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Selected Heavy Metals in Blood of Male Nigerian Smokers

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Abstract: Lead, cadmium and zinc levels were determined in the blood of 47 all male smokers (age range, 19-56 years). The subjects were classified into 4 subgroups based on the number of years of smoking, namely: 1-5, 6-10, 11-15 years, >16 years. Thirty all male non-smokers serves as the control. The weight, height and body mass indexes of all subjects were noted in addition to other information obtained through structured questionnaire. Those that were likely to be exposed to any of these metals either occupationally or through other life style habits were excluded from the study. The mean values of blood lead (BPb), blood cadmium (BCd) and blood zinc (BZn) in male smokers (n = 47) were 43.26±4.28, 98.21±6.39 and 104.84±3.66 μg dL^{-1}, respectively while the corresponding mean values for these parameters in the non smokers (n = 30) were 32.44±3.02, 76.51±4.59 and 90.38±2.55 μg dL^{-1}, respectively. The smokers have statistically significant higher BPb, BCd and BZn than the non-smokers ($p<0.001$, $p<0.001$ and $p<0.001$, respectively). The results appear to confirm the presence of these metals as component of cigarette and agree with similar findings from literature. Consequently, it is probable that high level of these metals in blood of smokers is from tobacco smoking. Additionally it appears that the number of years of smoking has nothing to do with the level of these metals in smokers' blood.

Key words: Smokers, blood lead, blood cadmium, blood zinc, non smokers

INTRODUCTION

Heavy metals are chemical elements with specific gravity that is at least five times the specific gravity of water (Passow *et al*., 1961; Goyer, 1996; Hawkes, 1997). Heavy metals have become entrenched in the literature of environmental pollution (Vouk, 1979; Anetor *et al*., 2002). There are 35 metals that concerns us because of occupational or industrial exposure, 27 of these are the heavy metals arsenic, bismuth, cadmium, manganese titanium, vanadium, chromium, iron, silver, gold, mercury, etc. (Nieboer and Richardson, 1980; Hawkes, 1997).

These heavy metals may enter the human body through food, water, air, or absorption through the skin (Shibko, 1972; Goyer, 1996). Some, such as cadmium, lead, mercury and zinc are particularly dangerous because they tend to bioaccumulate, that is increased in the concentration in the body and eventually a level is reached where symptoms and disability occur (Luckey *et al*., 1975; Nriagu, 1979; Babalola *et al*., 2005). Heavy metals which have received the most attention both in terms of sources and effects are the those which are considered either (or both) as essential or toxic or show a high geochemical abundance these include zinc, iron, copper, molybdenum, lead, mercury and cadmium (Martin and Coughtrey, 1982; Hawkes, 1997; Anetor *et al*., 2002). The present study is focused on three of these metals namely: lead, zinc and cadmium.

Tobacco smoking contributes to the risk of developing heart and renal disease and is probably the most important single source of cadmium exposure since the tobacco plant contained a lot of cadmium (Martin and Coughtrey, 1982; Doll *et al*., 2004). In human beings, it has been shown that the normal accumulation of cadmium in the renal cortex is accompanied by an equimolar increase in zinc (Lindh *et al*., 1980). Lead is a cumulative poison. It has also been reported to interfere with the level of some divalent ions in human body, such as Cu and Zn (Dehpour *et al*., 1999; Anetor *et al*., 2002; Babalola *et al*., 2005). Consequently the study was designed to compare the level of these metals between smokers and non-smokers, so as to determine the contribution of this life style habit to metal toxicity in humans and the associated disorders.

MATERIALS AND METHODS

Subjects

Test subject: Forty Seven all male smokers aged between 19-56 years participated in the study. These comprise

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mainly office workers and students. Those that are likely to be exposed to any of this metals either occupationally or other life style habits were excluded from the study, They were classified into four groups based on the number of years of smoking: 1-5, 6-10, 11-15 and >16 years.

Participation in the study was purely voluntary. Informed consents were obtained from all the participants after they were properly educated about the benefit of the study.

Control subject: Thirty all male non-smokers, mainly office workers and students aged between 18-40 years participated as the controls. Special effort was made to select the control group to match the test in age, weight, height and body mass index. All the subjects were recruited from Akure in Ondo state of Nigeria between May 2004 to February 2005.

Anthropometrics indices: The current ages of the subjects were noted. The body weight was measured with minimum clothing using a beam scale balance. Height was also measured bare footed using a meter rule. Height (m) and weight (kg) were used to calculate the body mass index (kg m^{-2}).

SAMPLE COLLECTION

Blood samples: About 5 mL of venous blood were collected from each of the subject using disposable pyrogen free needle and syringe (Beckton-Dickinson, Dublin, Ireland). The blood samples were transferred into heparinized tube containing lithium heparin (Vacutainer system Inc., Rutherford, New-Jersey) and kept frozen at -70°C until analyzed.

Sample treatment: The Frozen blood sample were retrieved and allowed to thaw. One millilitre of the blood was pipetted (using micropipette) into clean test tube. To this 2 mL of Conc. HNO_3 containing 0.1% Triton X-100 was added and left on the bench overnight to digest the blood samples. The solution was later made up to 25 mL with distilled deionized water, Alpha 4 Atomic Absorption Spectrophotometer, Chemtech 4200 was used to determine the blood levels of lead, cadmium and zinc at wavelength specific for each of the metal at Obafemi Awolowo University, Ile-Ife Central laboratory. Standard solutions of each of the metals were aspirated to calibrate the AAS before the aspiration of the of the samples.

