4.00	0.00	200.00	0.00	107.0	94.0	57.0	86.20	1.40	33.50	68.30	SW
16:00	1.00	0.00	2.00	0.00	400.00	0.00	68.0	95.0	37.0	75.00	2.50	33.20	65.60	NE
17:00	0.00	0.00	5.00	0.00	600.00	0.01	95.0	78.0	32.0	87.60	1.80	31.00	67.00	NE
Range	0.0-1.0	0.0-1.0	0.0-7.0	0.0-1.0	200.0-600.0	0.0-0.01	68.0-604.0	62.0-520.0	32.0-260.0	71.3-92.0	1.0-3.2	29.5-33.5	65.6-89.0	
Mean	**0.50**±0.53	**0.13±0.35**	**3.25±2.25**	**0.13±0.35**	**312.50±155.26**	**0.01**	**208.0±196.77**	**203.63±184.85**	**101.25±91.20**	**82.86**	**1.88**	**31.98**	**73.95**	
FMEnv Limit	0.01	0.06	10	NA	NA	NA	250	NA	NA					
NAAQS Limit	0.14	0.1	9	NA	NA	NA	200	150	35					

Table 3.6: Result of Ambient Air quality monitoring at SDP Junction

27-03-17 $N4^0$47'15.240" $E7^0$00'09.366"														
Time	**SO_2 (ppm)**	**NO_2 (ppm)**	**CO (ppm)**	**H_2S (ppm)**	**C_xH_y (ppm)**	**NH_3 (ppm)**	**TSPM (µg/m³)**	**PM10 (µg/m³)**	**PM 2.5 (µg/m³)**	**Noise dB (A)**	**Wd spd (m/s)**	**Temp (⁰C)**	**Rel. Hud.(%)**	**Wind direct**
9:15	1.00	0.00	0.00	2.00	400.00	0.00	368.0	355.0	170.0	80.40	0.80	32.50	72.20	NW
10:15	1.00	1.00	4.00	1.00	200.00	0.00	183.0	114.0	54.0	77.80	1.40	32.60	70.40	NW
11:15	1.00	1.00	1.00	0.00	300.00	0.01	48.0	37.0	18.0	78.60	1.00	33.20	68.00	NW
12:15	0.00	0.00	5.00	0.00	600.00	0.00	114.0	100.0	50.0	75.50	1.40	34.90	60.80	NE
13:15	1.00	1.00	5.00	1.00	400.00	0.01	119.0	113.0	56.0	70.50	1.10	35.90	55.20	NW
14:15	0.00	1.00	2.00	0.00	200.00	0.00	124.0	115.0	58.0	73.40	1.80	36.50	55.10	SE
15:15	1.00	0.20	4.00	0.00	400.00	0.01	94.0	84.0	31.0	81.20	2.40	33.50	57.90	NE
16:15	0.00	0.00	2.00	0.00	100.00	0.00	118.0	102.0	60.0	72.00	1.20	31.10	68.10	SW
Range	0.0-1.0	0.0-1.0	0.0-5.0	0.0-2.0	100.0-600.0	0.0-0.01	48.0-368.0	62.0-520.0	18.0-170.0	70.5-80.4	1.0-3.2	31.1-36.5	55.1-72.2	
Mean	**0.63±0.52**	**0.53± 0.51**	**2.88± 1.89**	**0.50± 0.76**	**312.50± 158.11**	**0.00**	**146.00± 97.09**	**127.50± 95.46**	**62.13± 46.02**	**76.18**	**1.39**	**33.78**	**63.46**	
FMEnv Limit	0.01	0.06	10	NA	NA	NA	250	NA	NA					
NAAQS Limit	0.14	0.1	9	NA	NA	NA	200	150	35					

Table 3.7: Result of Ambient Air quality monitoring at Semidia Junction

29-03-17 **$N4^0$45'46.60" $E7^0$01'07.919"**														
Time	**SO_2 (ppm)**	**NO_2 (ppm)**	**CO (ppm)**	**H_2S (ppm)**	**C_xH_y (ppm)**	**NH_3 (ppm)**	**TSPM (µg/m³)**	**PM_{10} (µg/m³)**	**$PM_{2.5}$ (µg/m³)**	**Noise dB (A)**	**Wd spd (m/s)**	**Temp (⁰C)**	**Rel. Hum. (%)**	**Wind direct**
9:00	1.00	0.00	4.00	0.00	600.00	0.00	412.0	285.0	129.0	74.00	1.20	31.60	78.00	SW
10:00	0.00	0.00	24.00	0.00	800.00	0.00	486.0	345.0	155.0	76.50	1.40	32.20	68.40	NE
11:00	0.00	1.00	31.00	0.00	600.00	0.00	240.0	175.0	85.0	82.50	1.10	33.80	60.00	NE
12:00	0.00	0.00	20.00	0.00	400.00	0.00	114.0	98.0	48.0	76.80	2.00	34.90	57.60	NE
13:00	1.00	0.00	7.00	0.00	300.00	0.01	1059.0	1036.0	538.0	74.80	2.20	35.40	55.80	NE

14:00	0.00	1.00	11.00	0.00	500.00	0.00	382.0	369.0	159.0	78.10	1.20	35.90	50.20	SW
15:00	2.00	0.00	3.00	1.00	200.00	0.00	283.0	202.0	100.0	87.00	1.10	32.10	60.00	SE
16:00	0.00	0.00	14.00	0.00	400.00	0.00	212.0	164.0	78.0	78.00	2.00	31.80	65.00	NW
Range	0.0-2.0	0.0-1.0	4.0-31.0	0.0-1.0	200.0-800.0	0.0-0.01	114.0-1059.0	62.0-520.0	78.0-538.0	74.0-87.0	1.1-2.2	31.6-35.9	50.2-78.0	
Mean	**0.50± 0.76**	**0.25± 0.46**	**14.25± 10.02**	**0.13± 0.35**	**425.0± 190.86**	**0.00**	**398.5± 292.42**	**334.25± 298.53**	**161.5± 156.91**	**78.46± 4.3**	**1.53± 0.46**	**33.46± 1.75**	**61.88± 8.54**	
FMEnv Limit	0.01	0.06	10	NA	NA	NA	250	NA	NA					
NAAQS Limit	0.14	0.1	9	NA	NA	NA	200	150	35					

