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Evaluation of Serum Cd, Zn, and Cr in Male Cement Loaders in Benin City, Nigeria

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ABSTRACT: Production of cement is a dusty industrial process and its effect on the health of workers has been studied for many years. The aim of this research is to study the effects of cement dust on serum heavy metal in cement loaders in Benin City. The level of serum heavy metals: Cadmium,, Zinc and Chromium of thirty(30) male cement loaders and apparently thirty(30) healthy non-cement loaders (controls) were measured using standard methods. The results revealed that significant difference was observed in serum cadmium(0.4980mg/L) and chromium(1.220mg/L) concentration of cement factory workers exposed to cement dust when compared with control (0.4030mg/L and 0.03434mg/L respectively) at $p<0.05$). Proper safety measures such as wearing of face mask and workshop coat is thus advised to minimize the health effects of the cement dust.

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Hydraulic cement or Portland cement is one of the important construction materials needed for housing and infrastructure development manufactured from clay and limestone mixture that is calcined in kiln. Portland cement silicate is a class of hydraulic cements containing tri- and dicalcium silicate ($2CaO.SiO_2$and $3CaO.SiO_2$) in addition to aluminum, tricalcium aluminate and iron oxide. The final product usually contains silicate compounds (75% calcium silicates), 5-10% calcium aluminates, 5% calcium sulfate, 2-4% magnesium oxide, but little or no quartz.

Work in mines, quarries, foundries, and construction sites, in the manufacture of cement, ceramics, and abrasive powders, and in masonry workshops are particularly risky.

The principal compounds used in the manufacture of cement are a combination of calcium, silicon, iron, and aluminum compounds in the form of limestone and clay. These elements are detrimental to health if they find their way into the body.

The silicates are minerals in which silicon and oxygen are combined with other elements. The increased production of cement due to its high demands has led to increased risk of occupational hazard it poses to exposed workers. Production of cement is a dusty industrial process and its effect on the health of workers has been studied for many years. Most studies on the effect of cement dust (Alakija *et al.,* 1990; Noor *et al.,* 2000; Laraqui *et al.,* 2001; Al –Neaimi *et al.,* 2001; Meo *et al,* 2002; Mwaiselage *et al,* 2005) or granite dust (Azah *et al.*, 2002) exposure in humans have tended to focus on the respiratory system. However, it appears that cement dust exposure may affect other systems such as skin color, hair color and haem as well. For instance, the cement industry has the highest number of reported cases of dermatitis and conjunctivitis in Nigeria, suggesting that cement dust affects the skin and the eyes. Also evidence from experimental animals suggests that cement dust may have deleterious effects on the liver and bone. The principal compounds used in the manufacture of cement are a combination of calcium, silicon, iron, and aluminum compounds in the form of limestone and clay. These elements are detrimental to health if they find their way into the body. Because of the increasing demand for cement and associated products in Nigeria, there is a need to investigate the health risk of cement dust exposure on the workers. The Objective for this paper is to provide the evaluation of serum heavy metals (Cd, Zn, and Cr) in 30 male cement loaders and apparently 30 healthy non-cement loaders (controls) using standard methods.

MATERIALS AND METHOD

This study was carried out in the metropolitan city of Benin, Edo State formerly mid-western but now south-south Nigeria. Benin City is the current capital of Edo State with an estimated average population of 1,147,188 in the 2006 general census.

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*Sample Collection***:** Adult male and female workers within Benin City, who have consistently worked in cement stores for a minimum of one year, were selected. Subjects with deformities of the thoracic cage, vertebral column, and musculoskeletal system, known cases of neuromuscular diseases, gross anemia, diabetes mellitus, chronic obstructive pulmonary diseases, malignancy, drug addicts and cigarette smokers were excluded. Apparently healthy adult male and female not exposed to cement dust were used as control.

Sample Processing and Treatment: Males aged 25-50 years comprising of 30 cement loaders who have loaded cement for at least 3 Years and 30 apparently healthy non-cement loaders (controls) were mobilized for the study.

Statistical Analysis: The results were expressed as mean + Standard error of mean (SEM). The results were computed statistically by one way Analysis of Variance (ANOVA) using Statistical Package of Social Science (SPSS) software Version 2.0, post hoc test was performed for inter group comparison using LSD. Values of $p<0.05$ were considered statistically significant.

