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EFFECTS OF CEMENT DUST ON HAEMATOLOGICAL PARAMETERS IN ADULT WISTAR RATS

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ABSTRACT

Cement production is a rapidly growing industry in developing countries like Nigeria. The process is a dusty industrial one with consequent occupational hazards to workers in the production industry. In this study, twenty rats of mixed sexes were divided into five study groups of four rats each. Group1 was retained as control in the departmental animal house. Groups 2 to 5, which serve as treatments were exposed to very heavy, heavy, medium and mild dust environment, defined by distances from site of production in centimetres. At the end of a month exposure, the animals were sacrificed and blood tissue obtained for haematological analysis by standard methods. The results of haemoglobin concentration (g/dl) of the treatment groups were significantly lower than that of the control at $p<0.05$. The red blood cell Concentration ($x10^6$cells/μL) of the treatment groups were significantly lower than that of the control at $p<0.05$ while white blood cell Concentration ($x10^3$cells/μL) of the control at $p<0.05$ was significantly lower than that of the treatment groups.

KEYWORDS: Platelet count, Hemoglobin, packed cell volume, total red and white blood cell.

INTRODUCTION

Cement is one of the most important building materials in the world (Zeleke *et al.*, 2011). The demand for cement is directly associated to economic growth, and many growing economies are striving for rapid infrastructural development which underlines the tremendous growth in cement production (Cement sustainability initiative, 2014). A cement plant can be a significant source of air pollutants because of the components used in the production process (Zeleke *et al.*, 2011). The basic components of cement are calcium oxide, silicon dioxide, aluminum trioxide and iron oxide (Fell *et al.*, 2010). However, the burning and calcinations process of cement produces pollutants such as heavy metals, dioxins, particulates, chromium, sulfur dioxide, nitrogen dioxide and carbon dioxide (Akinola *et al.*, 2008). Due to the fact that dust is toxic to the biological system, there are pathological effects of dust, which may eventually lead to illnesses or diseases, if not controlled and abated. Exposures to cement dust have been reported to cause a decrease in blood parameters which indicates microcytic anaemia (Mojiminiyi *et al.*, 2007). Cement dust is an environmental pollutant that can cause ill health through inhalation, skin contact or eye contact, and the extent of damage depends on the duration of exposure, level of exposure and individual sensitivity (Abdul-Wahab, 2006). These pollutants have been implicated in many diseases including respiratory abnormalities, genetic disorders, haematological complication, organs and system teratogenic effects (Meo, 2004).

The human haematopoietic system is exceptionally sensitive to some environmental influences because of rapid synthesis and destruction of cells with consequent heavy metabolic demand (Fell *et al*., 2010). Blood is a fluid that transports oxygen and nutrients to the cells and carries away carbon dioxide and other waste products (Lockard and Robert, 1998). Because it has direct contact with the ambivalent environment, the respiratory system is mostly affected, as total dust deposits along the respiratory tract and might be associated with respiratory symptoms from the upper and lower airways. The thoracic fraction o the total dust may provoke local responses in the tracheobronchial region of the lung (Gardiner *et al*., 2005).

The production of cement leads to the production of cement dust which the workers are exposed to daily. A single and short term exposure to cement dust presents with little or no hazard. However, prolonged or repeated exposure depending on the duration, level of exposure and individual sensitivity have health implications on the skin, eye, respiratory and digestive, circulatory systems (Osaro *et al*, 2013). The hazardous materials in cement include alkaline compounds such as lime (calcium oxide) that are corrosive to human tissue, crystalline silica which is abrasive to the skin and damage the lungs and chromium that causes allergic reactions (Meo, 2004; Syed *et al*., 2013). Cement causes skin dryness, discomfort, irritation, dermatitis and burns due to its caustic, abrasive and drying properties (Bour *et al*., 2011). Some workers become allergic to the hexavalent chromium in the cement with the development of symptoms ranging from a mild rash to severe skin ulcers. Air borne cement dust may cause immediate or delayed inflammation, eye irritation, abrasion, red eye, chemical burns and blindness. Inhalation of cement dust may occur when workers empty bags of cement. In short term, such exposure irritates the nose and throat and can cause choking and difficulty breathing.

