# EFFECT OF WOOD SMOKE ON SELECTED BLOOD ANTIOXIDANT PARAMETERS, ESSENTIAL AND HEAVY METAL LEVELS IN WOMEN

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**Abstract**

The study was set to assess the effect of exposure to firewood smoke on the levels of essential trace, toxic elements and antioxidant parameters in exposed adult female subjects. A total of 90 blood samples were collected. 60 samples were collected from women who in the process of using firewood as a means of domestic fuel are exposed to the smoke. The remaining 30 were women who are not exposed to wood smoke, these served as control. Determinations of essential Trace metals (Copper, Zinc, and selenium), Heavy metals (Arsenic, cadmium, lead and, mercury) and antioxidant parameters (Superoxide dismutase [SOD] and Thiobarbituric acid reducing substances [TBARS]) was carried out on all blood samples, the result of which was subjected to statistical analysis. The student's t test was the tool of choice and significance was tested at $P<0.05$. All heavy metals determined were significantly elevated while all essential trace elements were significantly lowered in subjects constantly exposed to smoke. The mean SOD was found to be significantly lower while TBARS was significantly lower in exposed subjects. It appears that the use of firewood as a means of household fuel exposes these subjects under examination to agents that cause oxidative stress. This research also goes further to confirm that exposure to gaseous products of wood combustion has a depleting effect on the essential trace element levels and antioxidant system and therefore deleterious to human health. It is also associated with an increase in blood levels of toxic metals .

**Keywords:** Essential trace elements, Heavy/ toxic metals, Antioxidant parameters, Wood smoke

## Introduction

Under ideal conditions, Reactive oxygen species (ROS) are generated in a controlled manner at low concentrations and function as signaling molecules regulating vascular contraction-relaxation and cell growth (Touyz and Schiffrin, 2004). ROS can be defined as reactive derivatives of $O_2$ metabolism. They exist in the environment and in all biological systems, ROS play a crucial physiological role in humans among which is the maintenance of cardiac and vascular integrity. However they also perform a pathophysiological role in cardiovascular dysfunction associated with several clinical conditions (Griendling *et al*., 2001; Landmesser and Harrison, 2001)

Essential trace metals are elements that occur in human tissues in milligrams per Kilogram or less, thus they are metals whose deficiency results in death or some form of malfunction in living organisms (Milne, 2010). Heavy metals on the other hand could be defined as toxic metal substances that even in trace amount result in death or some form of malfunction in living organisms. Examples are arsenic(As), Lead(Pb), Mercury(Hg) and, Cadmium(Cd). One of the problems insinuated by the investigators in the present research are those likely to be precipitated by the end products of wood combustion, This research work was therefore designed to estimate the effect of wood smoke on the blood levels of both Essential and some heavy metals as well as some selected antioxidant parameters.

## Materials and method

**Source of samples**: A total of 90 blood samples were collected. Sixty (60) blood samples were collected from female individuals who as a daily routine are exposed to wood smoke. The remaining thirty (30) was collected from female individuals who are not, on daily basis, exposed to wood smoke. The criterion of the selection of subjects was that no one should be a smoker or have a history of smoking, whether active or passive. They are also required not to be on any form of extra dietary supplements. All subjects included in the present study were thus normal healthy subjects.

**Study location** is Offa in Kwara state, North-central, Nigeria.

**Blood collection**

Five milliliters (5mls) of each blood sample was collected by venous puncture of the cubital fossa using 22G needle and syringes. Two milliliters (2mls) of the blood collected was immediately dispensed into lithium heparin bottles, mixed and refridgerated for at most 24 hours. This was used for the

estimation of both trace essential and heavy metals. Two milliliters (2mls) of the blood collected was immediately dispensed into lithium heparin bottles, mixed and. centrifuged at 2000 r.p.m for 10 minutes. The supernatant plasma was then removed and dispensed while the red cell portion was washed in saline and refridgerated for at most 12 hours before being used in the estimation of red cell SOD activity. The remaining 1ml was allowed to clot; it was then centrifuged at 2000rpm for 10 minutes. The serum was removed and placed in a plain bottle. It was then refridgerated at $4^{o}$C until needed for the estimation of TBARS.