Table 3.8: Result of Ambient Air quality monitoring at NLNG round about

29-03-17 **N4^{0}45'25.481" E7^{0}02'02.004"**														
Time	**SO_2 (ppm)**	**NO_2 (ppm)**	**CO (ppm)**	**H_2S (ppm)**	**C_xH_y (ppm)**	**NH_3 (ppm)**	**TSPM (µg/m^3)**	**PM_{10} (µg/m^3)**	**$PM_{2.5}$ (µg/m^3)**	**Noise dB (A)**	**Wd spd (m/s)**	**Temp (^{0}C)**	**Rel. Hud.(%)**	**Wind direct**
9:30	0.00	0.00	0.00	0.00	200.00	0.00	482.0	313.0	145.0	55.80	0.80	28.30	84.60	SW
10:30	0.00	0.00	0.00	0.00	0.00	0.00	367.0	226.0	113.0	53.70	1.00	28.70	83.00	SW
11:30	1.00	0.00	1.00	0.00	100.00	0.00	464.0	316.0	210.0	60.10	0.80	28.60	80.10	SE
12:30	0.00	1.00	0.00	0.00	0.00	0.00	347.0	263.0	117.0	57.60	1.40	29.60	75.70	SE
13:30	0.00	0.00	2.00	0.00	400.00	0.00	282.0	212.0	108.0	62.00	2.00	31.00	68.00	NE
14:30	0.00	0.00	0.00	0.00	0.00	0.00	118.0	100.0	89.0	48.00	1.70	33.10	64.20	SW
15:30	1.00	0.00	0.00	1.00	0.00	0.00	111.0	101.0	84.0	53.60	0.90	34.60	56.70	SW
16:30	0.00	0.00	0.00	0.00	0.00	0.00	201.0	110.0	76.0	60.80	1.40	33.00	57.30	NW
Range	0.0-1.0	0.0-1.0	0.0-2.0	0.0-1.0	0.0-400.0	0.00	108.0-482.0	100.0-313.0	76.0-210.0	48.0-62.0	0.8-2.0	28.3-34.6	56.7-84.6	
Mean	**0.25± 0.46**	**0.13±0.35**	**0.38± 0.74**	**0.13±0.35**	**87.50± 145.77**	**0.00**	**296.50± 144.22**	**205.13 ± 91.58**	**117.75 ± 43.23**	**56.45± 4.66**	**1.25± 0.45**	**30.86 ±2.44**	**71.20± 11.22**	
FMEnv Limit	0.01	0.06	10	NA	NA	NA	250	NA	NA					
NAAQS Limit	0.14	0.1	9	NA	NA	NA	200	150	35					

Table 3.9: Noise Levels Measured at each Junction

Time (hour)	Bonny round about dB(A)	Time (hour)	SDP junction dB(A)	Time (hour)	Semidia Junction dB(A)	Time (hour)	NLNG round about dB(A)
10AM	77.70	9:15AM	80.40	9AM	74.00	9:30AM	55.80
11AM	85.70	10:15AM	77.80	10AM	76.50	10:30AM	53.70
12Noon	92.00	11:15AM	78.60	11AM	82.50	11:30AM	60.10
1PM	87.40	12:15PM	75.50	12Noon	76.80	12:30	57.60
2PM	71.30	1:15PM	70.50	1PM	74.80	1:30PM	62.00
3PM	86.20	2:15PM	73.40	2PM	78.10	2:30PM	48.00
4PM	75.00	3:15PM	81.20	3PM	87.00	3:30PM	53.60
5PM	87.60	4:15PM	72.00	4PM	78.00	4:30PM	60.80
Range	71.3-92.0		70.5-81.2		74.0-87.0		48.0-62.0
Mean, Lavg	85.10		76.90		79.5		57.40
FMEnv limit	**90**		**90**		**90**		**90**
Leq	86.50		77.60		80.8		58.20
NESREA Leq limit	**70**		**70**		**70**		**70**

3.1.4 Discussion of Air quality and Noise level test

Assessment of Air Pollution Impacts in study area

The protection of human health should be a major issue of concern to the transportation industry today. This is because of its associated exhaust air pollution that is hazardous to the human health. This section discusses and describes the potential air quality impacts associated with vehicular traffic as obtained at the selected junctions monitored in the study area. These impacts can be extremely serious, especially as they affect human health in particular and the environment in general.

Meteorology

The meteorological conditions of the study area are presented and discuss as follows. Values ambient temperature, relative humidity, wind speed and wind direction were measured during field monitoring and their influences on air quality are discussed.

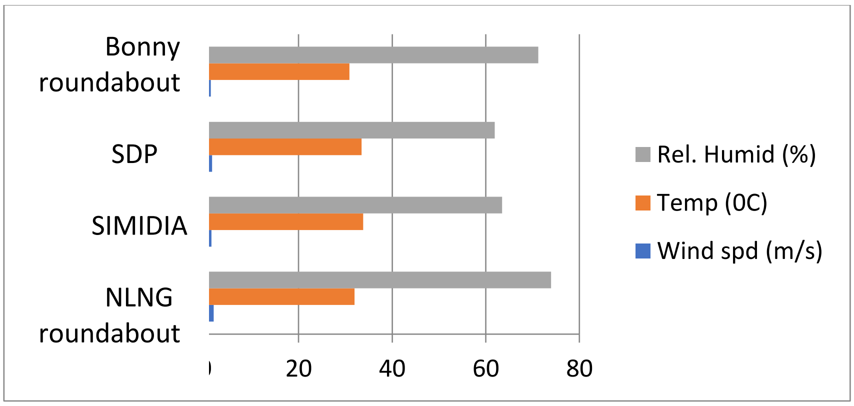


Figure 3.1: Mean values of temperature, Wind Speed and Relative Humidity at monitored Junctions

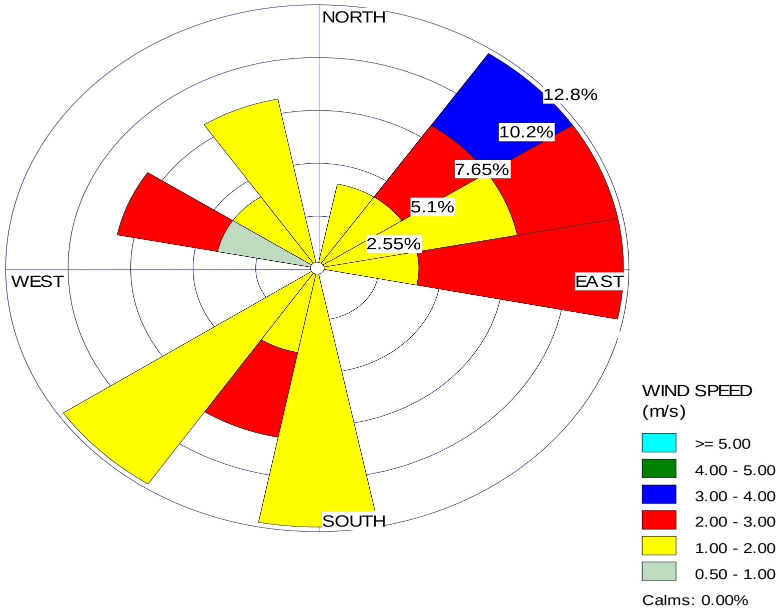


Figure 3.2: Wind Rose showing Wind Directions monitored at the Junctions

(a) Ambient Temperature

Ambient temperature monitored at Bonny Round About ranged between 29.5^{0}C and 34.0^{0}C with a mean deviation of 31.98±1.55^{0}C; air temperature measured at SDP junction ranged from 31.6^{0}C to 35.9^{0}C with a mean value of 33.4±1.75^{0}C; similarly, ambient temperature recorded at Semidia junction ranged from 31.1^{0}C to 36.5^{0}C with a mean deviation of 33.78±1.84^{0}C; while temperature values measured at the NLNG Round About ranged from 28.3^{0}C to 34.6^{0}C with mean deviation of 30.08±2.44^{0}C. These temperature values are common characteristic tropical climate with high intensity sunshine of the study area. Average values of ambient temperature for each junction are shown in Figures 3.1.

