

## Original Research Article

# Toxicological effects of prolonged exposure of soot-polluted air on some haematological and biochemical parameters of residents of Port Harcourt

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## ABSTRACT

**Background:** Soot is a by-product of incomplete combustion of carbon derived from substances that contains carbon like hydrocarbons, which is associated with various human diseases. The objectives of the studies are to evaluate the toxicological effects of prolonged exposure of soot polluted air on some haematological and biochemical parameters.

**Methods:** One hundred apparently healthy residents of Port Harcourt residing in soot polluted environment for a minimum of 12 months and one hundred apparently healthy subjects residing in non-soot polluted environment outside Port Harcourt were recruited for this study. 5ml of venous blood was collected from each subject after 10hours of overnight fast to estimate the PCV, Hb, RBC, WBC, lymphocytes, neutrophils, bicarbonate, total cholesterol, triglyceride, low density lipoprotein and high density lipoprotein using automated autoanalyzer.

**Results:** There was a statistically significant decrease in the PCV, Hb, RBC and increase in WBC, Lymphocytes and neutrophils. There was also a significant increase in the bicarbonate, total cholesterol and LDL with a decrease in HDL cholesterol as compared to the control.

**Conclusions:** It is concluded that prolong exposure to soot polluted air is harmful and associated with deterioration of haematological parameters and also induces oxidative stress and lipid peroxidation which may increase morbidity and mortality.

**Keywords:** Haematological, Lipid profile, Port Harcourt, Prolong, Soot, Soot-polluted air

## INTRODUCTION

Soot (black carbon) is essentially the by-products of incomplete combustion of carbon and substances that contains carbon.<sup>1</sup> Soot is a fine powdery mass of carbon and is regarded as an impure carbon derived from incomplete combustion of substances that contain carbon like hydrocarbon especially the polyaromatic hydrocarbons (PAHs).<sup>2,3</sup>

Soot is particulate matter with varying sizes. They exit in the range of 10nm to 1mm in size and have less than 60% of carbon in their total mass.<sup>4,5</sup> Regrettably, soot emissions are reportedly largest in developing countries.<sup>6</sup> It is associated with various diseases in the human population, these diseases include respiratory diseases, cardiovascular diseases, cancers, and probably reproductive system defects.<sup>7,8</sup>

Port Harcourt is a densely populated city that host multinational companies that are involved in one form of exploration and mining. The increasing level of soot in the air and environment of Port Harcourt is largely due to two factors, the activities of security agencies that burn off illegally bunkered petroleum products and the activities of unlawful oil refinery operators who run their operations from the creeks and surroundings of some of the communities around and surrounding Port Harcourt.

However, there has been little research on the toxicological effects of the soot on health of the resident of Port Harcourt. This work was done to evaluate the toxicological effects of soot on some biochemical and haematological parameters among residents of Port Harcourt who are exposed to soot polluted air.

**METHODS**

**Human subjects**

This work was carried out in one hundred (100) residents of Port Harcourt, who are exposed to soot polluted air and 100 control subjects who reside outside Port Harcourt and have never been exposed to soot polluted air.

The subjects included in this experimental group were subjects between the ages of 18 to 60 years and have been leaving in Port Harcourt for a period of 12 months, who are non-smokers and without any form of chronic medical diseases or on any medications that will affect the outcome of the study. The subjects were counselled, and informed consent obtained from the subjects before the commencement of the study.

**Sample collection**

The subjects were asked to fast for 10hours overnight and a fasting blood samples were collected through venepunction into lithium heparin and EDTA (Ethylenediaminetetraacetic acid) bottles for the determination of some haematological and biochemical parameters.

**Determination of haematological parameters**

The haematological parameters of the subjects in both the experimental and control groups were determined using haematology autoanalyzer (Sysmex KX-21n, Kobe, Japan) which determine the Packed Cell Volume (PCV), Red Blood Cell (RBC) count, White Blood Cell (WBC) count, neutrophils and lymphocytes.

**Determination of biochemical parameters**

The biochemical parameters of the subjects in both the experimental and control groups were determined using biochemical autoanalyzer (BC 300, CONTEC Medical, China) to analyzer the level of bicarbonate, total

cholesterol, triglyceride, high density lipoprotein and low density lipoprotein.

**Data analysis**

Data was presented as mean±standard error of mean (SE). The significance of difference among groups was assessed using one way and multiple way analyses of variance (ANOVA) with p-value <0.05 was considered as significant.

**RESULTS**

**Demographic characteristic of subjects**

A total of 100 experimental subjects and 100 control subjects were recruited for the study. In the experimental group 60% were male while 40% were female. In the control group, 55% of the subjects were male and 45% were female. The mean age of the subjects in the experimental group was 26±10 years and that of the control was 28±5 years (Table 1).

**Table 1: Demographic characteristic of subjects.**

Sex	Experimental (%)	Control (%)
Male	60	55
Female	40	45
Mean age	26±10 years	28±5 years

**Effects of soot polluted air on haematological parameters in residents of Port Harcourt**

The mean haematological value of the packed cell volume (PCV), Haemoglobin (Hb), Red blood cell (RBC) as well as the Total white blood cell (TWBC), lymphocyte and neutrophils are presented in Table 2. It shows a general decrease in the mean PCV, Hb, RBC values and an increase in Total white blood cell count, lymphocytes and neutrophils of the experimental subjects as compared to the control (p<0.05) following a prolong exposure to the environment pollutant (soot).

