Diurnal Assessment of Air Quality at Zuba Motor Park, Abuja of Nigeria

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Exposure to air pollutants is increasing respiratory and cardiovascular morbidity and mortality with developing countries still experiencing the worst air pollution. This stimulates this study on diurnal assessment of air quality at Zuba Motor Park, Abuja of Nigeria. Air pollutants data (CO, SO_2, NO_2, PM, VOCs and NO), were collected at the centre of Zuba Motor Park. Measurement of the air pollutants was carried out three times (morning, afternoon and evening) in a day for a duration of 7 days in December 2022 with the intention to get a comparative result that would show the intensity at various times of the day and how they contribute in air pollution. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) Version (22.0). AQI was calculated using US.EPA equation. Results shows that the concentration of CO, SO_2, $PM_{2.5}$ and PM_{10} are more in the morning and evening (6a.m. - 7a.m. and 6p.m. - 7p.m.) when traffic volumes were high within the Motor Park. The ambient concentration of CO and SO_2 at the motor park in the morning exceeds the NESREA permissible limit creating threat to human health same goes to $PM_{2.5}$ at the motor park in the morning and evening for only the working days that was above the NESREA permissible limit while PM_{10} for all time of the day and all days of the week were within the NESREA permissible limit. The study also concludes that there is potential hazards during the morning and evening period in the study area for SO_2, CO and $PM_{2.5}$ with the pollutants of health risk to hawkers, road users and transport workers. Based on the findings of this study, there is a need for promoting and sensitizing the vulnerable and sensitive groups on the dangers of air pollution and there is for consistent vehicle inspection with vehicle emission testers to determine the emission status of vehicles patronizing Zuba Motor Park.

Keywords: Diurnal, Air Quality, Zuba Motor Park, Ambient

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INTRODUCTION

Transport is a vital part of modern life whereby there is opportunity to travel short and long distances for personal development and professional activities, more importantly, the economic development of entire regions depends on the easy access to people, goods and services assured by contemporary transport (Oderinde *et al.,* 2016). Motor parks are usually associated with transportation that involves the use of commercial vehicles by offering a place for commuters to come and board vehicles to their places of destination (Salami *et al.,* 2020). Motor parks are widespread and common public spaces in urban areas in Nigeria because many people use public transport systems, however, they differ in design, nature and services (Godson & Olusola, 2015).

The two main sources of air pollutants in urban areas are transportation (predominantly automobiles) and fuel combustion in stationary sources including residential, commercial, industrial heating and cooling and coal-burning power plants (USEPA, 2016b). Motor vehicles produce high levels of carbon monoxide (CO) and a major source of nitrogen oxides (NOx). Whereas fuel combustion in stationary sources is the dominant source of sulphur dioxide (SO_2). Currently, fossil fuels supply about 86% of the global primary energy consumption for transportation, industrial, commercial and residential uses. Due to the combustion of fossil fuels, large quantities of pollutants are emitted into the air, which have serious impact on the local, regional and global air quality (USEPA, 2016a).

Clean air is a vital resource needed for good health and the well-being of humans, animals, and plants (Murat, 2017). Sadly, our atmosphere is being continuously polluted thereby jeopardizing the air quality. Many cities around the world, particularly in developing countries like Nigeria, are experiencing rapid growth (UNICEF & UN Habitat, 2020). Yet, in the absence of adequate environmental policy and action, this growth occurs at a considerable, and often increasing, economic and social cost. Human activities have had a detrimental effect on the makeup of air (Ioannis & Elivaset, 2020). Use of automobiles, burning of coal, oil and other fossil fuels, and open or agricultural burning have changed the composition of air by introducing many pollutants.

Exposure to air pollutants is increasing respiratory and cardiovascular morbidity and mortality with developing countries still experiencing the worst air pollution (WHO, 2016). The World Health Organization (WHO) and other International Agencies have long identified urban air pollution as a critical public health problem (World Health Organization, 2021). Air pollution is the 4th largest health threat worldwide and the topmost environmental risk to human health (WHO, 2016). Outdoor air pollution contributes about 4.2 million premature deaths annually, with particulate matter noted as the major contributor to air pollution and having the greatest health risk among the air pollutants (WHO, 2020). Globally, nine out of ten people breathe unsafe polluted air; resulting to approximately 7 million deaths annually, as more than 90% of people

live in settlements with unhealthy air quality (WHO, 2018 & 2021).

