

Vehicle Emissions and Health Impacts in Abuja, Nigeria



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Key Questions

- Are vehicle emissions contributing to elevated levels ambient pollution in Abuja?
- If yes, is there evidence that this is impacting health?

Outline

- Background on vehicle pollution and health effects
- Sub-Saharan Africa
- Why Abuja?
- Methods
- Results
- Recommendations

Traffic Pollutants

- **NO_x**: respiratory disease, reduced lung function
 - **CO**: nausea, lightheadedness, fainting, death
 - **SO₂**: eye and mucosal irritation, reduced lung function
 - **Pb**: neurobehavioral consequences, reduced IQ
 - **Particulates**: reduced lung function, lung cancer, mortality
 - **VOC's**: carcinogens, reproductive toxicants, ozone
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- Significantly higher health effects in exposed v. unexposed

Factors Related to High Pollution and Health Impacts

- Urbanization
- Vehicle Profile
- Fuel Composition
- Population Vulnerability

Comparison of Factors: Sub-Saharan Africa

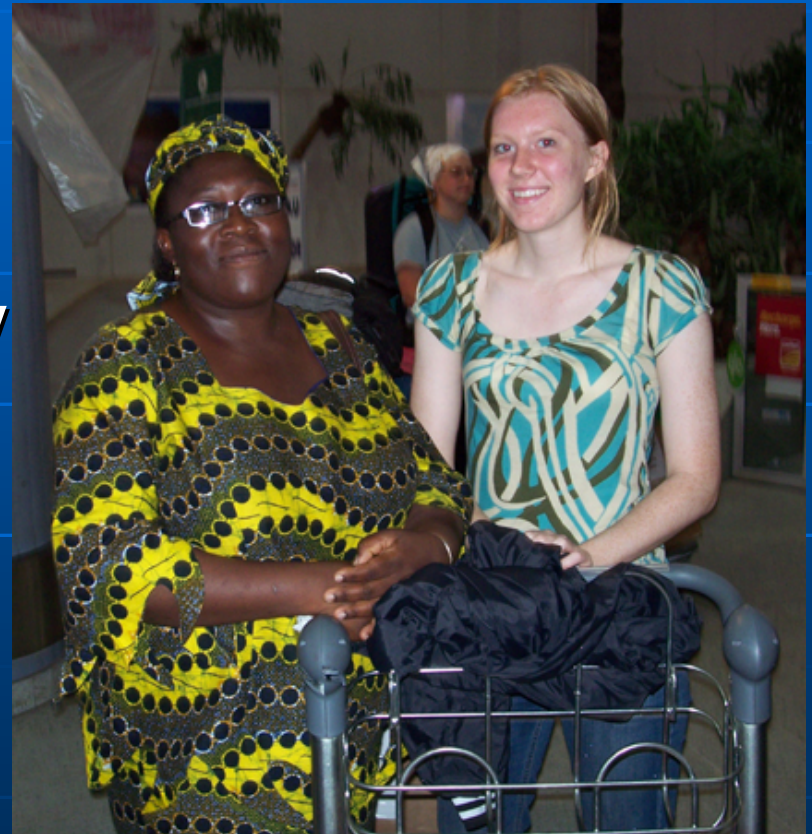
Factor	United States	Sub-Saharan Africa
Urbanization	81%, 1.5% annual	40%, ~4.6% annual
Vehicle Maintenance	Emission Testing, Catalytic Converters	Imports, Super-emitters
Sulfur content in Fuel	15 ppm	500 – 10,000 ppm
Malnutrition	~1%	~ 33%

Abuja, Nigeria



Why Abuja?

