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Full Length Research Paper

Assessment of vehicular emissions and health impacts in Jos, Plateau State

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Vehicular emissions are significant contributors to ambient air pollution, especially in urban areas. This study is set to assess vehicle emissions and health impacts in Jos, Plateau state. Jos, a rapidly developing city, presents a unique opportunity to investigate the impacts of transport-related pollution because of the less number of industries and other major sources of air pollution. To achieve this aim, the trend figures of vehicles registered within Jos metropolis spanning for a period of ten (10) years were obtained from Plateau State Board of Internal Revenue (PSBIR), and trend figures of air pollution related-diseases were also obtained for the same period of ten years from three major hospitals in Jos. Three air pollution related-diseases were used as case study (Asthma, Cadiovascular and bronchitis). It was hypothesised that there is no significant relationship between vehicle emissions and human health. The result indicated that as the number of vehicles increases, the incidences of diseases and deaths related to air pollution also increase. Therefore, the study concludes that, there is a significant relationship between vehicle increase, high exposure to vehicle emissions and increase in air pollution related diseases. Recommendations were therefore made toward mitigating the problem on human health and the environment. The pearson product moment coefficient correlation statistical technique was used to test the hopothesis.

Keywords: Vehicular emissions, air pollution diseases, health impacts.

INTRODUCTION

Transport is a vital part of modern life. The freedom to travel short and long distances opens the horizons for personal development and professional activities, increases the options for leisure and holidays, and allows better contact and understanding between people. To a large extent the economic development of the various regions of the world is facilitated by contemporary transport technology. Owing to its flexibility, road transport is a major transport mode, and cars are objects of desire and pride in many societies.

However, transportation is also associated with some hazards to the environment and human health, particularly road transport (Dora and Phillips, 2000). One of the leading concerns is the adverse health effect of air pollution from transport. Outdoor air pollution harms health, and the evidence points to air pollution that stems from transport as an important contributor. Majority of today's vehicles use internal combustion engines that burn gasoline or other fossil fuels, and neglect to replace worn or deterioted components by Motorists which result in poor engine performance, higher fuel consumption, engine damage excess emissions. (Prather, 1995; Martin, 2003). In the process of combustion, a number of gaseous materials and inpurities are generated. These combustion by-products are emitted into the environment as exhaust gases. Among the critical pollutants, are nitrogen oxides, carbon monoxides, sulphur dioxide, lead and particulate matters. The Environmental Protection Agency, (EPA) in the United States reports that vehicle emissions account for 51% of carbon monoxide, 34% of Nitrogen oxides and 10% of particulate matter released each year in the US (EPA, 2007). The emissions from the vehicles pose serious health threat to humans. It has been assertd that, in developing countries of the world, vehicular growth has been largely unchecked by environmental regulating bodies creating high levels of pollution (Hans, 2006).

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Similarly in Chinese cities, for example, concentrations of particulates and other transport-related pollutants are up to six times higher than WHO-recommended guideline. The ratio of person to vehicle in China is 80 vehicles per 100 persons compared to 75 vehicles per 100 persons in the USA (Faiz, 2000).

An epidemiological study in US has shown that acute exposure to vehicle emissions over a ten year period reduces lung function among tunnel officers, (Enemari, 2001). A similar study confirms that there is a prevalence of chronic bronchitis and asthma in street cleaners exposed to vehicle pollutants in concentrations higher than the recommended guideline of the World Health Organisation (WHO), thus leading to significant increase in respiratory problems (Brook et al., 2004). Carbon monoxide causes blood clotting when it reacts with haemoglobin, which cuts the supply of oxygen in the respiration system after long exposure. This is a common occurrence in urban centres with a high level of commercial activity (Ackerman et al. 2002; Glen et al., 1996; Johnson et al., 2000). Research conducted, in Toronto, Canada, revealed that vehicular emissions will increase due to the increase in vehicular traffic, which is expected to degrade the air quality along the streets of Bloor state (Chan et al., 2002).

It is worthy to note that, vehicular pollution can not be avoided as the emissions occur at the near ground level where humans breathe. It will continue to remain a threat to environmental health problem which is expected to be on the increase as vehicle ownership level increases in the world. Attempts by various governments to improve on air quality to meet the WHO recommended baseline but these have proved futile. Some of such efforts include; legal sanctions on the age of vehicles to be imported into countries, setting guidelines on vehicular emissions, and regulatory framework put in place by government agencies. Despite all these conscious efforts to improve on the air quality, problem of vehicular emissions and the associated health problem still persist. The present study is focused on the impacts of vehicular emissions on human health in the growing city of Jos, Nigeria. The city is fast growing with vivid increased vehicle ownership level as traffic congestions within the metropolis seem to suggest. Industrially, there are few industrial facilities, not commensurate with the growth of the city.