(b) Relative Humidity

Relative humidity measured at Bonny Round About ranged in values from 65.6% to 89.0% with a mean deviation of 73.95±8.27%; relative humidity monitored at SDP junction ranged between 50.2% and 78.0% with a mean value of 61.88±8.54%; likewise, values of relative humidity recorded at Semidia junction ranged from 55.1% to 72.2% with a mean deviation of 63.46±7.0%; while relative humidity monitored at NLNG Round junction ranged from 56.7% to 84.65% and a mean deviation of 71.2±11.22%. Humidity values oscillate in tandem with air temperature, but as opposite fluxes. High relative humidity of this nature is expected in the month of April because of the coastal nature of the area. Irrespective of the season the area experiences high relative humidity that is maximum at dawn (over 90%) and minimum by late afternoon (<60%). Average values of Relative Humidity in study area are shown in Figures 3.1.

(c) Wind Speed

Wind speed measured at Bonny Round About varies from 1.0m/s to 3.2m/s with a mean value of 1.88±0.76; also, wind speed recorded at Semidia junction during field measurement ranged between 1.1m/s and 2.2m/s with a mean deviation 1.53±0.46m/s; similarly, wind speed monitored at SDP junction ranged from 0.8m/s to 2.4m/s with a mean deviation of 1.39±0.51m/s; while wind speed at the NLNG Round About ranged from 0.8m/s to 2.0m/s with a mean deviation of 1.25±0.45m/s. mean wind speed monitored at the junctions are shown in Figure 3.1.

(d) Wind direction

Wind directions were predominantly North-Easterly, South- Westerly, and some period of North-Westerly as represented in Wind Rose of Study Area (Figure 3.2). These wind directions determined the distributions or dispersions of air pollutants observed at the junctions monitored.

a) Sulphur Dioxide (SO_2)

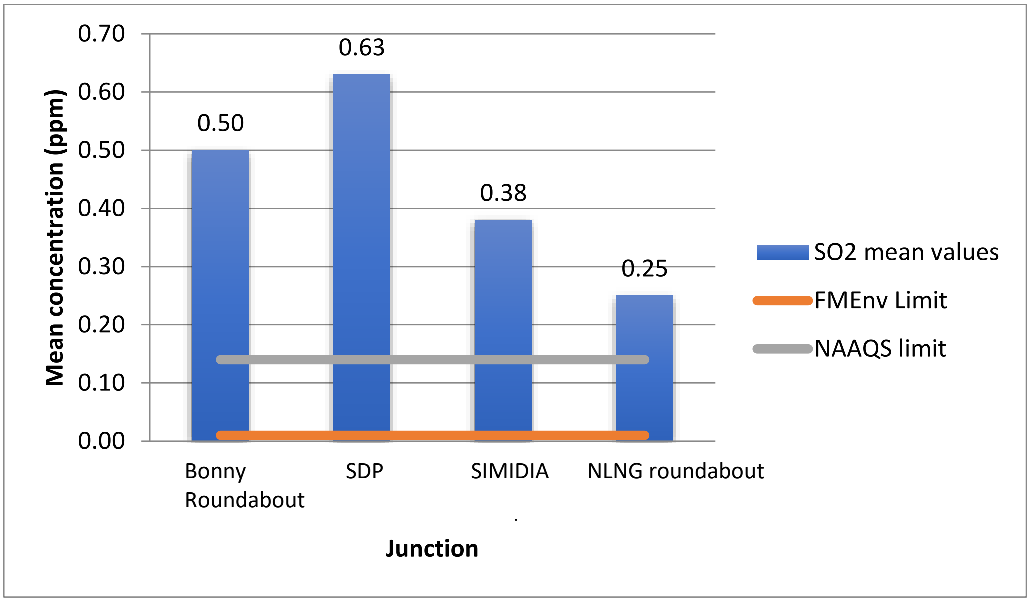


Figure 3.3: Mean Concentrations of SO_2 Measured at each Junction

Computed mean concentrations of sulphur dioxide at each junction are shown in Figure 3.3. Mean concentrations of SO_2 at all junctions including control far exceeded both FMEnv and NAAQS permissible exposure limits (Figure 3.3). These high concentrations of SO_2 can be injurious to public health. Exposure to high levels of Sulphur dioxide irritates the eyes. Also, Sulphur dioxide has the ability to affect the mucous membranes when inhaled. Commercial drivers and petty traders doing business at the junctions are therefore at risk of health effects of this pollutant. Sulphur dioxide can oxidize in the atmosphere to form sulphuric acid which results in acid rain. This pollutant can also contribute to respiration illness, and other associated diseases such as bronchospasms with it when inhaled.

b) Nitrogen Dioxide (NO_2)

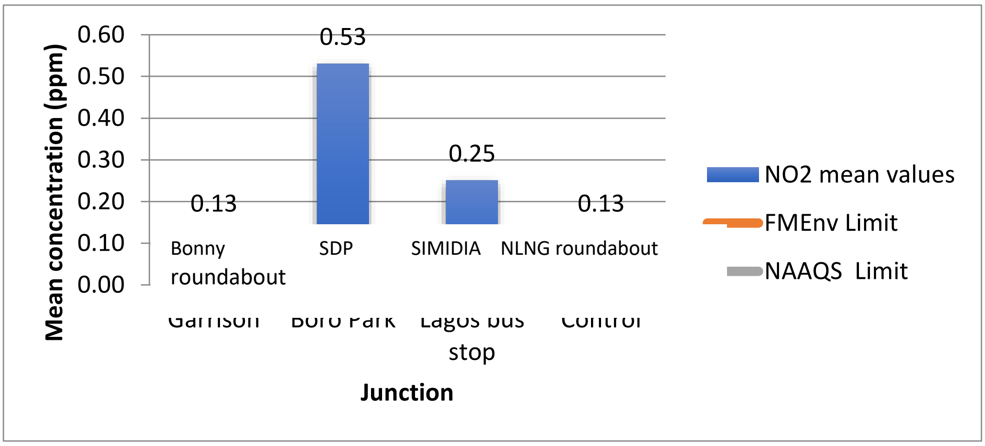


Figure 3.4: Mean Concentration of NO_2 Measured at each Junction

Computed average values of nitrogen dioxide for all the junctions are very high with respect to FMEnv and NAAQS exposure limits (Figure 3.4). These levels of nitrogen dioxide are capable of causing slight increase in respiratory illness and decrease in pulmonary function. Continued exposure may result in an abnormal accumulation of fluid in the lung causing pulmonary discomfort. Also, nitrogen dioxide can oxidize in the atmosphere to form nitric acid which results in acid rain.

c) Carbon Monoxide (CO)