- Luce Fellowship – Tola
- Rapidly developing city
- Absence of industry
- No monitoring data



SO₂, NO₂, and CO Standards

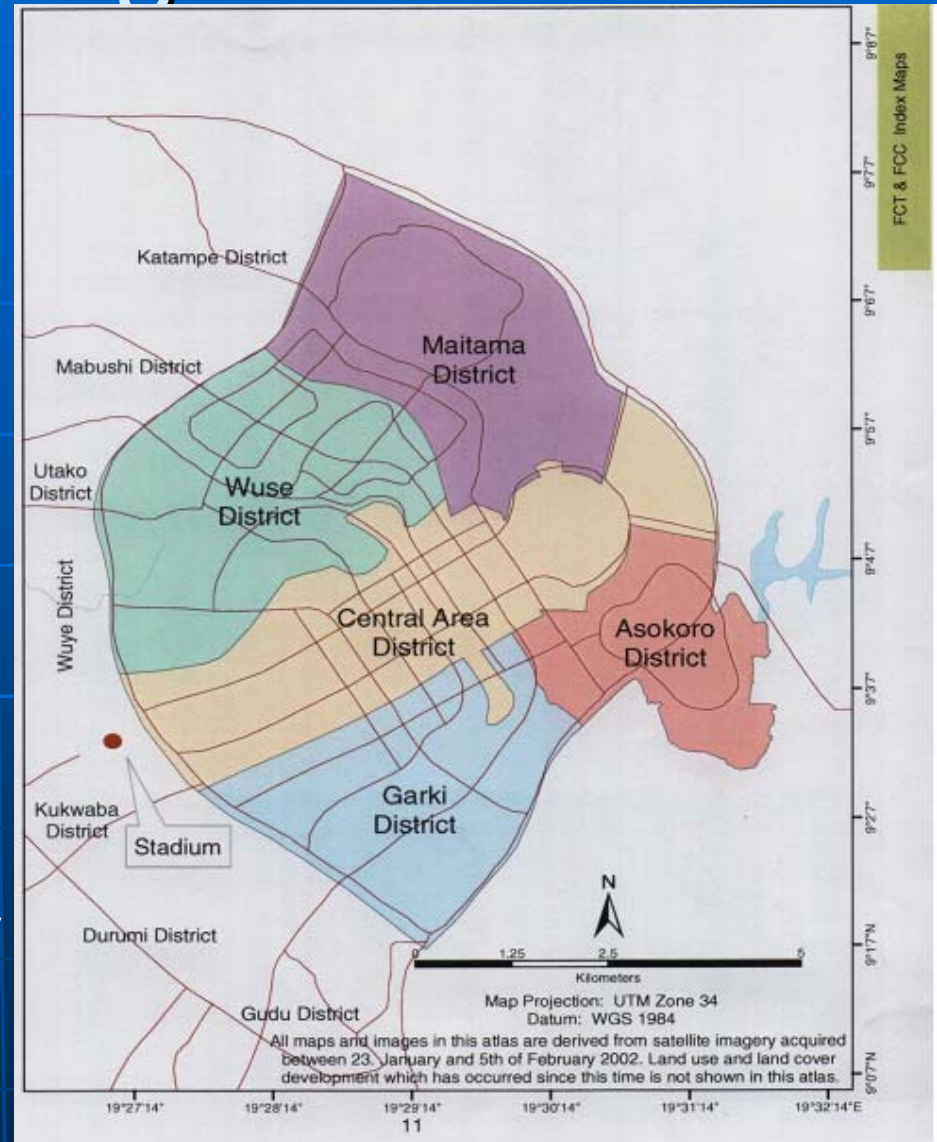
Compound	Health Effects	WHO Guideline (ppm)	Nigerian Ambient Standard (ppm)	Averaging Time
Carbon Monoxide	Headache, weakness, dizziness, fainting, confusion, and nausea	26	35	1 hour
Nitrogen Dioxide	Aggravation of asthma and allergies, coughing, shortness of breath, increased respiratory infections	0.10	0.04-0.06	1 hour
Sulfur Dioxide	Change in lung function, difficulty breathing, aggravation of respiratory diseases, eye irritation	0.175 -	- 0.1	10 min 1 hour

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Abuja Background

- Federal Capital of Nigeria (1991)
- Population: estimated 4 million
- Purpose-built city: four phases of development to ensure sustainability
- 900 vehicles registered/week
- Air pollution not considered a priority