Statistical analysis: Results were expressed as mean±standard deviation (SD). Student t-test was used to determine significance between means. The 5% ($p<0.05$) level of significance using the two-tailed t-table was used to compare the calculated and critical t-value from the table and thus statistical significance.

RESULTS

Table 1 shows the mean values of the anthropometric indices of both the smokers and non smokers, in addition to the values for, the mean blood lead, blood cadmium and blood zinc in these two groups. The mean age and mean height of the smokers and non smokers were comparable i.e., there was non significant differences in these values, however there were slight differences in the mean weight and the mean body mass indices of these two groups ($p<0.01$, $p<0.01$, respectively). Additionally, the mean blood lead, blood cadmium, blood zinc were significantly higher in smokers than non smokers ($p<0.001$, $p<0.001$, $p<0.001$, respectively).

The values for the anthropometric indices were comparable in all the four groups, this was also true with the values for the blood lead, blood cadmium, blood zinc in the four groups. The highest mean value for blood lead was found in group 1 and the lowest in group 3. Blood calcium has the highest mean value in group 4 and lowest in group 3 while the mean blood zinc was highest in group 3 and lowest in group 2 (Table 2).

Table 1: Age, weight, height, body mass index, blood lead, blood cadmium and blood zinc in smokers and non-smokers (Mean±SD)

Parameters	Smokers (n = 47)	Non-smokers (n = 30)	t-value	p-value
Age (years)	30.10±07.50	27.42±6.85	1.613	NS
Weight (kg)	62.42±10.20	68.10±7.11	2.877	$p<0.01$
Height (m)	1.66±00.17	1.70±0.11	1.254	NS
BMI (kg m^{-2})	23.21±03.20	26.80±6.15	2.952	$p<0.01$
Bpb (μg dL^{-1})	43.26±04.28	32.44±3.02	13.492	$p<0.001$
Bcd (μg dL^{-1})	98.21±06.39	76.51±4.59	17.313	$p<0.001$
Bzn (μg dL^{-1})	104.84±03.66	90.38±2.55	20.414	$p<0.001$

n = No. of subjects, BMI = Body Mass Index, BPb = Blood lead, Bcd = Blood cadmium, Bzn = Blood Znc, NS = Not significant, SD = Standard Deviation

Table 2: Age, weight, height, body mass index, blood lead, blood cadmium and blood zinc in different groups of smokers (Mean±SD)

Parameters	Group 1 (n = 19)	Group 2 (n = 9)	Group 3 (n = 12)	Group 4 (n = 7)
Age (years)	27.81±09.52	30.65±10.42	29.11±9.62	28.16±11.78
Weight (kg)	60.13±10.93	52.72±07.32	57.42±9.37	49.70±06.20
Height (m)	01.48±00.17	1.62±00.12	1.62±0.15	1.69±00.21
BMI (kg m^{-2})	27.34±06.60	23.32±04.65	24.41±7.86	29.43±07.21
Bpb (μg dL^{-1})	46.11±07.10	42.41±05.52	36.47±10.72	45.61±03.45
Bcd (μg dL^{-1})	90.34±0 6.01	96.22±09.30	93.45± 5.89	108.30±09.22
Bzn (μg dL^{-1})	100.39±5.46	97.38±06.25	106.89±3.20	102.37±03.47

n = No. of subjects, BMI = Body Mass Index, BPb = Blood lead, Bcd = Blood cadmium, BZn = Blood Znc, SD = Standard deviation, Group 1 = 1-5, Group 2 = 6-10, Group 3 = 11-15, Group 4>6 years

DISCUSSION

Present result appears to confirm the presence of cadmium and lead as component of tobacco; it is probable that higher levels of these metals in blood of smokers are from tobacco smoking. The result obtained from this study is consistent with the following observations from literature.

Blaurock-Busch (2001) reported that each cigarette contains approximately 1 μg of cadmium; out of these approximately 30% goes into the lungs and is absorbed, while the remaining 70% enters the atmosphere and that perhaps the greatest source of cadmium exposure in human is due to cigarette smoke. Earlier Fischbein (1983) observed that one of the sources of lead contribution to the human tissue is through smoking. This is so because lead is found to be part of the components of cigarette and pipe or cigar.

Cadmium when absorbed is deposited mainly in the kidneys and the prostate gland. A high blood cadmium level has been shown to cause acute renal failure, hardening of the arteries (atherosclerosis) and high blood pressure. Blood level cadmium may also increase the risk of peripheral artery disease (Goyer, 1996).

Lead toxicity on the other hand has been reported to affect many human organs. It has special affinity for bone and brain tissues (Grandjean, 1975; Babalola *et al*., 2005). All known effects of lead on biological system are deleterious. Many physiological system including those of the renal, nervous, heamopoietic, immune, reproduction and endocrine are principal targets of this environmental toxicant (Anetor *et al*., 2002). Lead is probably the most studied of all the heavy metals (Babalola *et al*., 2005).

Although zinc is one of the essential micro-nutrients for humans, animal and plants. It is everywhere in the environment and as such the level of zinc may be found to increase to toxic level. Zinc toxicity from excessive ingestion has been reported to results in gastrointestinal problem and diarrhea (Broun *et al*., 1990). Significantly higher zinc level in smokers also probably suggests that this heavy metal is obtainable from ingested or inhaled tobacco smoking

Since tobacco use is widespread throughout the world, from countries with low-income economies to the most affluent industrialized nations. Apart from the active smokers, millions of people are involuntary subjected to environmental tobacco smoke (IPCS, 1992). Consequently the observed high level of selected heavy metals in blood of smokers probably suggest that many individuals who are exposed to tobacco smoke in the environment stand an equal risk of health hazard associated with these metal intoxication.

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