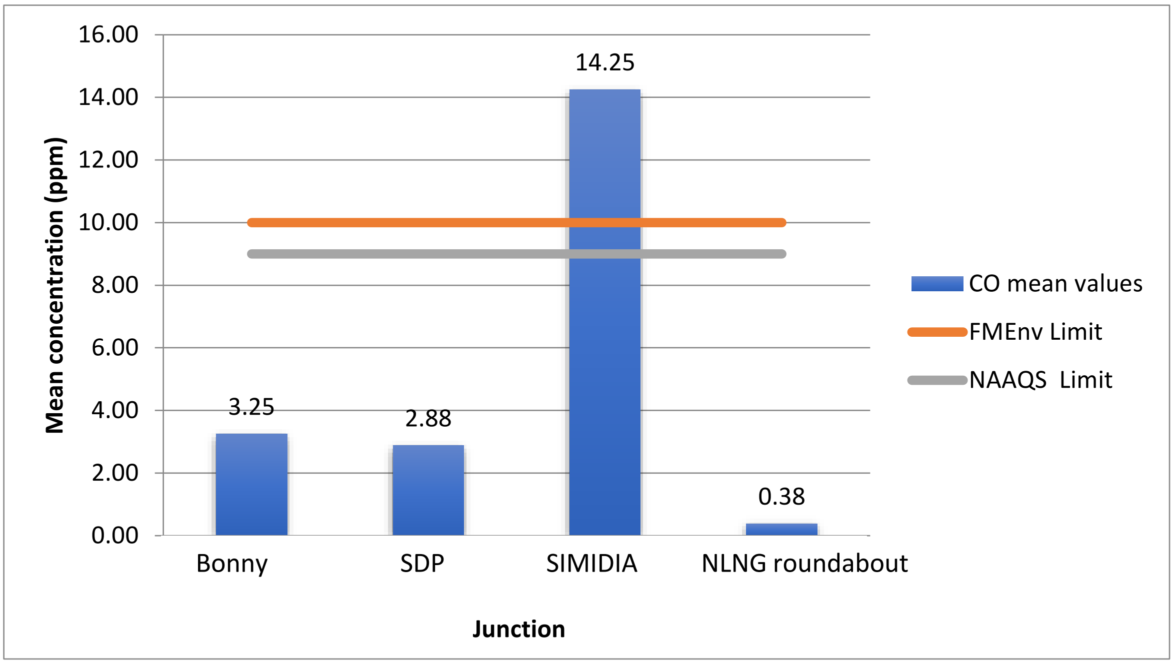


Figure 3.5: Mean Concentration of CO Measured at each Junction

Carbon monoxide was below permissible limits at the junctions (Figure 3.5) except at Semidia junction where it exceeded FMEnv exposure limit by 42.5% and NAAQS limit by 58.3%. Prolonged exposure to this pollutant may result in increased cases of asthma, and respiratory diseases among the drivers, petty traders and close residence. Cases of chronic bronchitis, pulmonary emphysema, and cancer of the bronchus mucous membrane caused by air pollutants may be prevalent in the study area. Carbon monoxide has the ability to combine with the hemoglobin of the blood to form carboxyhemoglobin (COHb) which reduces the ability of the hemoglobin to carry oxygen to the body tissues. Carbon monoxide can also affect the central nervous system of the exposed population. Similarly, people who spent more time around the junction may suffer heart attacks and other related diseases.

d) Hydrogen Sulphide (H_2S)

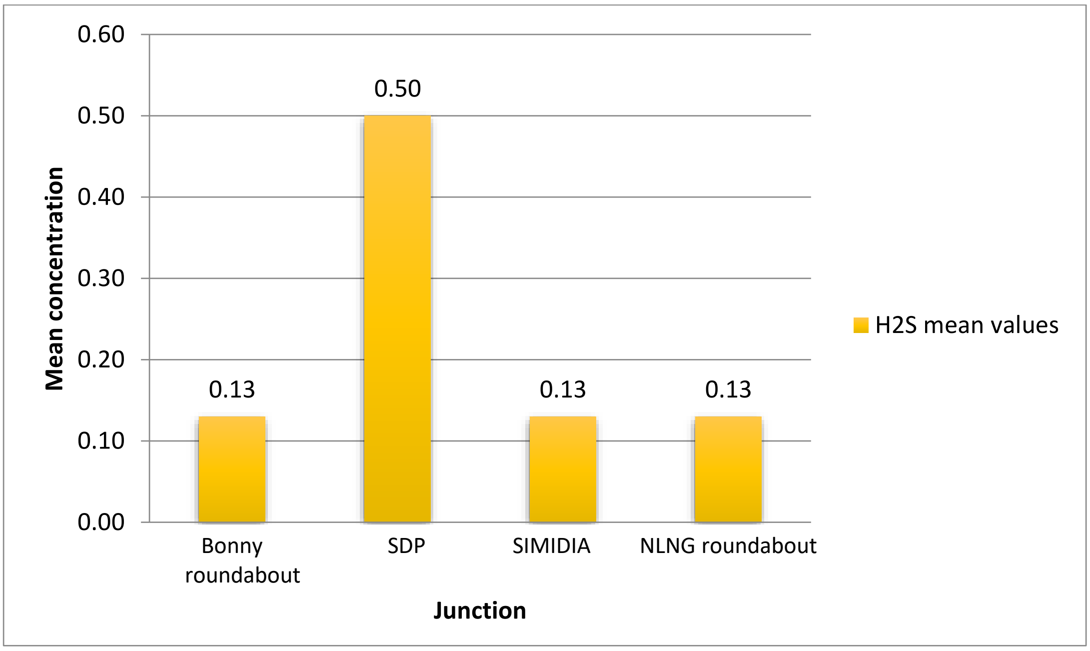
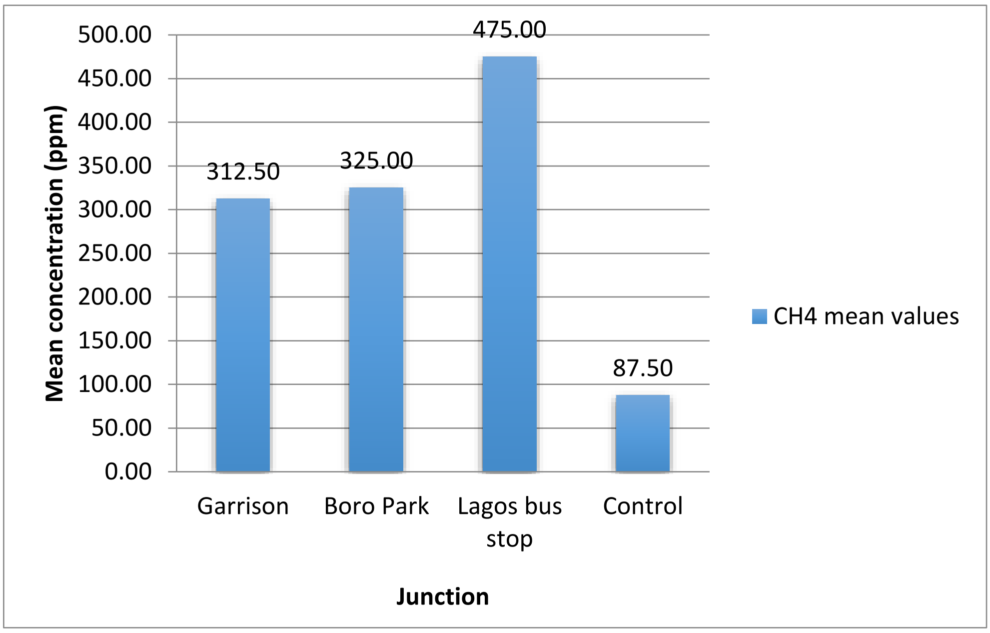


Figure 3.6: Mean Concentration of H_2S Measured at each Junction

Concentrations of hydrogen Sulphide were low in all the junctions. However, it was slightly high at SDPJunction (Figure 3.6). Exposure to this level of hydrogen Sulphide for a long time can result in fatigue of the sense of smell.

e) Hydrocarbon



Bonny Roundabout SDP SIMIDIA NLNG Roundabout

Figure 3.7: Mean Concentrations of Hydrocarbon Measured at each Junction

Mean concentrations of total hydrocarbon measured at the junctions are shown in Figure 3.7. Results obtained indicated that concentrations of hydrocarbon were high in all the junctions except at the NLNG Round About. Acute health effect has been generally associated with exposure to elevated level of hydrocarbon. However, the exposure concentration and exposure duration leading to the onset of acute health effects varies between individual hydrocarbons, and this may influence the effects of exposure to mixtures. Health effects associated with prolonged exposure to hydrocarbons are asphyxiation (death due to lack of oxygen), narcosis (that is depression of the central nervous system; anesthesia), cardiac arrest and aspiration. Exposure to hydrocarbons vapour/aerosol mixtures can cause acute adverse health effects at concentrations below those presenting an explosion or asphyxiation risk (death due to lack of oxygen).

