The Pharmaceutical and Chemical Journal, 2018, 5(3):50-54

Available online www.tpcj.org

Research Article

ISSN: 2349-7092
CODEN(USA): PCJHBA

Trace Element Levels in Carpenters Exposed to Sawdust in Port Harcourt Metropolis, Rivers State, Nigeria

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Abstract This study was carried out to determine the concentrations of trace elements in carpenters exposed to sawdust within Port Harcourt Metropolis, Rivers state. A total of thirty carpenters exposed to sawdust were compared with twenty-six apparently healthy individuals who work in an offices setting far away from saw dust as control. Atomic absorption spectrophotometer was used to estimate the plasma concentrations of zinc, cobalt, selenium and copper in all subjects. The mean concentrations of zinc, cobalt, selenium and copper for carpenters is 0.785 ± 0.111mg/l, 0.028 ± 0.011mg/l, 0.303 ± 0.238mg/l, and 0.236 ± 0.048mg/l respectively while the concentrations in control are 0.705± 0.106mg/l,0.032 ± 0.230mg/l, 0.785 ± 0.106mg/l and 0.796 ± 0.172mg/l. The result showed that Zinc concentration is significantly higher ($P<0.05$) in carpenters exposed to sawdust compared to control while cobalt concentration was not significantly deferent in carpenters exposed to sawdust when compared to control ($P>0.05$). However selenium and copper concentrations were significantly lower ($P<0.05$) in carpenter expose to sawdust when compared to control. The study has shown that sawdust caused changes in trace elements among carpenters.

Keywords Trace elements, Zinc, Cobalt, Sawdust, Carpenters

Introduction

'Sawdust is a by-product of cutting, grinding, drilling, sanding or otherwise pulverizing wood with a saw or other tool' [1]. It can originate from hard wood or soft wood. Timber wood consist of low molecular height such as organic compounds ,waxes,fatty terpenses acid and resin acids . Timber a type of hardwood use by carpenters in marine base carpentry shade in port Harcourt Rivers State, Nigeria is composed of cellulose, hemicellulose and lignin. Lignin in hard wood is derived from sinapyl alcohol and coniferyl alcohol [2]. Wood contains toxins that may affect the health of a person exposed to it and may be potentially carcinogenic [3].

Studies show that exposure to saw dust in carpenters can occur through direct contact with wood dust on the hand and foot [4]. Exposure to wood dust has been associated with allergic respiratory problems, dermatitis and cancer [5]. Saw dust may affect mucous membranes by mechanical action or by chemical irritation [5].

Trace elements such zinc, cobalt, selenium and copper are required for proper body function. Zinc is an essential regulatory ion that functions in protein synthesis, catabolism and energy metabolism [6]. Zinc is one of the most important trace elements in the body and it is essential as catalytic structural and regulatory ion. Zinc binding proteins (metallothoneins) are protective in situation of stress [7]. Zinc affects protein synthesis and is required for proper function of red and white blood cells. Zinc is found in every tissue in the body and is a powerful anti-oxidant. Zinc is also directly involve in the maintenance of hormone levels. Its deficiency makes both men and women

infertile and causes low libido. Low zinc level also exacerbates the effects of stress on the body and accelerates ageing. Low zinc results in altered sense of taste leading to craving of saltier sweeter food. Deficiency can also be indicated by diarrhea, low energy, chronic fatigue, infertility, poor immunity, bad memory and inability to focus. Other symptoms are slow wound healing, nerve dysfunction and ringing in the ears [8]. Inhaling zinc oxide fumes can result in zinc excess which can cause diarrhea and vomiting [9]. Zinc in the mucosa cells can bind to protein and be transmitted through the membrane of the mucosal cells where it binds to serum albumin [10].

Cobalt promotes red blood cell formation and it's absorption in the body is affected by nutritional factors. Cobalt is absorbed in the digestive tract. When in small doses, cobalt is almost completely absorbed, but when in larger doses, it is poorly absorbed.