To come up with a scientific viable fact about the impacts of vehicular emissions on human health in the study area one hypothesis was stated:

Hypothesis

H_o: There is no significant relationship between vehicular emissions and human health status.
H_1: There is significant relationship between vehicular emissions and human health status.

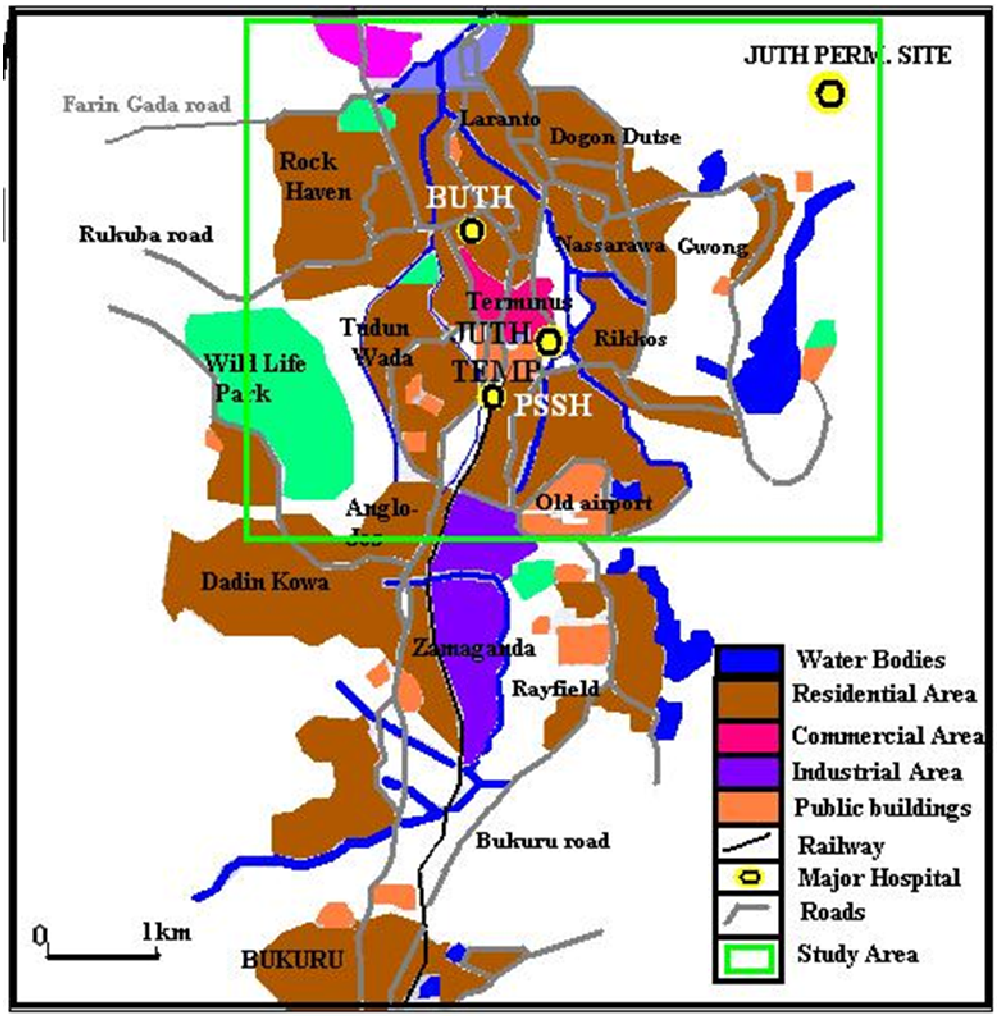
The study area

Jos city, is in the middle belt of Nigeria and the administrative capital of Plateau state. It is strategically located near the centre of the Jos-plateau, a tropical high land near the centre of Nigeria with the surface area of about 7,800km^2 and lies at the general altitude of 1,300metres. It is located between latitude $8^0.30'$ and $10^030'$ North and Longitude $8^020'$ and $9^030'$ East, (see Figure 1). It has an average elevation of about 1,217 metres (about 4,062ft) above sea level and stands at a height of about 600 metres above the surrounding plains (Adepetu and Dung, 1999). The climate of the area is influenced by its altitude and position, across the seasonal migration of Inter-Tropical Discontinuity (ITD), it is the wet and dry type classified as Tropical Rainy (AW) climate by Koppen (1923). It is characterised by a mean Annual rainfall of about 1,260mm (1,050-1,400mm), attending its peak between July and August while the mean annual temperature is about 22^0C, but mean monthly figures vary between 19.4^o C during the month of December which is the coolest month as influenced by the cool and dry north-easterly tropical continental air mass (harmmattan) and 24.5^o C in the hottest month of April. It lies within the northern Guinea Savannah vegetation zone, which is open woodland with tall grasses. The vegetation of the plateau is altered by human activities such as tin mining, agriculture, grazing and the demand for timber and fire woods (Keay, 1953). The geology of the area comprises of precambian basement complex rocks (magmatites, gneiss and older granites), the Jurassic younger granites (mostly biotite granites) and the tertiary as well as Quaternary volcanic rocks (mainly basalt, pumice, lava flows and ash deposits) (Macleod et al., 1971). The variation in geological and topographical features, results to variation in soil types. Entisols, inceptisols, afisols and ultisols are the major soils in Jos (Olowolafe and Dung, 2000)

MATERIALS AND METHOD

The description of the areas

The study was carried out by collecting secondary data from the record departments of four relevant institutions that have direct bearing to the study. The numbers of vehicles registered from within the metropolis were collected from the Plateau State Board of Internal Revenue (PSBIR). This institution is a better option for obtaining data on the trend of vehicles registration. The other three intitutions are the major Hospitals in Jos, namely, Plateau State Specialist Hospital (PSSH), Jos University Teaching Hospital (JUTH) and Bingham University Teaching Hospital (BUTH), data were collected to assess the trend of air pollution related diseases caused by vehicles emissions. The choice of these res-