About 91% of the world's population lives in places where the air quality is above the WHO limits for Particulate Matter ($PM_{2.5}$ and PM_{10}), Ozone (O_3), Nitrogen dioxide (NO_2) and Sulfur dioxide (SO_2) as leading pollutants with the greatest health concern (WHO, 2018). Cohen *et. al.* (2017) reported that, of the 4.2 million reported premature deaths caused yearly are as a result of ambient air pollution, ambient $PM_{2.5}$ (particulate matter less than 2.5 micrometres in diameter) was responsible for up to 16.5% with an estimate of 1.7 million lung cancer death worldwide. Polluted air was responsible in 2015 for 6.4 million deaths worldwide - 2.8 million from household air pollution and 4.2 million from ambient air pollution (Prüss-Üstunet *et al.,* 2016). In the absence of aggressive control, ambient air pollution is projected by 2060 to cause between 6 million and 9 million deaths per year (Organisation for Economic Cooperation and Development, 2016).

Urban air quality is noted to be improving in cities of developed countries as against those of low- and middle-income countries such as Abuja in Nigeria (WHO, 2016). Nigeria is said to have the highest burden of mortalities from poor air quality in Africa and 4th globally (Health Effects Institute, 2018). The country was ranked 150th out of 180 countries for poor environmental performance index on air quality (Yale Center for Environmental law and Policy, 2018). Some cities across Nigeria have been noted to have poor air quality and with continuous increase in population, urbanization, anthropogenic activities and climate change, concern on the state of air quality in Abuja and other cities across the world, such remains an important discuss (Akinfolarin *et al.,* 2017).

The goal of establishing of motor parks is to provide satisfaction to its users and commuters. Motor parks play a crucial role in the management of traffic and congestion in cities. However, the activities of a motor park could pollute the air especially from exhaust pipes of vehicles coupled with the use of fossil fuel through incomplete combustion by the engine causing air pollution in the forms of smokes, dusts and so on. This is resulting from poorly managed vehicles, general use of the two stroke engine automobiles (mainly motorcycles and tricycles) for shuttling commuters and traffic congestions which generate high levels of localized air pollution that can affect population health (Oluwole *et. al.,* 2017; Salami *et. al.,* 2020). Traders in motor parks spend about 6 - 8 hours daily in those motor parks, hence they are at risk of possible exposure to carbon monoxide arising from vehicles and other emission sources in motor parks (Olusola *et. al.,* 2018).

In Nigeria, an empirical study was carried out to assess air quality in major motor parks at Kwara State (Salami *et. al.,* 2020). Though several other studies have been carried out with regards to air quality in urban areas and even under several land uses in the FCT in particular (Ishaya *et al.,* 2017; Harrison, 2020; Magaji and Hassan, 2015), yet, diurnal studies on air quality within motor parks are limited in FCT, Nigeria. It is in view of this that this study is propelled to fill in the gap by generating novel air quality/air pollution assessment data of Zuba Motor Park at different time of the day. It will also identify likely impacts on those that engage in activities in the motor park.

STUDY AREA

Zuba Motor Park is located in Zuba town. Zuba town is a ward under Gwagwalada Area Council of the Federal Capital Territory (FCT) in Nigeria. The Zuba Park is located at Latitude 9°5'47" N and Longitude 7°12'46" E on elevation of 432 meters above sea level and sharing boundary with Madalla in Niger State. Zuba town experiences a warm, humid rainy season and a blistering dry season. In between the two, there is a brief interlude of harmattan occasioned by the northeast trade wind, with the main feature of dust haze, intensified coldness and dryness. The rainy season begins from April and ends in October, with a daytime temperature reaching 28^{o}C to 30^{o}C and night time lows around 22^{o}C to 23^{o}C. In the dry season, daytime temperatures can soar as high as 40^{o}C and night time temperatures could dip to 12^{o}C. Rainfall in Zuba town reflects the territory's location on the windward side of the Jos Plateau and the zone of rising air masses. Due to the hilly and mountainous nature of town, orographic activities bring heavy and frequent rainfall of about 1,650mm per annum. Beginning in March to November, the rainy season peaks in September, during which abundant rainfall is received in the form of heavy downpours. The town falls within the northern boundary of the Guinea Savannah having vegetation slightly different comprising shrub savanna vegetation types (Adakayi, 2000).

MATERIALS AND METHODS

Data Used

Air pollutants data (CO, SO_2, NO_2, PM, VOCs and NO), were collected at the centre of Zuba Motor Park. Measurement of the air pollutants was carried out three times (morning, afternoon and evening) in a day for a duration of 7 days in December 2022 with the intention to get a comparative result that would show the intensity at various times of the day and how they contribute to air pollution.