Selenium is a trace element incorporated in clusters of proteins called selenoproteins. It is an essential component of glutathione peroxidase enzyme system which acts as a major antioxidant defense system within the body [11]. The two most common forms of Selenium that enters the body are selenothionine and selenocystein which are found mainly in plants and animals respectively [8]. Selenium protects the cell from oxidative stress and free radical formation. Selenium deficiency may only occur when a low selenium status is linked with an additional stress, such as chemical exposure or increased oxidant stress due to vitamin E deficiency.

Copper is use by the body as a natural remedy for arthritis, prevention of aging, balancing of hormones and sustainance of energy level. It is obtained through diet from nuts, oysters, fish and beans.Copper absorbtion is impaired by high intake of Iron and Zinc. Deficiency of Copper is manifested in fatique, arthritis, osteoporosis, brittle bone and joint pain.

Carpenters that work in marine base carpentry shade in port Harcourt, Rivers State Nigeria saw the timber woods without proper protective clothing and also use the saw dust produced as part of the floor covering of their carpentry shade as a consequence they are directly expose to the sawdust produce. It is pertinent therefore to investigate if exposure to these saw dust affect normal body function. This study therefore sought to determine the concentration of Zinc, cobalt, selenium and copper in carpenters expose to saw dust.

Materials and Method

Study Area

This study was conducted in marine base carpentry area within Port Harcourt Metropolis Rivers State of Southern Nigeria.

Study Population

The study comprised of a total of 56 subjects age between 21 – 43 years. The subjects comprises of 30 carpenters who are directly expose to saw dust in their working environment and 26 apparently healthy individuals who work in an office setting away from marine base carpentry Area which formed the control group. The number of years of exposures to saw dust among the carpenter was determined by years of working with timber wood. Years of exposure to saw dust among these carpenters ranges between 4 – 15 years. Informed and well understood consent was obtained from the participant. Questionnaire was used to obtain data on health history such as nasal, problem, smoking, chest pains, eye problem, blood pressure, push, and weight and height.

Sample Collection

5ml of blood were collected from the medium vein into a well labeled lithium heparin. The samples were centrifuged at 1500 rpm for 5 minutes to obtain blood plasma sample for the analysis of Zinc, Cobalt, Selenium and Copper

Test Method

Copper, Zinc, Selenium Cobalt where estimated using Atomic Absorption spectrophotometer by [12].

Principle: When small amount of a solution containing was Aspirated using the Atomic Absorption spectrophotometer, the flame coming out of the Atomic Absorption spectrophotometer changes indicating the type of trace element. The colour is been converted into digital number which appear on the screen of the machine.

Procedure: 1ml of blood sample plasma was added to, 6ml of concentrated analytical grade nitric acid (HNO_3) was added. 2ml of concentrated analytical per chloric acid ($HClO_4$) with 20ml of distilled water was added to digest the

sample. The samples were evaporated in a hot plate to the lowest possible volume. 10 to 20ml of the beaker. The samples were allowed to stay on the hot plate until digestion was completed as shown by a light colour clear solution. The samples were filtered through watch man filter paper of 0.2 mm, the filtrate was transferred to a 50ml volumetric flask. Distilled water was added to a known mark. The samples were tested using the atomic absorption spectrophotometer. Results were printed out directly from the machine.

Results

This study was conducted to estimate the concentration of trace element (zinc, cobalt, selenium, copper) in thirty (30) carpenters expose to sawdust and twenty six (26) apparently healthy individual who work in an office setting far away from sawdust. Data are presented in tables below.