**Determination of Blood heavy and essential trace metals** was done using Atomic absorption spectrophotometry (Perkin-Elmer, USA) at specific wavelengths as originally explained by Robinson (1960)

**TBARS** as a marker for lipid peroxidation and therefore oxidative stress, was determined using the thiobarbituric acid (TBA) method of Okhawa H *et al.*, (1979).

**Erythrocyte SOD activity** was assessed according to the method of Marklund and Marklund (1979) which is based on the ability of SOD to inhibit auto-oxidation of pyrogallol. One unit of SOD being the activity of enzyme required to inhibit the auto-oxidation of pyrogallol by 50% in the assay mixture. The results are expressed in units/gHb.

**Statistical analyses**: Results were expressed as mean and standard deviation (SD). Statistical analysis was carried out using the SPSS program. All values are expressed as mean±SD and were found to be significant or otherwise at P<0.05 (version 17.0 software, SPSS Inc. Chicago, Illinois, USA

**Statistical analysis** was done using SPSS.The students' t was the tool of choice. significance was tested at P <0.05.

## Results

| Variables (µg/dl) | Exposed | Control | Students't | Pvalue |
|---|---|---|---|---|
| Zinc(Zn) | 416.13±112.1 | 637.42±98.62 | 9.17** | .000 |
| Selenium(Se) | 9.27±2.19 | 16.89±3.68 | 12.30** | .000 |
| Copper(Cu) | 87.34 ± 18.06 | 119.07± 12.32 | 8.66** | .000 |

**= significant at P<0.001

| Toxic metals (µg/dl) | Exposed | Control | Students t | P value |
|---|---|---|---|---|
| Arsenic (AS) | 2.44± .32 | 0.61±.18 | 30.81** | .000 |
| Cadmium(Cd) | 0.46± .13 | 0.17±.076 | 11.27** | .000 |
| Lead(Pb) | 1.68± .41 | 0.51± .12 | 15.27** | .000 |
| Mercury(Hg) | 2.79±.69 | 0.49± .11 | 18.09** | .000 |

**= significant at P<0.001

| Antioxidant parameter s | Exposed | Control | Students t | P value |
|---|---|---|---|---|
| SOD(U/gHb) | 1164.77±83.41 | 1495.87±101.39 | 16.50 ** | .000 |
| TBARS(nMol/L) | 3.92±.96 | 1.87±.41 | 11.173** | .000 |