Equipment and software used

i. Testo 350 Flu Gas Analyzer which gave an instantaneous reading and results recorded in real time of O_2, CO_2, ambient CO, draft and pressure, temperature and combustion efficiency;
ii. Minivol Portable Air Sampler is an ambient air sampler for particulate matters;
iii. Crowcon Gas Detector Meter a portable multi-gas monitor for field detection and recordings of concentration levels of air pollutants (CO, NO_2, NO, O_3, H_2S, SO_2) and ambient temperature;
iv. Handheld digital Global Positioning System (GPS) Garmin Dakota 20 device**;** and
v. All hand-held devices used were pre-calibrated before usage for effectiveness and quality assurance purposes

vi. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) Version (22.0).

Methods of data analysis

Descriptive statistical tools such as averages, percentages, and tables were used to present the data for easy understanding of the pattern and variability of air quality. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) Version (22.0).

The hypothesis postulated state:

I. Ho_1: There is no significant difference in the daily concentration of pollutants in Zuba Motor Park.

II. Ho_1: There is no significant difference in the daily and diurnal concentration of pollutants from the NESREA limit.

The result of the mean values of the observed air quality parameters was compared with the permissible limits in the National Environmental (Air Quality Control) Regulations, 2014 with the view of finding the deviation from the recommended limits and to determine if the activities carried out within park have significant effect on the air quality within the park.

The Air Quality Index (AQI) establishes daily air quality, to examine the health implication relating to air pollution. This AQI is divided into six categories indicating increasing levels of health concern. The results from the AQI computation were subjected to the air quality rating table to determine the condition of the air as presented in Table 1. The pollutant's index concentration is expressed as a percentage of the relevant air quality standard. In the present study, AQI was calculated by the equation given by the US. EPA (2017) as follows:

$$Index = \frac{Polution\ concentration}{Pollution\ standard\ level} \text{ x } 100 \qquad eq1$$

Table 1: Air Quality Rating Table

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Source: USEPA, 2014.

RESULT AND DISCUSSION

Air Quality Status in the Study Area

The concentration of ambient pollutants (CO, SO_2, $PM_{2.5}$ and PM_{10}) in the study area were presented to determine the trend of air pollution related to motor park activities in during the days of the week (Monday-Sunday). The results were assessed on a daily and diurnal trend of morning, noon and evening hours (6a.m – 7a.m, 12p.m. – 1p.m, and 6p.m. – 7p.m.) to determine the transit hours associated with air pollution. The average concentrations of the ambient pollutants were also compared with the NESREA permissible limit for hourly outdoor concentration.

Ambient concentration of CO and comparison with NESREA limit

The concentration of ambient CO measured in Zuba Motor Park varied substantially during the days of the week as shown in Figure 1. In the morning, the highest (12.7ppm) concentration of CO was recorded on Tuesday while the lowest (8.4ppm) was recorded on Sunday. In the afternoon, the highest (8.6ppm) CO was recorded on Thursday. It is glaring that the CO concentration is more in the evenings with the highest concentration (21.4ppm) recorded on Wednesday while the lowest (10.1ppm) concentration of CO was recorded in the evening on Thursday. Morning and evening are recognized as period of vehicular movement at Zuba Motor Park with many people going and returning from work leading to increasing emissions of vehicular emissions of CO. This result is in agreement with the findings of Ogunleye *et al.* (2018) where they established that motor parks around Ibadan Metropolis tend to have high concentration of CO during peak period of vehicular movement.

The ambient concentration of CO at the motor park showed deviation from the NESREA permissible limit (Figure 1). In the morning, CO concentration on Monday was 10.8ppm, 12.3ppm on Tuesday, 10.7ppm on Wednesday, and 10.4ppm on Saturday were above the permissible limit (10ppm) of NESREA. In the afternoon the concentration of CO was within the permissible limit of NESREA while in the evening, the concentration of CO for all the days of the weeks were above permissible limit of NESREA. The implication of this result is that park traders, transport workers and passengers will invariably be exposed to CO on a long run. The findings of this study is in line with the work of Ogunseye *et al.* (2018) which reported high CO concentration within motor parks in Ilorin with its associated effects on park works, users and traders.