Adopted from Ihemebgulem V.C & Nyong, Jos, African African Atlas

Figure 1. map of study area (Jos city).

pondents was based on the fact that these institutions are strategically located within the metropolis; they are the major hospitals and also believed to have long medical records of air pollution related diseases. This makes the selected institutions a better option for obtaining such data, and as they have a good knowledge of the problem

Method of investigation

The trend figures of vehicles registered from within Jos metropolis spanning for a period of ten (10) years, ranging from 2002 to 2011 were obtained. Data were also collected from Hospital from the record departments of the three renown hospitals for the same period of time for these diseases; Asthma, Cardiovascular (Heart disease), and Bronchitis which were used as case study. Data collected was analysed using the pearson product moment c oefficient correlation, PPMCC, statistical technique was used to test the hopothesis.

RESULTS AND DISCUSSION

The Table 1 is the trend figures of vehicles registered within Jos metropolis, within the period of ten (10) years. Spanning from 2002 to 2011. The vehicles type registered were Cars, Buses, Lorries, Trailers, pick-ups, Motor cycles as the commonly used vehicles. From 2002 -2005, the total vehicles registered were 2,508; 2,667; 3,295 and 3,532. There were slide drop between the years 2006 – 2008, with the following respective figures; 3,490, 3,190, and 3,161. Afterward the figures increase progressively from 2009 – 2011 as indicated thus, 4,666; 4,733; and 5,431 within the period under view. The over all total for the ten (10) years is 36,676. The figures gredient from the table above shows that there is considerable increase of vehicles ownership within Jos

Table 1. Vehicles Registered within Jos Metropolis; 2002-2011.

	Vehicle Type Registerd						
Year	**Cars**	**Buses**	**Lorries**	**Trailers**	**P/Up**	**M/Cycles**	**Total**
2002	1,301	230	81	60	90	746	2,508
2003	1,364	210	77	27	100	889	2,667
2004	1,532	317	68	36	117	1,225	3,295
2005	1,576	298	83	41	190	1,344	3,532
2006	1,689	249	74	52	102	1,324	3,490
2007	1,680	360	72	45	76	960	3,190
2008	1,800	365	82	62	84	768	3,161
2009	3,012	342	102	98	112	1,000	4,666
2010	2,851	378	100	76	108	1,220	4,733
2011	3,361	356	97	86	119	1,412	5,431
Total	20,166	3,105	583	583	1,098	10,888	**36,676**

Source: Plateau State Board of Internal Revenue; 2012

Table 2. Air Pollution Related Diseases: Cases Reported in Three (3) Selected Hospitals in Jos Metropolis; 2002-2011.