Photochemical and other reactions can transform the pollutants as they are transported in air resulting in spreading of air pollutants around the vicinity of the junctions. Also, the high concentration levels of hydrocarbon can volatilize and react with nitrogen dioxide in the presence of sunlight to form photochemical smog and ground level ozone. This is the cause of haze fogs that reduce visibility as often experienced at major junctions in Bonny LGA.

f) Total Suspended Particulate Matter (TSPM)

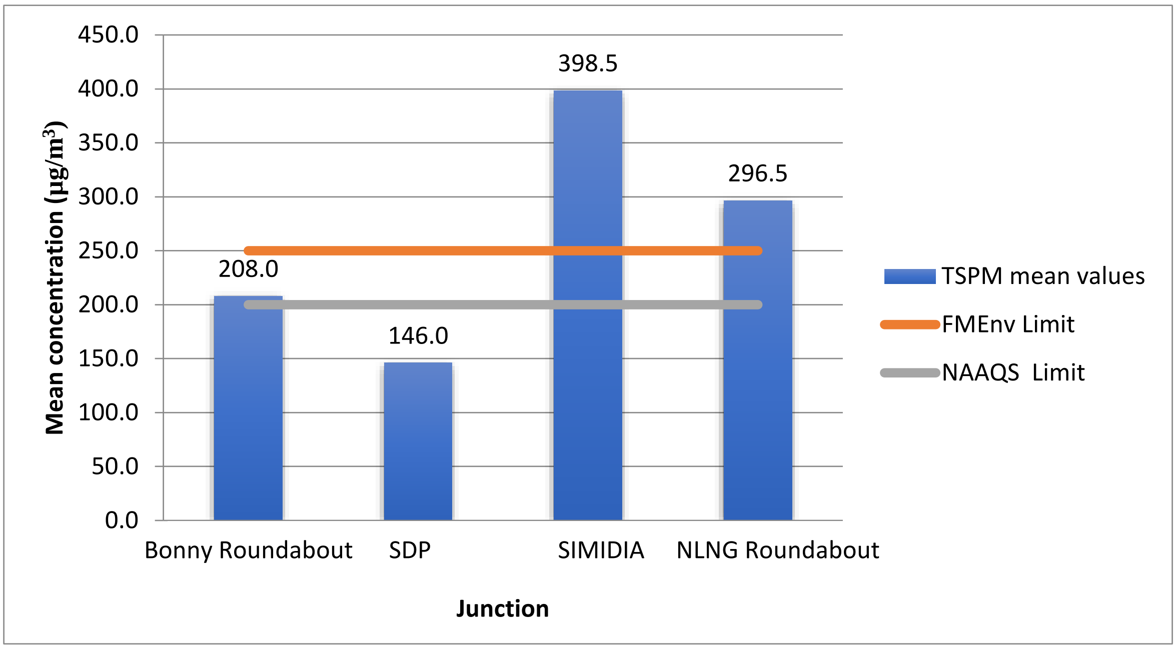


Figure 3.8: Mean Concentration of TSPM Measured at each Junction

Mean concentrations of total suspended particulate matter (Figure 3.8) were high at Bonny Round About, Semidia Junction and NLNG Round About. These values exceeded permissible exposure standards and have the potential to adversely affect public health. Inhaling these levels of TSPM may result in increased respiratory symptoms and chronic bronchitis.

g) Respirable Particulate Matter, PM_{10}

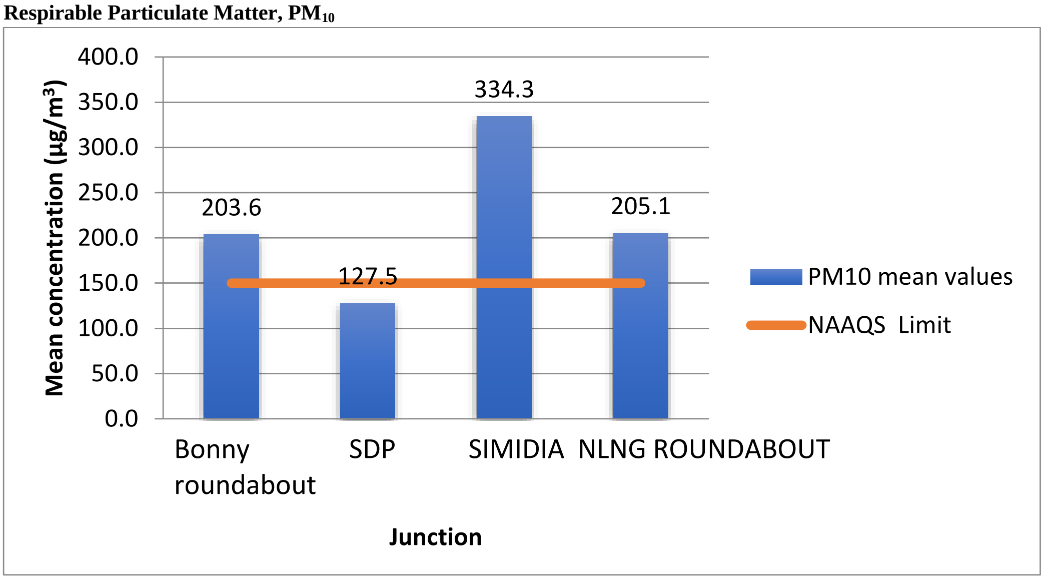


Figure 3.9: Mean Concentration of PM_{10} Measured at each Junction

Average concentrations of particulate matter less than 10 micrometer (PM_{10}) were high in Bonny Round About, Semidia Junction and NLNG Junction except at SDP Junction (Figure 3.9). The mean values exceeded NAAQS stipulated limit and are therefore hazardous to public health. The exposed public or population around these junctions may at risk of acute and chronic respiratory symptoms, asthma, and bronchitis. PM_{10} also contributed to early morning haze which causes visibility impairment.

h) Inhalable Particulate Matter ($PM_{2.5}$)

This size of particulate matter can penetrate deep into the lungs resulting in serious health problems such as respiratory impairment and symptoms.