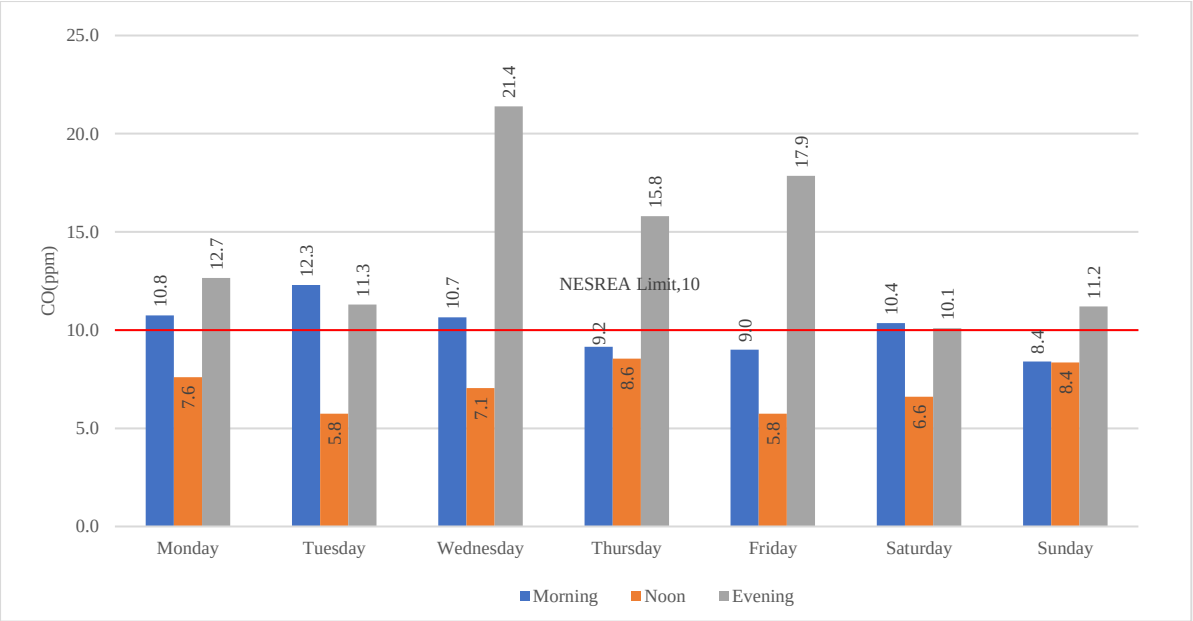

Figure 1: Concentration of CO in the study area

Ambient concentration of SO_2 and comparison with NESREA limit

The ambient concentration of SO_2 measured in Zuba Motor Park between 6a.m. - 7a.m., 12p.m. - 1p.m. and 6p.m - 7p.m. is presented in Figure 2. In the morning, the highest (0.17ppm) concentration of SO_2 was recorded on Monday while the lowest (0.07ppm) was recorded on Sunday. In the afternoon, the highest (0.07ppm) SO_2 was recorded on Sunday and the lowest (0.03ppm) was recorded on Monday. It is obvious that the SO_2 concentration is more in the evenings with the highest concentration (0.25ppm) recorded on Monday while the lowest (0.10ppm) concentration of SO_2 on Wednesday and Friday. Morning and evening are recognized as period of vehicular movement at Zuba Motor Park with many people going and returning from work leading to increasing emissions of vehicular emissions of SO_2 (See Figure 2).

Figure 2 shows that in the morning, the concentration of SO_2 in the study area were above the permissible NESREA limit of 0.1ppm except for values recorded on Thursday and Sunday which are below the NESREA limit. Just as observed with CO, in the afternoon the concentration of SO_2 were within the permissible limit of NESREA while in the evening, the concentration of SO_2 for all the days of the weeks were above permissible limit of NESREA except for Wednesday and Friday which fell at permissible limit (0.1ppm) of NESREA. It is obvious that users of Zuba motor park will be at risk to health-related complications associated with SO_2 more in the morning and evening. Ogunseye *et al.* (2018) also reported high CO concentration within motor parks in Ilorin with its associated health effects on park workers, users and traders.