Study Locations

- 6 major intersections – highest volume of traffic
- Traffic wardens present
- 5 districts with unique characteristics
- 6th site: newly built overpass



Methods - Monitoring

- Qualitative observations
- NO₂, SO₂, and CO
- Avg. 1-hour continuous monitoring
- Morning, low traffic hours
- Afternoon, high traffic hours
- 3-4 trials per location and time of day



Methods - Questionnaire

- Traffic wardens – high exposure group
- Developed in consultation with the Abuja Environmental Protection Board (AEPB)
- Created to assess:
 - 1 - health status of traffic wardens
 - 2 - effects of traffic and season on reported symptoms
 - 3 - opinions of air quality in the city
- Reported symptoms because no medical records
- Interview with AEPB member on site July 4th - August 7th
- Remaining questionnaires delivered to police headquarters
- Initially separated by gender, smoking status

Results



- Strong odor (sulfur)
- Black and white smoke
- Dust

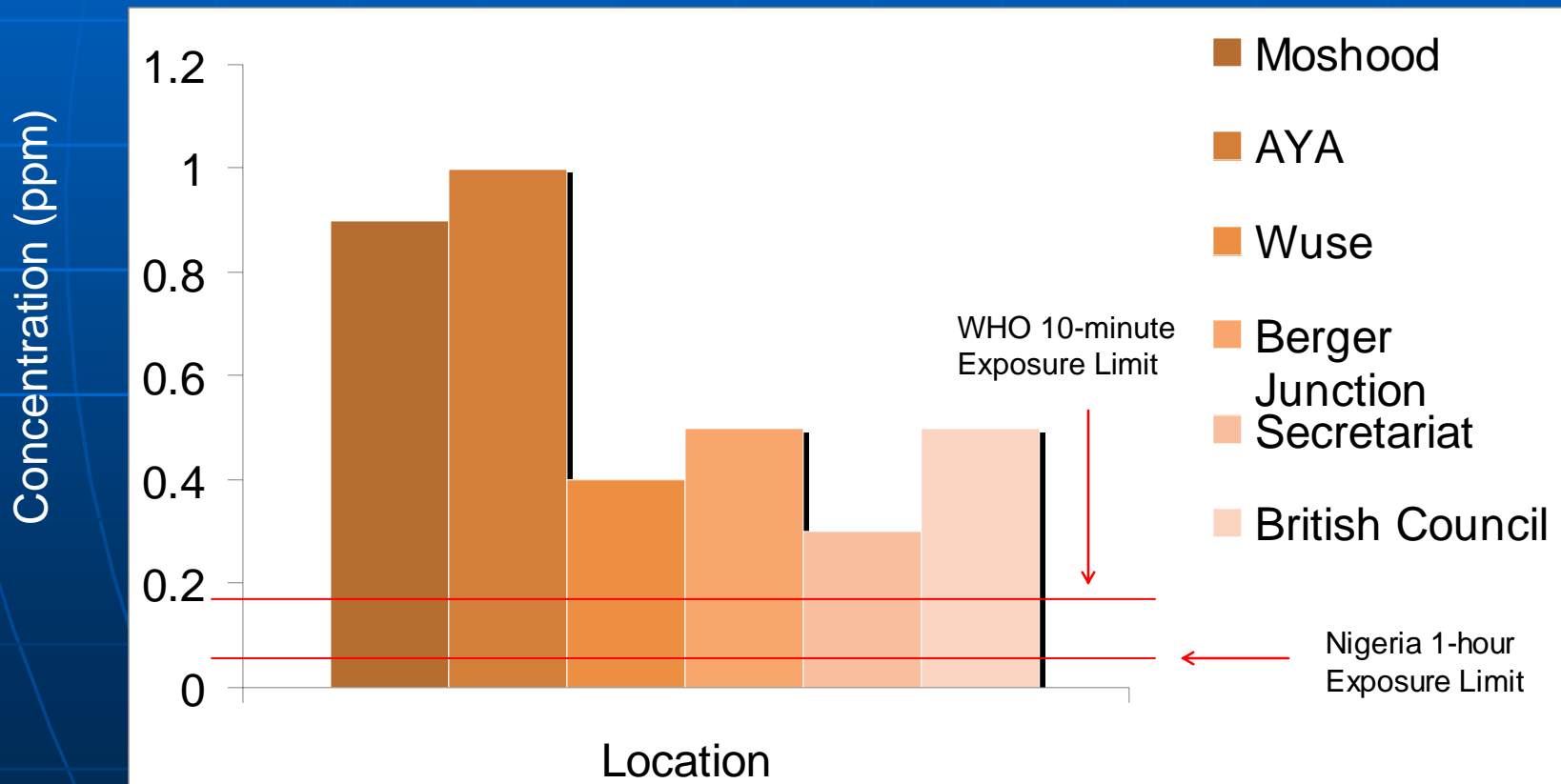


- Constant noise
- Personal health effects (?)

CO and SO₂ Concentrations

<i>Location</i>	<i>Time of Day</i>	<i>CO (ppm)</i> [26ppm -1hr]	<i>SO₂ (ppm)</i> [0.1ppm -1hr]
Moshood	AM	24±4	0.4±0.2
	PM	32±10	0.9±0.3
AYA	AM	18±4	0.4±0.2
	PM	38±20	1.0±0.6
Wuse	AM	12±3	0.4±0.1
	PM	16±6	0.4±0.1
Secretariat	AM	12±1	0.1±0.1
	PM	19±2	0.3±0.1
British Council	AM	20±3	0.3±0.1
	PM	19±4	0.5±0.1
Berger Jxn	AM	14±3	0.4±0.1
	PM	19±8	0.5±0.2

Average 1-Hour Afternoon SO₂ Concentration



Reported Symptoms

Prevalence of Reported Symptoms in Traffic Wardens

Reported Symptoms	Non-smokers (n=142)	Smokers (n=24)	Combined (n=166)
Asthma Attack	2	0	2
Headache	42	58	45
Coughing	23	46	26
Shortness of Breath	1	0	1
Wheezing	1	0	1
Body Ache/Fatigue	32	50	35
Eye Irritation	15	4	14
Nausea	1	8	2