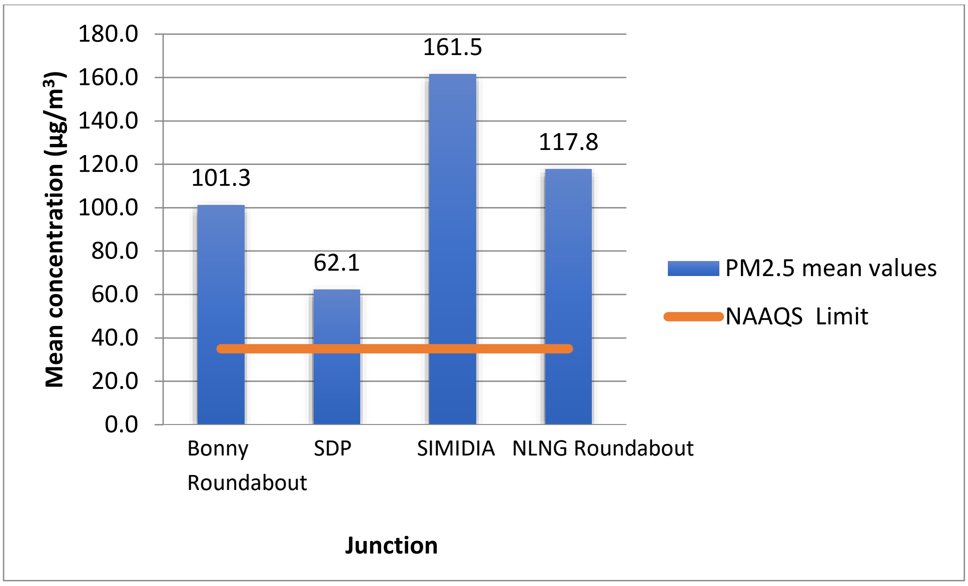


Figure 3.10: Mean Concentration of $PM_{2.5}$ Measured at each Junction

Next to PM_{10} are particulate matter less than 2.5 micrometer ($PM_{2.5}$). The mean concentrations of $PM_{2.5}$ (shown in Figure 3.10) were very high in all the junctions including NLNG Junction. Exposure to these levels of $PM_{2.5}$ result in increased respiratory symptoms, cardiovascular and cancer related deaths may occur. Exposed public may also suffer from pneumonia, lung malfunction, asthma, all of which may increase hospital admissions among the public. Generally, concentration levels of particulate matters obtained in the study were mostly influenced by the meteorological conditions of the area. Vehicular traffic contributed relatively little to the levels of particulates recorded at the junctions. Particulate concentrations were relatively high in the morning hours when the relative humidity or water vapour in the atmosphere was high and temperature level was low, but as relative humidity decreases and temperature increases the concentration levels decreases. There was increased in concentration around 12.0Noon at Semidia Junction due to the effect of wind direction blowing from the sea coastline. Some black particles deposited on vehicles were observed during monitoring when sea breeze was predominant. This also contributed to the levels of particulate matter obtained in the study area.

3.1.5 Noise Study

Noise measurement was carried out alongside air quality study in all the sampling junctions. Various studies have attributed high noise levels on different busy roads to vehicular traffic (Rylander et al., 1976; Cowan, 1994; Calix et al., 2003; and Ugbebor et al., 2015). High traffic noise can be hazardous to human health, especially people living in close proximity to busy junctions. Prolonged exposure to noise of levels higher than regulatory limits can result in temporary loss of hearing (temporary threshold shift) or permanent loss (permanent threshold shift). The FMEnv permissible noise limit for an 8-hour exposure is 90dB. Noise levels measured at the junctions during field survey are shown in Figures 3.11 to 3.

Noise Levels at Bonny Round About

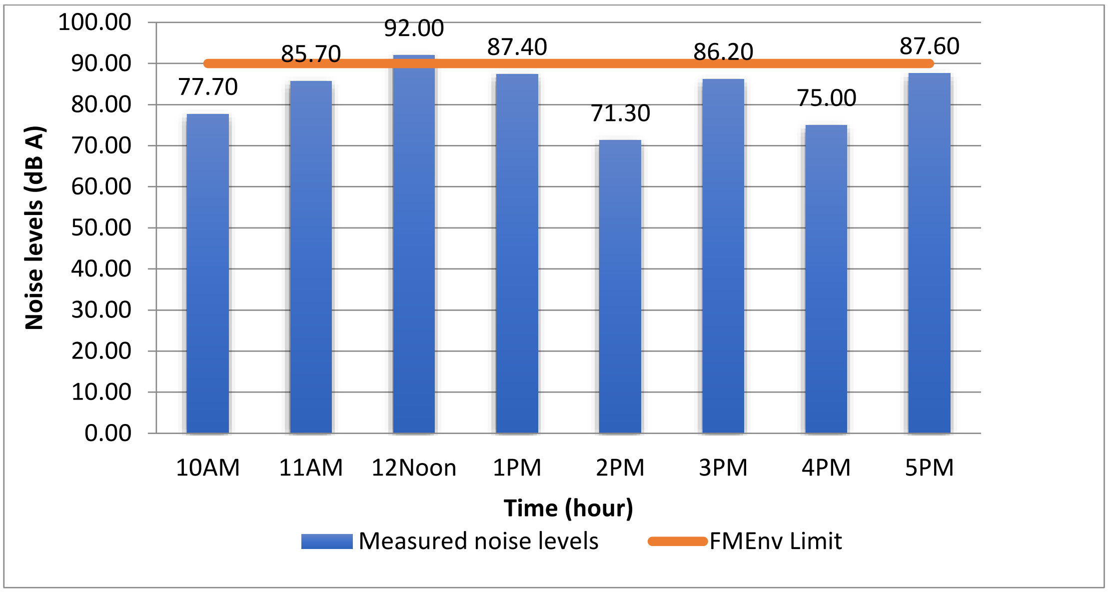


Figure 3.11: Noise Levels Measured at Bonny Round About

Noise measurement at Bonny Round About ranged from 71.3dB (A) to 92.0dB (A) with a mean value of 85.1dB (A) as shown in Figure 3.11. A maximum noise value of 92.0dB (A) was recorded around 12.0Noon; while a minimum value of 71.3dB (A) was recorded around 2.0PM. The maximum noise level obtained during monitoring exceeded FMEnv regulatory standard by 2.22%. Prolong exposure to this level of noise could lead to hearing impairment among drivers and petty traders doing business at the junction.