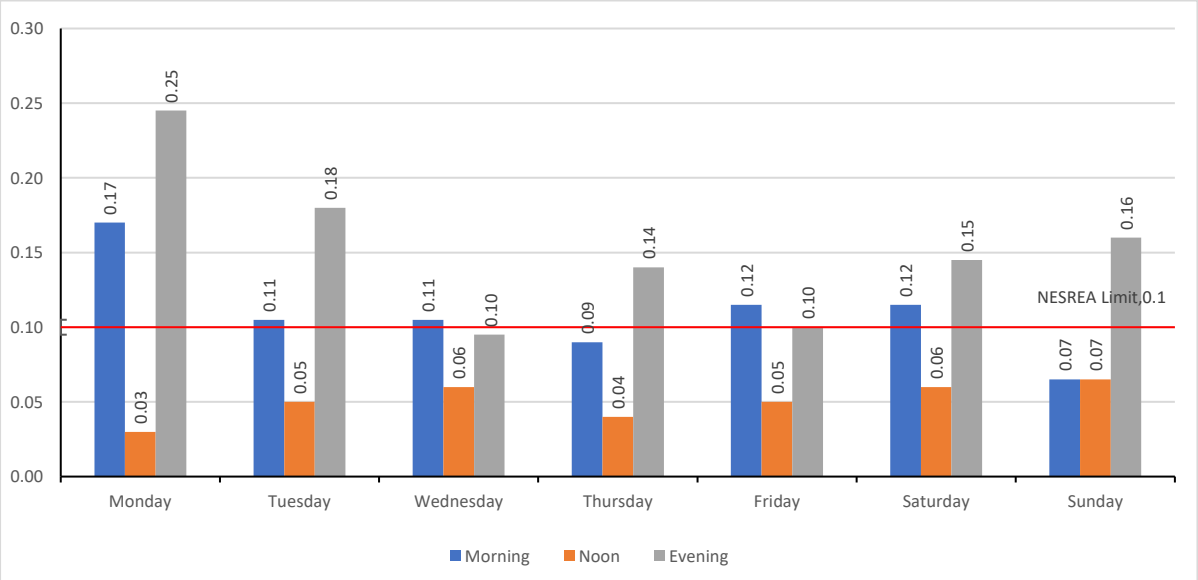

Figure 2: Concentration of SO_2 in the study area

Ambient concentration of particulate matter and comparison with NESREA limit

The ambient concentration of particulate matter in the study area for both fine particles (2.5ug/m^3) and coarse particles size (10ug/m^3) is presented in this section.

Particulate Matter 2.5 ($PM_{2.5}$)

The concentration of fine particulate matter ($PM_{2.5}$) measured in Zuba Motor Park varied temporally substantially as shown Figure 3. In the morning, the highest (85.3 ug/m^3) ambient concentration of $PM_{2.5}$ was recorded on Wednesday 88.1ug/m^3 and 85.3 ug/m^3 on Monday while lowest concentration (64.2 ug/m^3) of $PM_{2.5}$ in the morning was recorded on Saturday. In the Afternoon, the highest concentration (85.2 ug/m^3) of $PM_{2.5}$ was observed Wednesday and the lowest concentration (33.1ug/m^3) of $PM_{2.5}$ which coincides with the period Muslims usually go for Jumat prayers in Zuba town. In the evening, $PM_{2.5}$ concentration is higher on Monday with 97.3 while the lowest concentration (59.8ug/m^3). Generally, the result indicates high amount of $PM_{2.5}$ during the morning and evening period compared to the recorded values at noon. The rate of ambient $PM_{2.5}$ was higher during the peak hours (morning and evening) which are the peak transit period, implying that the concentration of $PM_{2.5}$ in the study area may be attributed to vehicular emissions.

The mean concentration of $PM_{2.5}$ varied across the days of the week as well as time of the day (morning, noon and evening period). Figure 3 shows that in the morning, $PM_{2.5}$ concentration all the values were above the NESREA limit of 80 ug/m^3 on Monday, Wednesday, Thursday and Friday. In the afternoon $PM_{2.5}$ concentration exceed the NESREA limit of 80 ug/m^3 only on Monday and Wednesday while in the evening it exceeds the NESREA limit on Monday, Tuesday, Wednesday, Thursday and Friday. Concentration of $PM_{2.5}$ is more in the Morning and Evening mostly in the working days of Monday to Friday. This depicts a potential health risk to users of the Zuba Motor Park due to exposure to $PM_{2.5}$. Similar results of $PM_{2.5}$ have been reported in Motor Parks around Kaduna Metropolis by Mohammed *et. al*., (2013) where he observed more concentration and associated health risk of $PM_{2.5}$ in the Morning and Evening within the working days. The result is also not farfetched from the observations of Salami *et. al*., (2020) whose reports showed high amount of particulate matter in motor parks around Ilorin Metropolis during the official working days.