Table 1: Concentration of trace elements (zinc, cobalt, selenium and copper) in carpenters exposed to sawdust and control

Parameters	Carpenters exposed to sawdust. N=30	Control N= 26	T	P Value
Zinc (mg/l)	0.785 ± 0.111	0.705 ± 0.106	2.746	0.0082
Cobalt (mg/l)	0.028 ± 0.011	0.032 ± 0.023	0.848	0.4002
Selenium (mg/l)	0.303 ± 0.238	0.785±0.106	9.531	0.0001
Copper (mg/l)	0.236 ± 0.048	0.796 ± 0.172	17.103	0.0001

Zinc concentration was significantly higher in carpenters ($p<0.05$) than in control while Selenium and Copper were significantly lower in carpenters ($p<0.05$) than in control. Cobalt concentration did not differ between carpenters and control.

Table 2: Concentrations of zinc, cobalt, selenium and copper in carpenters that smoke and carpenters that do not smoke

Parameters	Carpenters that smoke N=8	Carpenters that Do not smoke N= 22	T Value	P value
Zinc (mg/l)	0.841 ± 0.076	0.763 ± 0.115	1.772	0.0872
Cobalt (mg/l)	0.027 ± 0.012	0.022 ± 0.010	1.150	0.2601
Selenium (mg/l)	0.406± 0.306	0.265 ± 0.203	1.470	0.1540
Copper (mg/l)	0.265± 0.050	0.226 ± 0.041	2.175	0.0382

In table 2, Carpenters that were exposed to sawdust who smoke cigarettes had increased zinc and copper concentration compared to carpenters that do not smoke ($P<0.05$) while cobalt and selenium concentrations in carpenters did not show any significant difference between carpenters that smoke and carpenters that do not smoke($p>0.05$)

Table 3: Concentrations of trace elements (zinc, cobalt, selenium and copper) in carpenters exposed to sawdust with reference to years of exposure.

Parameters	Carpenters exposed tosawdust between 2-8 years N=18	Carpenters that are exposed to sawdust between 9-15 years N=12	T Value	P Value
Zinc (mg/l)	0.782 ± 0.114	0.788 ± 0.112	0.142	0.8879
Cobalt (mg/l)	0.029 ± 0.011	0.025 ± 0.009	1.046	0.3045
Selenium (mg/l)	0.249 ± 0.195	0.383 ± 0.281	1.546	0.1334
Copper (mg/l)	0.248 ± 0.055	0.219 ± 0.036	1.607	0.1045

Concentrations of Zinc, Cobalt, Selenium and Copper did not differ in carpenters with increase in years of exposure to saw dust.

Discussion

The result of the study showed that zinc concentration was significantly higher in carpenters expose to sawdust than in control. Zinc metal found in every tissue of the body helps to exacerbate the effects of stress on the body. Increase zinc in carpenters expose to sawdust can be as a result of zinc in mucosa cells binding to proteins and albumin which help in transport of various materials across membranes.

In this study, copper is significantly lower in carpenters expose to sawdust than in control. This could be as result of higher concentration of zinc in carpenters expose to sawdust since zinc is an antagonist to copper [13]. Metabolism of copper is negatively influence by Zinc [14].

This study also showed that selenium was significantly higher in carpenters expose to saw dust than in control. Selenium functions as an anti-oxidant which is require for proper activity of gluthanione peroxidase, which plays a key role in the body's detoxification system and protects against oxidative stress [8].

Cobalt concentration in this study was significantly lower in carpenters expose to sawdust than in control. Cobalt plays an important role in the process of erythropoiesis which influences DNA synthesis and acceleration, stimulating heamoglobin synthesis.

In table II, this study showed that carpenters expose to sawdust that smoke had selenium concentration not different from control, this is in contrast to a research work which studied the relationship of blood selenium levels to smoking in healthy male volunteers and found lower selenium levels in whole blood and serum of cigarette smokers than of non smoker [15].

In table III, Zinc, cobalt, selenium and copper concentrations in carpenters exposed to sawdust did not differed significantly with increase in years of exposure to sawdust.

In conclusion, this study indicates that exposures to sawdust affects trace element concentrations in carpenters expose to sawdust. The concentrations of zinc, cobalt, selenium and copper are not affected by prolong exposure to saw dust.

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