Noise Levels at SDP Junction

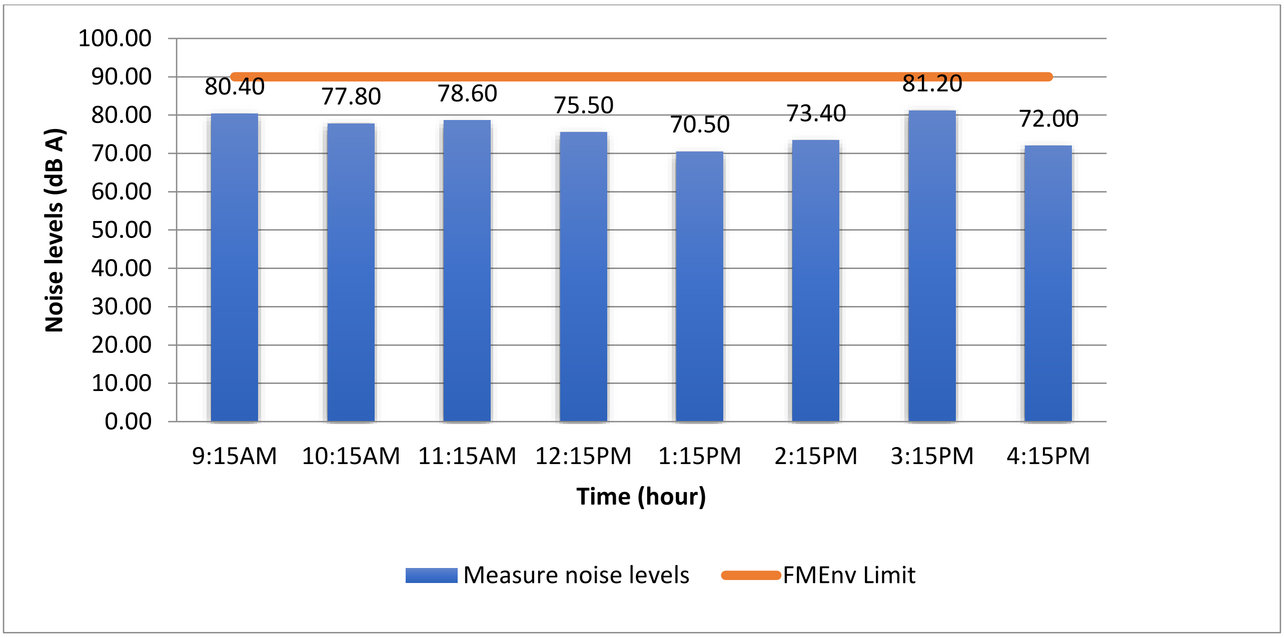


Figure 3.12: Noise Levels Measured at SDP Junction

Noise levels measured at SDP junction ranged from 70.5dB (A) to 80.4dB (A) with a mean value of 76.9dB (A) as shown in Figure 3.12.these noise levels are below FMEnv limit are shown in Figure 3.12 and thus pose no immediate threat to public health. However, prolong exposure could be hazardous to human health.

Noise Levels at Semidia Junction

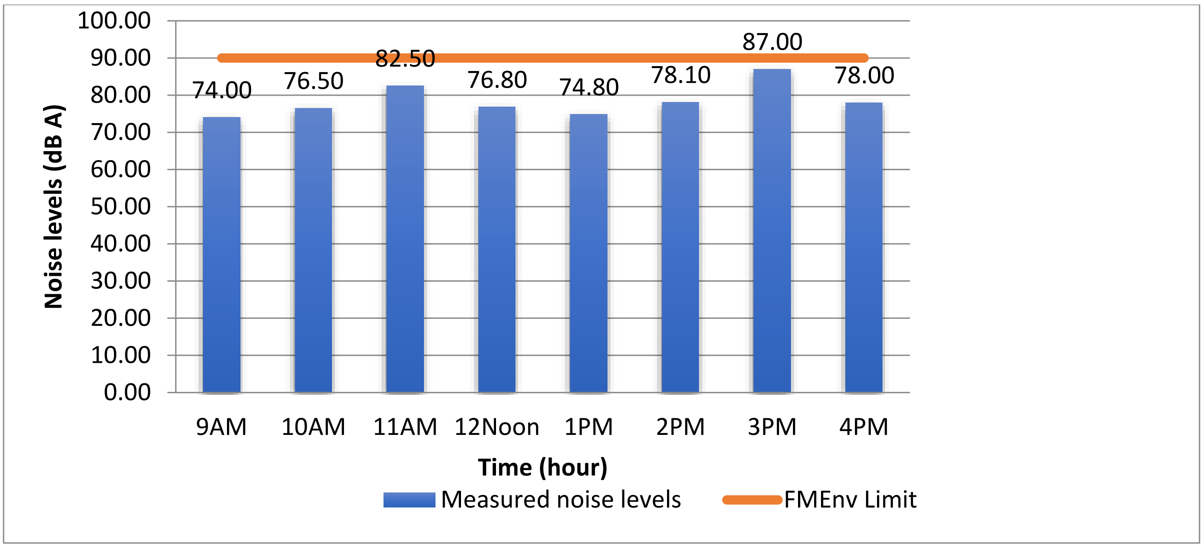


Figure 3.13: Noise Levels Measured at Semidia Junction

Result showed that noise levels monitored at Semidia junction ranged from 74.0dB (A) to 87.0 3dB (A) with a mean value of 79.5dB (A) as shown in Figure 3.13. These noise levels are below FMEnv prescribed limit of 90dB (A) and therefore do not constitute immediate threat to human health. However, prolong exposure can be dangerous to public health.

Noise levels recorded at the Control junction varied from 48.0dB (A) to 62.0dB (A) and an average value of 57.4dB (A) as shown in Figure 3.14 below. These values are far below FMEnv permissible limit and thus do not constitute hazards to public health.