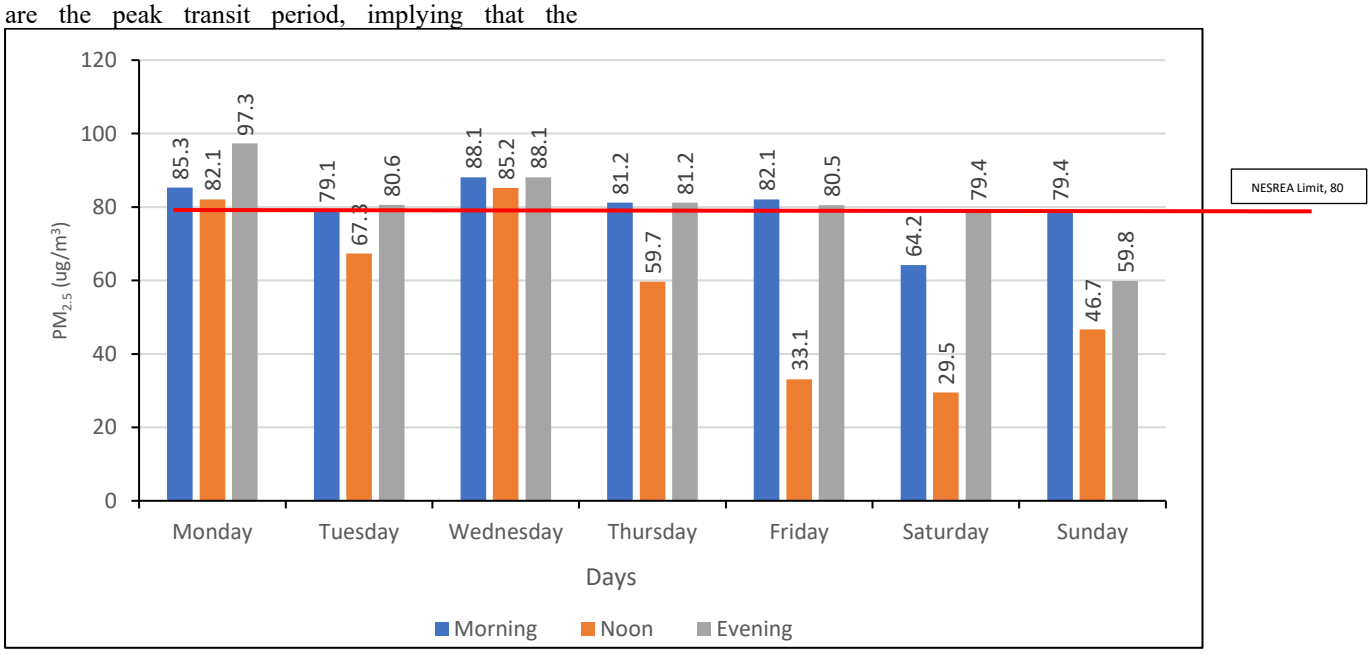

Figure 3: Concentration of $PM_{2.5}$ in the study area

Particulate Matter 10 (PM_{10})

The ambient record of PM_{10} in Zuba Motor Park varied both temporally and diurnally. In the morning, the highest ambient concentration of PM_{10} was recorded on Monday with PM_{10} value of 102.6 ug/m^3 while the lowest concentration (64.2ug/m^3) of PM_{10} recorded in the morning was observed on Saturday. At noon, the highest concentration of PM_{10} (88.3 ug/m^3) was observed on Wednesday and the lowest concentration (33.1 ug/m^3) of PM_{10} was recorded on Friday. At evening, the highest concentration of PM_{10} (137.1 ug/m^3) was observed on Monday while the lowest concentration of PM_{10} (109.2 ug/m^3) was recorded in recorded on Wednesday. The recorded ambient concentration of PM_{10} during the weekend (Saturday and Sunday) is lower than the working days in Zuba Motor Parks. All the values of PM_{10} were within the NESREA limit of 250 ug/m^3 (See Figure 4). The result implied that the concentration of ambient PM_{10} in Zuba Motor Park irrespective of time of the day nor week portrays no risk to health. Result of this study clearly shows that $PM_{2.5}$ is of more implication to health than PM_{10}. This finding coincides with the observations of Salami *et al*. (2020); Ogunseye *et al.* (2018); Mohammed *et al*. (2013) that exposure to $PM_{2.5}$ is usually higher than PM_{10} in motor parks and around urban related activities

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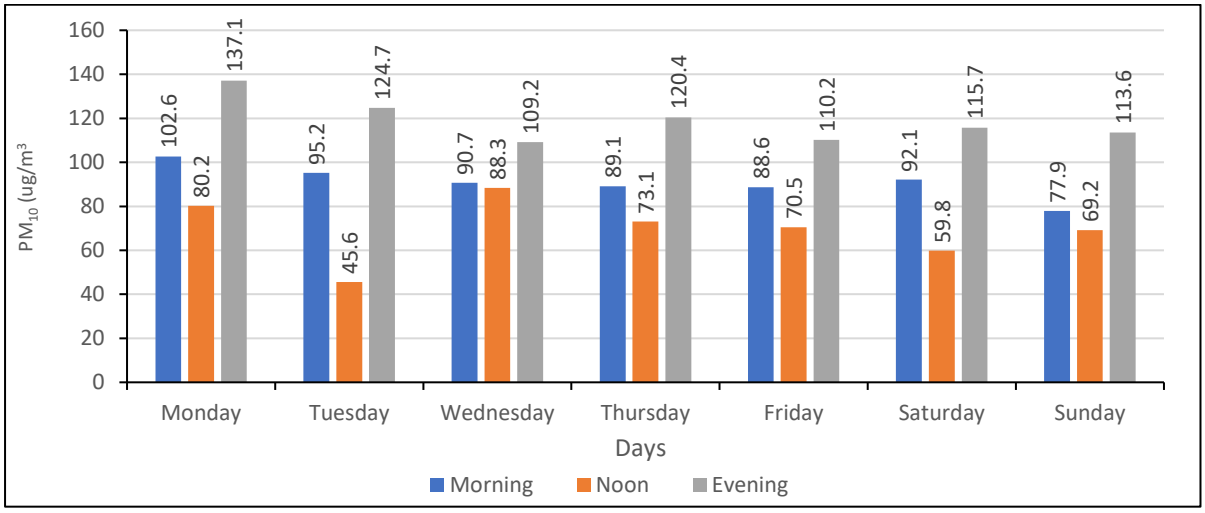