RESULTS AND DISCUSSION

A total of 60 subjects were studied with 30 healthy non-cement loaders (control) and 30 cement loaders subjects. All subjects completed the study. The subjects' characteristics are shown in table 1.

Table 1: Subjects Characteristics in Mean, Standard Error, and P-Values

	No of values	Heavy metal	Mean (mg/L)	Standard Error	P-Value
Control	30	Cadmium	0.4030	0.01353	P<0.0001
Experimental	30	Cadmium	0.4980	0.01804	P<0.0001
Control	30	Zinc	1.084	0.05061	P>0.01
Experimental	30	Zinc	1.152	0.06137	P>0.01
Control	30	Chromium	0.9900	0.03434	P<0.01
Experimental	30	Chromium	1.220	0.06065	P<0.01

Cement dust contains hazardous toxic metals. This study revealed an increase in the serum concentration of heavy metals which include cadmium, zinc, and chromium. This agrees with the studies of Ayaz (2013) who reported that blood samples of rats exposed to dust contain trace elements such as zinc, cadmium, selenium etc. Warnes *et al.,* (2000) reported that exposure to dust can lead to accumulation of trace elements calcium, silicon, zinc and aluminum. Cadmium is one of the major constituent of cement dust chronic exposure could increase lipid peroxidation in different tissues resulting in neurotoxicity, renal failure and anemia (Mohammadirad and Abdollahi, 2011).

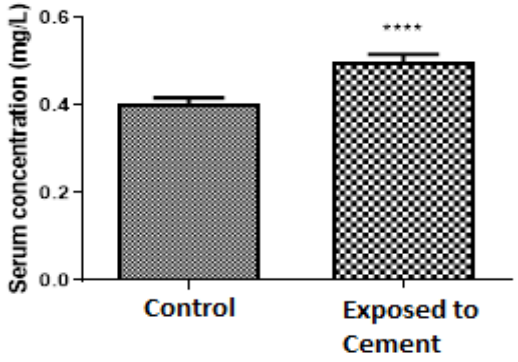

Fig 1 Cadmium concentration of cement loaders exposed to cement dust and control. There was significant increase in the cadmium concentration of cement loaders exposed to cement dust compared with control (P<0.0001).

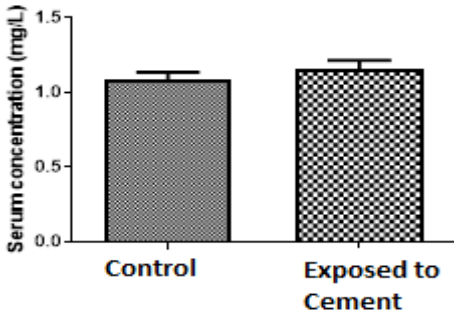

Fig 2: Zinc concentration of cement factory workers exposed to cement dust and control. There was no significant differences in the serum zinc concentration of cement loaders exposed to cement dust compared with control (p>0.05).

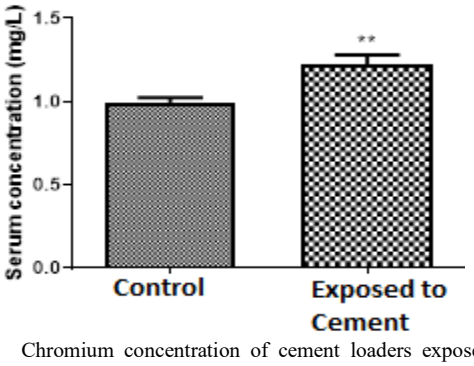

Fig 3: Chromium concentration of cement loaders exposed to cement dust and control. There was significant increase in the serum chromium concentration of cement loaders exposed to cement dust compared with control (p<0.05).

Occupational exposure to dusts has been demonstrated as a contributor to pulmonary diseases, such as asthma and bronchitis (Vermeulen *et al*., 2002). These and other negative health effects of dust exposure are widely recognized, but these exposures continue to occur globally. While workplace controls are being implemented in developed nations, little is done in the developing countries (Beaucham *et al*., 2012).

Conclusion: This study has revealed an increase in the serum level of heavy Metals such as zinc, cadmium and Chromium in cement loaders compared with control. Proper safety precautions such as wearing of face mask, and protective coats should be adhered to in order to minimize the degree of exposure to cement dust. Regular medical checkup should also be advised so as to avert any occupational health hazard.

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