		Diseases			
Year	**Hospital**	**Asthma**	**Cardiovascular**	**Bronchitis**	**Total**
2002	JUTH	3	3	6	12
	PSSH	13	24	6	43
	BUTH	45	38	59	142
	TOTAL	61	65	71	**197**
2003	JUTH	2	10	5	17
	PSSH	29	23	15	67
	BUTH	57	41	63	161
	TOTAL	88	74	83	**245**
2004	JUTH	4	11	6	21
	PSSH	42	89	23	154
	BUTH	36	54	72	162
	TOTAL	82	154	101	**337**
2005	JUTH	3	25	2	30
	PSSH	16	108	35	159
	BUTH	51	67	81	199
	TOTAL	70	200	118	**338**
2006	JUTH	1	22	4	27
	PSSH	30	65	60	155
	BUTH	49	45	96	190
	TOTAL	80	132	160	**372**
2007	JUTH	3	52	2	57
	PSSH	40	72	31	143
	BUTH	62	58	111	231
	TOTAL	105	182	144	**431**
2008	JUTH	3	44	4	51
	PSSH	91	94	55	240
	BUTH	59	74	121	254
	TOTAL	153	212	180	**545**
2009	JUTH	3	59	-	62
	PSSH	67	104	42	213
	BUTH	64	81	132	277

Table 2 Continue

	TOTAL	134	244	174	**552**
2010	JUTH	3	56	-	59
	PSSH	38	75	9	122
	BUTH	53	98	140	291
	TOTAL	94	229	149	**472**
2011	JUTH	4	139	2	145
	PSSH	19	53	12	84
	BUTH	54	85	154	293
	TOTAL	77	277	168	**522**
	GRAND TOTAL				**4,011**

Source: Medical Records Departments of JUTH, PSSH, BUTH, 2012
Note: Analysis can be made beyond the content of the table above, because not all cases of air polluton related diseases were reported to the Hospitals.

Table 3. Incidences of Deaths from Air Pollution Related Diseases Recorded In Three (3) Selected Hospitals Within Jos Metropolis: 2002-2011.

Year	Hospital	Asthma	Cardiovascular	Bronchitis	Total
2002	JUTH	1	1	-	
	PSSH	-	7	-	
	BUTH	1	3	2	
2003	JUTH	-	2	-	
	PSSH	-	3	-	
	BUTH	-	1	2	
2004	JUTH	-	4	-	
	PSSH	-	27	4	
	BUTH	-	-	-	
2005	JUTH	-	4	-	
	PSSH	-	19	2	
	BUTH	-	2	-	
2006	JUTH	-	10	**-**	
	PSSH	1	25	1	
	BUTH	-	-	1	
2007	JUTH	1	25	-	
	PSSH	3	26	2	
	BUTH	-	2	-	
2008	JUTH	-	27	-	
	PSSH	-	31	-	
	BUTH	-	1	1	
2009	JUTH	1	43	-	
	PSSH	-	39	-	
	BUTH	1	2	2	
2010	JUTH	-	30	-	
	PSSH	-	10	4	
	BUTH	-	-	-	
2011	JUTH	-	40	-	
	PSSH	1	11	2	
	BUTH	-	-	-	
	TOTAL	10	403	23	**436**

Source: Medical Records Departments of JUTH, PSSH, BUTH, 2012
Note: Analysis can be made beyond the content of the table above, because not all cases of air polluton related diseases were reported to the Hospitals.