Figure 4: Concentration of PM_{10} in the study area

Test of Hypotheses

Result of ANOVA statistics testing for significance in the daily concentration of pollutants in the study area during the period of investigation (See Table 2). It provides answer to the study hypothesis one (HO_1: There is no significant difference in the daily concentration of pollutants in Zuba Motor Park). Based on the statistical outcome, it can be concluded that the atmospheric level of ambient pollutants concentration in Zuba Motor Park is not statistically significant for all the pollutant measured with the P value of 0.913 (CO), 0.874 (SO_2), 0.243 ($PM_{2.5}$) and 0.971 (PM_{10}) which are all greater than the critical value (0.05) at 95% confidence level. Thus, the postulated null hypothesis is accepted.

Table 2: Level of significant in the daily concentration of pollutants in Zuba Motor Park

Pollutant	Source of Variation	SS	df	MS	F	P-value	F crit
CO	Between Groups	107.719	6	17.95317	0.325124	0.913	2.847726
	Within Groups	773.0733	14	55.21952			
	Total	880.7924	20				
SO_2	Between Groups	0.021695	6	0.003616	0.389402	0.874	2.847726
	Within Groups	0.13	14	0.009286			
	Total	0.151695	20				
$PM_{2.5}$	Between Groups	2567.932	6	427.9887	1.517498	0.243	2.847726
	Within Groups	3948.5	14	282.0357			
	Total	6516.432	20				
PM_{10}	Between Groups	837.1695	6	139.5283	0.20075	0.971	2.847726
	Within Groups	9730.5	14	695.0357			
	Total	10567.67	20				

The postulated hypothesis two (There is no significant difference in the daily and diurnal concentration of pollutants from the NESREA limit). Based on the statistical result from the student t-test, the diurnal (morning, afternoon and evening) concentration of CO (p value 0.813), SO_2 (p value 0.423) and $PM_{2.5}$ (p value 0.846) were not significantly different from the NESREA limit with p-value higher than 0.05, while that of PM_{10} was statistically different (p value 0.000). However, the t-test direction shows a negative difference (-13.389), which implied that the diurnal concentration of PM_{10} in the study area are below the NESREA limit, depicting a good condition.

The daily concentration of CO, SO_2 and $PM_{2.5}$ were also not statistically significantly different from the NESREA limit given by the p-value of 0.327, 0.464 and 0.433 respectively. On the contrast, the p value of PM_{10} (0.000) implied significant different in the daily concentration of particulate matter to the NESREA limit. However, the significant level tilt towards the negative curve implying that the ambient concentration of PM_{10} is statistically lower than the NESREA limit. The result implied that the HO_2 is accepted only for CO, SO_2 and $PM_{2.5}$ which are statistically not significant from the NESREA hourly permissible limit for human exposure.

Table 3: Statistical result for HO_2

Pollutant	df	t-statistics	P -value
Statistical result for diurnal concentration (Morning, Afternoon and Evening)			
CO	4	0.253	0.813
SO_2	4	0.207	0.423
$PM_{2.5}$	4	0.207	0.846
PM_{10}	4	-13.389	0.000*
Statistical result for daily concentration (week)			
CO	12	1.021	0.327
SO_2	12	0.757	0.464
$PM_{2.5}$	12	0.875	0.443
PM_{10}	12	-82.5727	0.000*

*Significant at 0.05.

Air Quality Index Rating (AQI) across the Study Routes

The Air Quality Index (AQI) result of the concentration of SO_2, CO, $PM_{2.5}$ and PM_{10} measured using the United States Environmental Protection Agency (2017) equation and NESREA standard limit for outdoor concentration of atmospheric pollutant were obtained (see Table 4). The AQI rating for ambient concentration of CO showed that the study area is rate moderate to very unhealthy. During the morning period, CO was rated unhealthy for sensitive groups on Monday, Tuesday and Wednesday, Saturday and Sunday respectively, while on Thursday and Friday the ambient concentration of CO in the morning hours was rated moderate. Similarly, CO was rated moderate across all the weekdays at noon. On the contrary, the ambient concentration of CO during the evening period was rated unhealthy for sensitive groups on Monday, Tuesday, Saturday and Sunday respectively, while it was rated very unhealthy on Wednesday and unhealthy on Thursday and Friday respectively. The result showed that the study area is only safe at noontime during the study period.