Noise Levels at NLNG Round About

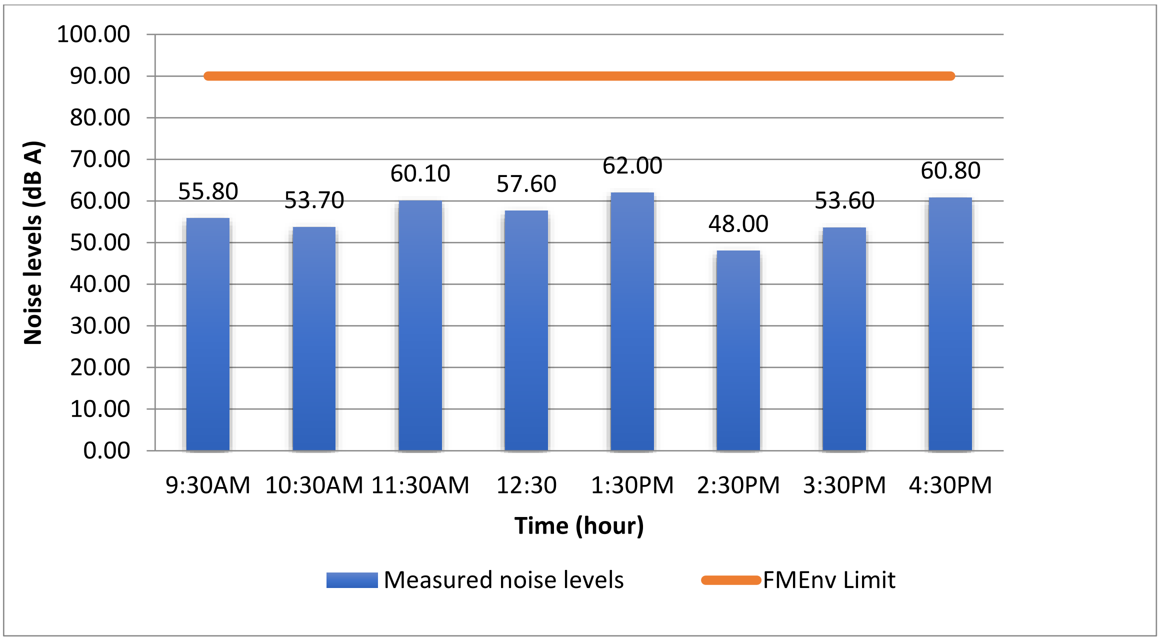


Figure 3.14: Noise Levels Measured at NLNG Round About

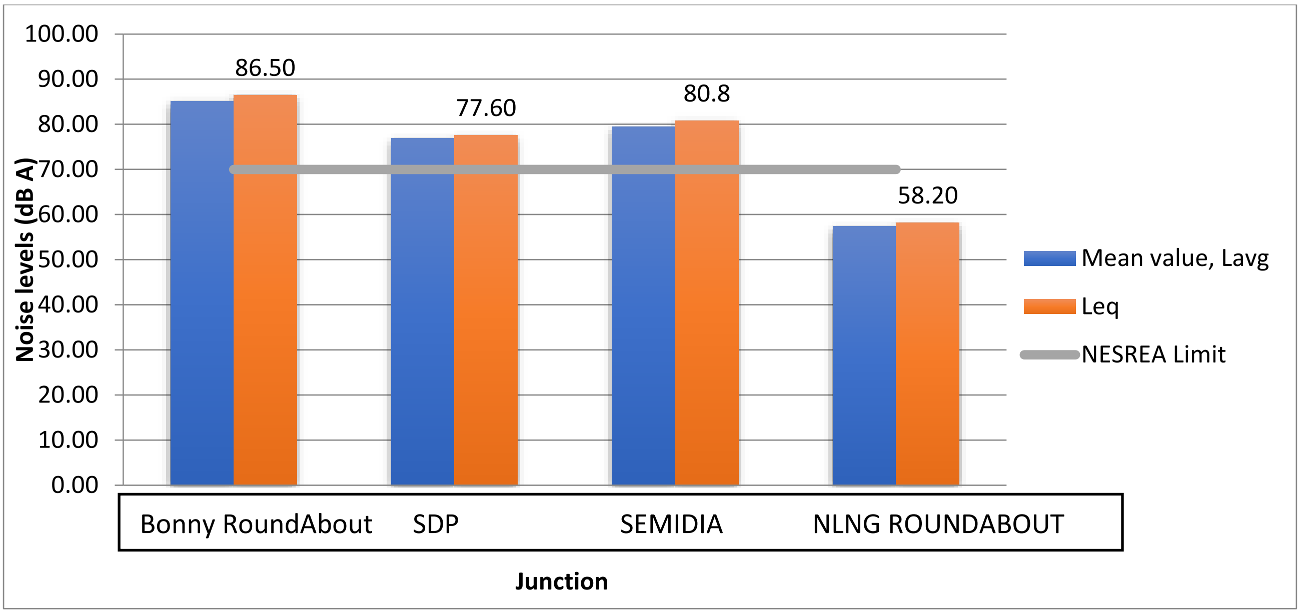


Figure 3.15: Mean Noise Values Measured at each Junction

Average noise level, Lavg, and Equivalent Continuous Equal Energy level, Leq for each junction are shown in Figure 3.15. Computed Equivalent Continuous Equal Energy level, Leq, values for Bonny Round About, SDP Junction and Semidia junctions exceeded NESREA permissible exposure limit of 70dB(A) by 23.6%, 10.9%, and 15.4% respectively. These Leq indices indicated that the noise levels at the junctions are capable of causing annoyance and interfere with speech communication among the public, especially drivers and petty traders who spent longer time at the junctions.

4.1 CONCLUSION AND RECOMMENDATIONS

4.1.1 Conclusion

An assessment study of the likely impacts of vehicular traffic on public health at selected junctions in Bonny, Rivers State has been carried out. Based on results of field measurement survey and data analysis, the following conclusion can be drawn.

Average concentration of Sulphur dioxide was found to be high which can be injurious to public health leading to illness such as irritation of the eyes, bronchospasms and respiratory problems among commercial drivers and petty traders doing business at the junctions.

Study showed that mean concentration of nitrogen dioxide are capable of causing slight increase in respiratory illness and decrease in pulmonary function in human beings.

Study also showed that level of carbon monoxide around Semidia junction is capable of aggravations cases of asthma, bronchitis and respiratory diseases among the drivers and petty traders as well as close residence.

Results obtained indicated that concentrations of hydrocarbon were high in all the junctions except at the NLNG Round About. Potential health issues among expose public may like be asphyxiation, narcosis (that is depression of the central nervous system), cardiac arrest and aspiration due to prolonged exposure. Cases of chronic bronchitis, pulmonary emphysema, and cancer of the bronchus mucous membrane caused by air pollutants may be prevalent among commercial drivers, petty traders and residents in the vicinity of the study junctions.

Study further revealed that concentrations of particulate matters (TSPM, PM_{10} and $PM_{2.5}$) were very high. Prolong exposure could lead to increased respiratory symptoms, cardiovascular and cancer related deaths may occur. Exposed public may also suffer from pneumonia, bronchitis, lung malfunction, asthma, all of which may increase hospital admissions among the public.

Computed noise Leq indices indicated that the noise levels in the junctions are capable of causing annoyance and interfere with speech communication among the public, especially drivers and petty traders who spent longer time at the junctions.

Overall results indicated that the public are exposed to high concentrations of air pollutants, especially sulphur dioxide, hydrocarbon, carbon monoxide, nitrogen dioxide, and particulate matters which may adversely affect their health or aggravate their health conditions due to prolonged exposure.

4.2 Recommendation

The protection of public health should be the ultimate concern of both Local governments and State.

From the proceeding conclusion, for us to tackle the present and future impact of vehicular traffic on public health and sanitize our environment from vehicle related pollution and congestion; this study provide the following recommendations;

- Government should introduce road pricing strategies in major roads junctions in Bonny town to prevent people parking indiscriminately on the road that causes congestion.
- Government should ensure that the road emergency management team are effective in clearing off the road any accident of broken down vehicles on the road as to avoid blockage of the road and which causes congestion.
- Government should encourage people to use non-motorized system of transportation such as the use of bicycles and walking as to reduce vehicle emission/ pollution and congestion.
- Government should enforce the law that prevent vehicles that are not road worthy to stop plying the road or face stiffer penalty.
- People are encouraged to involve carpooling or ride sharing to reduce the number of vehicles on the road that emit dangerous gases as well as congestion. Vehicle owners should service their vehicles when due as to avoid polluting the environment which is harmful to public health.
- Government should enact law that states that for annual renewal of vehicle particulars, emission testing of the vehicle must be carried out to ensure that the vehicle is road worthy and free from any form of pollution.
- Government should ban “Tokumbo” fairly used vehicles importation into Nigeria as to reduce the amount of vehicular- related pollution and encourage indigenous automobile companies to produce a brand new car at a control price. Banning of old vehicles and improved traffic management at the junctions are also recommended.
- Government should discourage the illegal refineries that produces fake petroleum products that caused a vehicle to be smoky.
- Government should established vehicle emission testing centers nationwide to reduce the high rate of emission from the vehicles.
- The use of traffic wardens to manage and control vehicular movement at the road junctions as to avoid traffic congestion which leads to increase in vehicular noise and air pollution is encouraged.
- Government should engage in public enlightenment campaigns, informing the public on the health impacts of noise, enforcement action taken, noise levels, complaints etc.
- Government should increase enforcement through deployment of more traffic police on the road junctions to check on vehicle noise. Irregular and unnecessary use of pressure horns by the drivers of truck, taxi, bus and other automobiles should be checked; punishment melted to those who default for the non-use of silencers and proper horns.
- Government should standardize noise levels of motor vehicles. Provision should be made in the Act regarding the limit of noise in terms of decibels as is done in other countries.
- Drivers and vehicle owners should ensure that the vehicle exhaust system is in good order and maintained regularly to avoid unnecessary noise and emission.
- Government should ban vehicles that are smoky on the road to reduce emission. Old vehicles generating high pollution should be scrapped.
- Government should support the proposed electric- driven car in the year 2025 by Wang Chuanfu, head of the Chinese electric car producer BYD, the essence is to cut pollution off and wipe out vehicle related disease.
- Norms for reducing pollution from the in-use vehicles should be enacted.
- Special task forces such vehicle inspection officers (VIO) should be diligent in checking grossly polluting vehicles as well as adulterated fuel in vehicles.
- Reduction of sulphur in diesel, use of cleaner fuel such as Compressed Natural Gas (CNG) of vehicles and commensurate fuel quality is highly recommended.

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