Chest Pain	14	21	15
Sore Throat	8	4	8
Runny Nose	15	21	16
Lightheadedness or Fainting	6	4	6
Symptoms per Individual	1.6	2.2	1.7

Work, Season, and Traffic

Reported Effects of Work, Season, and Traffic on Symptoms

	% Respondents
Effect of Work (n=109)	
Symptoms Improve	30
Symptoms Get Worse	49
No Effect	21
Effect of Traffic (n=108)	
Morning, high traffic	17
Afternoon, low traffic	11
Late afternoon, high traffic	39
No Effect	33
Effect of Season (n=110)	
Dry	42
Rainy	30
No Effect	28

Difficulties and Limitations

- Recalibration not possible
- Machine malfunction / lost power
- Rainy season only
- Reliability of questionnaire data
- No control group

Health Implications

- SO_2 : runny nose (16%), chest pain (15%), coughing (26%), eye irritation (14%)
- CO: headaches (45%) and fatigue (35%)
- Chronic Exposure
- Instantaneous concentrations

General Conclusions

- Vehicle emissions are a significant contributor to air pollution and should be a priority of research and policy
- Health effects cannot be determined because of study limitations, BUT it seems likely that the impact is significant and warrants further research

Recommendations

■ Policy

- *** Sulfur reduction of fuel ***
- Technology implementation
- Vehicle import regulations
- Include satellite towns

■ Immediate Actions

- Protect warden health – face masks, shift rotations, antioxidants
- Target commercial vehicles
- Awareness campaign

Future Research

- Health status of traffic wardens
 - CO levels, lung function, BLL
 - Edit questionnaires, use control group
- Air quality data
 - seasonal variations, particulates, modeling
- Public health impact
 - GIS mapping of pollutants, epidemiological studies (ie. hospitalization w/ pollution levels)

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