The rating of SO_2 during the morning period varied from unhealthy on Monday to unhealthy for sensible groups on Tuesday, Wednesday, Thursday, Friday and Saturday, while on Sunday, ambient SO_2 was rated moderate. The result indicates hazardous atmosphere on Mondays than any other days of the week. At noon, SO_2 was rated good on Monday, Tuesday and Thursday, while on Wednesday, Friday to Sunday the atmosphere was rated moderate for SO_2. Contrarily, AQI rating of SO_2 during the evening period was very unhealthy on Monday, unhealthy on Tuesday and Sunday and unhealthy for sensitive groups from Wednesday to Saturday in the study area.

Particulate matter concentration within the study area was not hazardous based on the AQI result (Table 4). $PM_{2.5}$ was rated moderate in the entire weekdays in the morning, noon and evening period except on Monday, Tuesday, Wednesday and Thursday in which PM2.5 was rated good at noontime. Similarly, PM_{10} was rated good in the entire study period at morning, noon and evening period respectively.

General, the result indicates potential hazards during the morning and evening period in the study area for SO_2, CO and $PM_{2.5}$ with criteria pollutants capable of causing critical health effects. Thus, people in and around the Zuba Motor Park such as hawkers, road users, transport workers will be highly exposed to poor air quality. This observation is in line with the findings of Ishaya *et al.* (2017) along Urbanization Gradient in Apo District of the Federal Capital Territory of Nigeria; Salami *et al.* (2020) in Major Motor Parks in Ilorin Metropolis; Godson *et al.* (2015) in three Motor Parks in Ibadan; Harrison (2020) in Mpape Area of Abuja. Acute ambient air pollution exposure has been associated with angina, stroke, acute myocardial infarction, heart failure hospitalization, arrhythmias, cardiac arrest, heart failure hospitalization and cardiovascular mortality (WHO, 2019). Given the result of this study such health-related diseases in and around Zuba Motor Park is possible.

Table 4: AQI rating of the Study Area

Pollutant		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
CO	Morning	108	123	107	92	90	104	84
	Noon	76	58	71	86	58	66	84
	Evening	127	113	214	158	179	101	112
SO_2	Morning	170	110	110	90	120	120	70
	Noon	30	50	60	40	50	60	70
	Evening	250	180	100	140	100	150	160
$PM_{2.5}$	Morning	69.3	77.4	58.8	69.6	69.8	65.5	68.1
	Noon	39.0	31.5	29.9	46.8	58.1	61.6	71.5
	Evening	59.8	77.1	70.8	83.1	89.1	81.8	79.6
PM_{10}	Morning	27.0	32.2	36.1	32.0	31.8	30.7	34.8
	Noon	19.7	21.4	21.0	23.5	20.1	17.8	26.2
	Evening	36.6	39.7	40.6	38.4	37.7	38.8	42.2

CONCLUSION

The diurnal assessment of air quality at Zuba Motor Park, Abuja, Nigeria was carried out through the measurement of air pollutants three times (morning, afternoon and evening) in a day for a duration of one week in December 2022. Based on the study findings, the concentration of ambient pollutants (CO, SO_2, $PM_{2.5}$ and PM_{10}) are more in the morning and evening (6a.m. - 7a.m. and 6p.m. - 7p.m.) during which traffic volumes were high within the Motor Park. The ambient concentration of CO and SO_2 at the motor park in the morning and evening showed exceeding deviation from the NESREA permissible limit creating threat to human health. The ambient concentration of $PM_{2.5}$ at the motor park in the morning and evening for only the working days was above the NESREA permissible limit while PM_{10} for all time of the day and all days of the week were within the NESREA permissible limit. The study also concludes that there is potential hazards during the morning and evening period in the study area for SO_2, CO and $PM_{2.5}$ with criteria pollutants capable of causing critical health risk to hawkers, road users and transport workers. The tendencies, for angina, stroke, acute myocardial infarction, heart failure hospitalization, arrhythmias, cardiac arrest, heart failure hospitalization and cardiovascular mortality is possible in and around the Zuba Motor Park.

Based on the findings and conclusions of this research, the following recommendations were made:

i. The Zuba Motor Park should be expanded and designed to accommodate exit route in order to reduce traffic jam of vehicles within the park;
ii. Motor park traders should be placed away from the proximity of the park to limit their level of exposure to harmful vehicle emission;
iii. There is a need to promote and sensitize the vulnerable and sensitive groups on the dangers of air pollution;
iv. Vehicle Inspection Department in the FCT Metropolis should be equipped with vehicle emission testers to determine the emission status of vehicles in the area.

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