**= significant at P<0.001

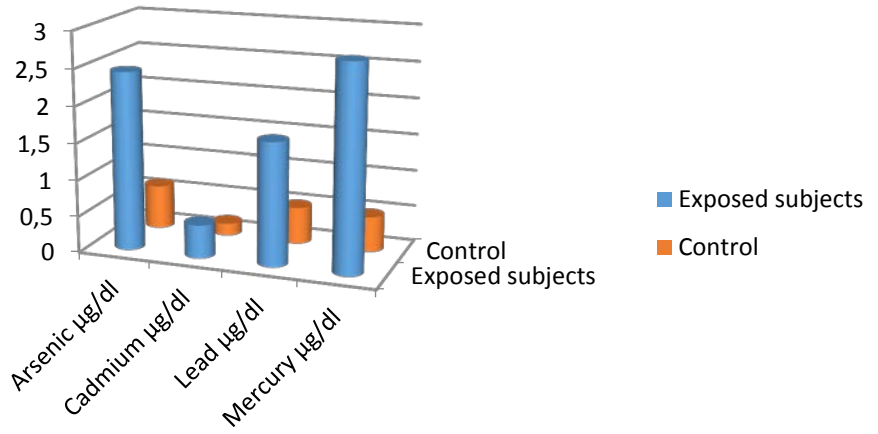


Figure 1. shows levels of all heavy metals in both exposed and control subjects

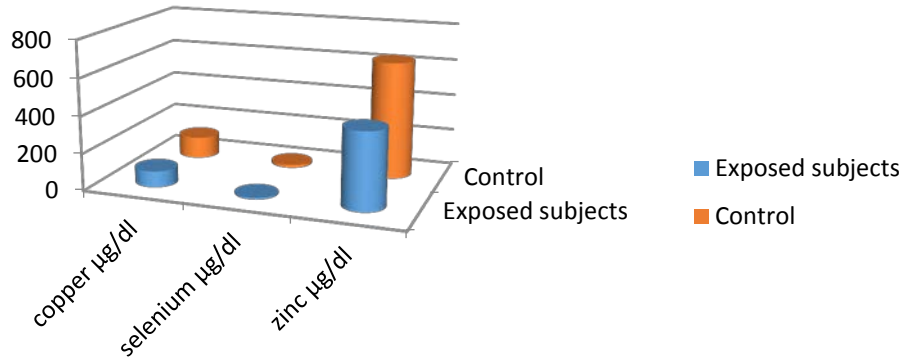


Figure 2. shows levels of all Essential trace metals in both exposed and control subjects

## Discussion

Wood and the by product (sawdust) are still important form of household fuel in Nigeria. Burning of wood results in the production of the regular gaseous products of wood combustion such as tar and $CO_2$. Other substances present in smoke are volatilized metallic substances originally present in the wood, this being absorbed by plants from contaminated or heavy metal laden soils (Khan *et al.*, 2007). This volatilization is made possible by the process of burning. The said volatilized metals get assess into human circulatory system through the alveoli of the lungs, this being sequel to the process of inhalation. In this research, it was discovered that the levels of all essential trace elements estimated were significantly lower in subjects

constantly exposed to wood smoke when compared to control. Conversely it is discovered that whole blood levels of all heavy metals were significantly higher in the exposed when compared with control. This need not be surprising as an overabundance of one trace element has been reported to greatly interfere with the metabolic use of another ( Levander and Cheng, 1980; Mill, 1981). Thus, it seems that the overabundance of Lead, Mercury, Arsenic and Cadmium levels in exposed subjects, as a matter of fact, interfere with physiological processes involving Zinc ,selenium and copper, The logical reason being that heavy metals, by virtue of their electronic configuration, have a higher affinity for sulphur containing compounds. This characteristic as described by Milne (2010) greatly influences the adverse effect of heavy metal on physiological processes. Aside the interferent and disruptive effects of heavy metals on essential trace metal levels and physiologic processes respectively, their carcinogenic effects could not be overemphasized (ATSDR, 1999).

Superoxide dismutase (SOD) is an antioxidant enzyme. Among the known antioxidant proteins, (SOD) is thought to play a central role because of its ability to scavenge superoxide anions, the primary ROS generated from molecular oxygen in cells(Fridovich, 1995), that it has been thought of as the body's first line of defense against oxidant damage(Fridovich, 1995; Recklies, 2000). In this research, there was a significant reduction in SOD activity when the exposed subjects were compared with control. The reason for the depletion of SOD activity could not be farfetched, the exposed subjects, like cigarette Smokers, are exposed to so many harmful substances. For example, heavy metals as explained above, such as lead and cadmium. As regards the deleterious effects of the heavy metals; SOD is a metalloenzyme, upon contamination with any of the heavy metals mentioned above, they are likely to replace Cu, Mn and Zn as the metal constituents of SOD (Huang, 2006). When this happens the enzyme activity is diminished, therefore the level of the superoxide, which should have been scavenged increases, leading to, among other conditions, accelerated lipid peroxidation. Lastly, It can therefore be said that there is an accelerated lipid peroxidation in the exposed as has been made evident by the significant increase seen in TBARS levels when compared with control.

## Conclusion

This research ventured into and found out that exposure to wood smoke has a deleterious effect on the human physiology. This is evident from the fact that exposure to wood smoke; increases toxic metals levels in blood, brings about a significant reduction in essential trace elements and antioxidant parameters.

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