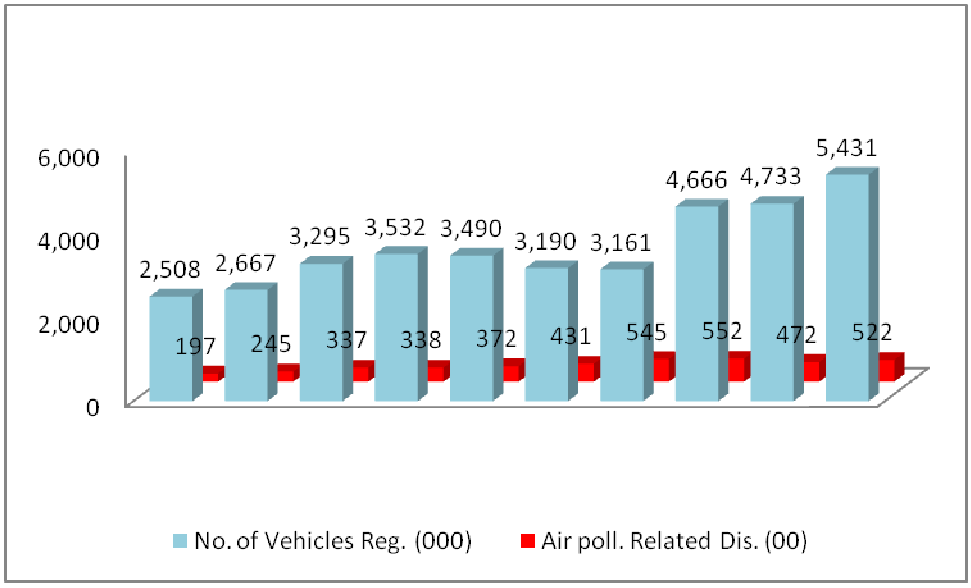


Figure 2. Vehicles Registered Versus Air pollution related diseases (2002-2011).

Metropolis.

Table 2 shows Air pollution related diseases that are common or predominant among the numerous air pollution related diseases. These diseases are; Asthma, Cardiovascular and Bronchitis, which were used as case study for this Study. Table 2, indicates figures of reported cases of these diseases within Jos metropolis, for the period under review; Spanning from 2002 to 2011. The study reveals, in 2002, the total reported cases of the three diseases in the three Hospitals was 197 recorded, 245 for 2003, 337 for 2004, 338 for 2005, 372 for 2006, 431 for 2007 and 545 for 2008. Cases of other respective subsequent years under review are; 2009 was 552, 2010 was 472, and 522 for 2011. In 2010 noticed a slide drop in the reported cases in the Hospitals, this could be because not all cases of air pollution related diseases were reported to the Hospitals.The over all total figures for the ten (10) years of these diseases was 4,011. The figures gredient from the table 2 indicates that there is considerable increase in the cases of these air pollution related diseases within Jos Metropolis.

The impacts of these diseases resulted to deaths of some patients in these Hospitals. Data from the three Hospitals indicates that between 2002 and 2011, 10 people died of Asthma, 403 died of Cardiovascular disease and 23 died of Bronchitis.The total number of deaths as a result of these diseases in the years under review is 436. (Table 3 and Figure 2)

Hypothesis

H_o: There is no significant relationship between vehicular emissions and human health status.

H_1: There is significant relationship between vehicular emissions and human health status.

Calculated t value = 5.42

Critical t value at 0.05% significance at 8 degree of freedom is = 2.31

Critical t value at 0.01% significance at 8 degree of freedom is = 3.36

Conclusion: In other to reject the null hypothesis, the computed value must be larger than the table value under a specified level of significance or degree of freedom. Hence the calculated t value is greater than the critical values at both 0.05% and 0.01% significance levels, it falls in the rejection zone. We accept the alternative hypothesis (H_1) which states that there is a significant relationship between vehicle emissions and human health status within Jos metropolis.

CONCLUSION

The study reveals that transport-related pollution in Jos is significant with possibly severe health consequences, especially for people living in areas or in locations close to busy roads. If allowed to continue, it is likely that air quality will only deteriorate as the city continues to grow. The resultant health care and lost productivity costs are very high, especially now that there is influx vehicle and high traffic build-up within the metropolis. The adoption of rigorous and implementation of transport policies, which will lead to an uptake of clean air, can play a very significant role in reducing air pollution and its consequential harm to the community and the national economy. The author suggest thus; Government should make fund available for research and development efforts

that can improve fuel economy and engine efficiency, broaden the diversity of available vehicle fuels, and diminish dependence on petroleum while helping to reduce the amount of harmful vehicle emissions released into the air. These can be achieved by,

• Alternative, non-petroleum-based fuels,
• Improved combustion processes.

Stringent vehicle importation measures, especially as to the age of vehicles should be enforced. Government should also encourage programs that will create awareness on the effects of long idling period of vehicles on highways and streets in order to reduce vehicular emissions; trees planting as it will help in reducing the amount of carbon in the atmosphere as the trees use Carbon as one of the products of vehicle emissions during the process of photosynthesis. Finally, with proper implementation of these recommendations there will be a high potential for emission reduction and related health hazards.

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