**Table 2: Mean values of haematological parameters.**

Parameters	Group(n=100)		ANOVA P-value
	Experimental group	Control group	
PCV (%)	41.53±0.78	43.32±0.91	0.01
RBC (x 10 <sup>12</sup> /L)	5.16±0.14	5.58±0.22	0.03
Hb (g/dl)	13.53±0.26	14.10±0.28	0.02
TWBC (x 10 <sup>9</sup> /L)	5.88±1.40	4.97±4.2	0.03
Lymphocytes (x 10 <sup>9</sup> /L)	4.19±9.04	4.80±7.89	0.01
Neutrophils (x 10 <sup>9</sup> /L)	5.83±9.45	5.20±7.89	0.01

PCV-Packed cell volume, Hb-Haemoglobin, RBC-Red blood cell, TWBC-Total white blood cell

### Effects of soot polluted air on haematological parameters in residents of Port Harcourt

The mean biochemical value of bicarbonate (HCO<sub>3</sub>), total cholesterol (TC), triglycerides (TG), high density lipoprotein (HDL) and low density lipoprotein (LDL) were determined and presented in Table 3. The result shows a general increase of the biochemical parameters of the experimental subjects as compared with control values. There was a significant increase in HCO<sub>3</sub>, TC, and LDL of the experimental subjects as compared to the control (p<0.05) as shown in Table 3.

**Table 3: Mean values of biochemical parameters of subjects.**

Group(n=100)			
Parameters	Experimental group	Control group	ANOVA P-value
HCO <sub>3</sub>	35.11±4.77	25.30±3.34	0.02
TC	5.88±2.21	5.58±0.22	0.02
TG	1.90±0.01	1.86±0.01	0.16
HDL	1.60±0.24	1.61±0.24	0.03
LDL	2.53±0.15	2.08±0.18	0.02

HCO<sub>3</sub>-Bicarbonate, TC-Total cholesterol, TG-Triglycerides, HDL-High density lipoprotein, LDL-Low density lipoprotein

### DISCUSSION

The present study confirmed the toxicological effects prolonged exposure of soot polluted air on some haematological and biochemical parameters such as PCV, Hb, RBC, WBC, bicarbonate, triglycerides, total cholesterol, high density lipoprotein and low density lipoprotein.

The result of the study shows that the environmental pollutants e.g. soot arises from the illegal activities of refinery of crude and burning of petroleum products caused a marked decrease in the PCV, Hb and RBC relative to the control.<sup>9</sup> However, the total white blood cell count, neutrophils and lymphocytes were significantly elevated. This may be as a result of inflammatory response of the immune system and bone marrow to soot with associated haemolysis. Many high molecular weight carbon compounds have one form of systemic toxicity. For instance, benzene is toxic in human at any concentration, and may cause with haematotoxicity and bone marrow depression, when inhaled for prolonged period. Naphthalene, another compound if inhaled in large amount, is known to destroy the membrane of red blood cells leading to haemolysis.

Previous studies done reported the effect of flared gases on humans is related to the exposure of hazardous air pollutant emitted during incomplete combustion of the flared gases.<sup>10</sup> Also related studies also reported a similar decreased in the PCV, Hb, and RBC among petrol station attendants.<sup>11</sup>

WBC count reported from similar studies has been contradictory. Some reported a reduction of the WBC count; others have reported an increase as was observed in this study.<sup>12,13</sup> The increased in the WBC count may be associated to stress induced changes in the haemopoietic pathway by components of the soot.

Also, the result shows that prolonged exposure to soot polluted air significantly increases the values of bicarbonate, total cholesterol, LDL cholesterol and reduced HDL cholesterol. This suggests that prolonged exposure to soot polluted air will cause high level of oxidative stress and lipid peroxidation.

Lipoprotein abnormalities play an important role in the pathogenesis of some cardiac diseases and also in diabetic atherosclerosis.<sup>14</sup> Dyslipidemia causes morbidity and mortality in patients with coronary artery disease, ischaemic heart disease and also in type 2 diabetes mellitus and the most common pattern is elevated total cholesterol, triglyceride, and LDL cholesterol and decreased HDL cholesterol concentration which is similar to the findings in this study.<sup>15</sup>

In this study, the prolong exposure of soot polluted air significantly increases the total cholesterol and LDL cholesterol with decrease HDL cholesterol, which suggest that patients with chronic medical diseases are at risk of increased morbidity and mortality when exposed to high level of soot polluted air.

### CONCLUSION

The findings from the study demonstrated that prolong exposure to soot polluted air has the capacity to inducing oxidative stress and lipid peroxidation with marked alteration in some biochemical and haematological parameters. These findings suggest that leaving in a soot polluted environment is harmful and may cause morbidity and mortality especially in patients with chronic medical diseases. This work may be a useful tool to help as a marker for biological control or monitoring of residents leaving in areas where the surroundings or community is polluted with environmental pollutants.

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