The sanding, grinding or cutting processes in cement production releases a large amount of cement dust which contains high level of crystalline silica and prolonged exposure can lead to silicosis (Kakooei *et al*., 2012). Some studies (Susan, 2009; Syed *et al*., 2013) indicated a link between crystalline silica exposure and lung cancer. Stern *et al*, (2001) has also reported a link between cement dust exposure with lung and laryngeal cancer. Silicosis increases the risk of tuberculosis. Individuals with lung diseases such as bronchitis, emphysema, chronic obstructive pulmonary disease can be aggravated by cement dust exposure (Ahmed and Abdullah, 2012). The hexavalent chromium content of cement has been implicated as the etiology of allergic occupational asthma that was developed by cement factory workers. Some studies showed an increase incidence of chronic kidney disease and end stage renal disease in workers exposed to respiratory crystalline silica.

MATERIALS AND METHODS

Animal breeding: Twenty five adult wistar rats weighing between 100-120g were used for the experiment. The rats were obtained from the Department of Pharmacology, University of Calabar, Calabar, Cross River State. The rats were kept to acclimatize for a period of seven days in the animal house of Faculty of Basic Medical Sciences, University of Calabar, Calabar before commencement of the experiment. Rats were fed twice daily with standard rat diet (grower) Clean water were provided in plastic water bottles with plastic nozzles.

Source of Cement dust and animal treatment: The cement dust used for this experiment was gotten from the air present at Lafarge Africa UniCem plant at Mfamosing, Akamkpa Local Government area of Cross River State. The animals were kept at the plant site to inhale cement dust for a period of 30 days (one month).

Animal sacrifice: At the end of treatment, the rats from each group were sacrificed by the chloroform inhalation method on the last day of treatment. Following sacrifice, the rats were dissected and a 2ml syringe and needle was used to draw blood samples from the heart into labeled heparinized capillary tube. The blood samples were then taken for laboratory analysis.

Determination of blood haemoglobin: Blood hemoglobin determined was carried out by the cyanomethamoglobin method of Crosby *et al*., 1954 as modified by Pla and Fritz, 1971. the ferricyanide oxides the hemoglobin to methemoglobin to form a non- toxic cyanomethemoglobin; Sodim bicarbonate was used in stabilizing the products.

Determination of haemacrite packed cell volume: The method permits determination of the volume occupied by the red blood cells in the blood. A capillary tude was filled with whole blood and spun in a centrifuge to pack the red blood cells. The haemacrit value which is the ratio of the height cells over the total height of fluid in the tube was read converted from a microheamatocrit reading device.

Estimation of total red and white blood cell counts: The red and white blood cell were counted by microscopic visual identification using appropriate diluting fluids, according to the methods of Dacie and Lewis (1975)**.**

Statistical analysis: All data collected were summarized as Mean SEM. Significant differences were determined using a Student`s t- test and ANOVA, the difference were considered significant at P <0.05.

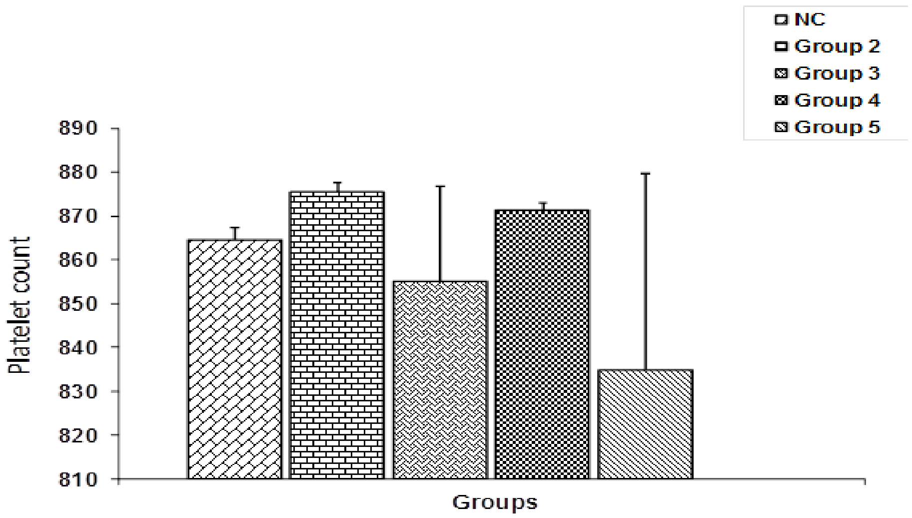

Figure 1.0 : Comparison of platelet concentrations in the different experimental groups.
Values are expressed as mean ± SEM, n = 4.

No significant difference between groups at p<0.05.

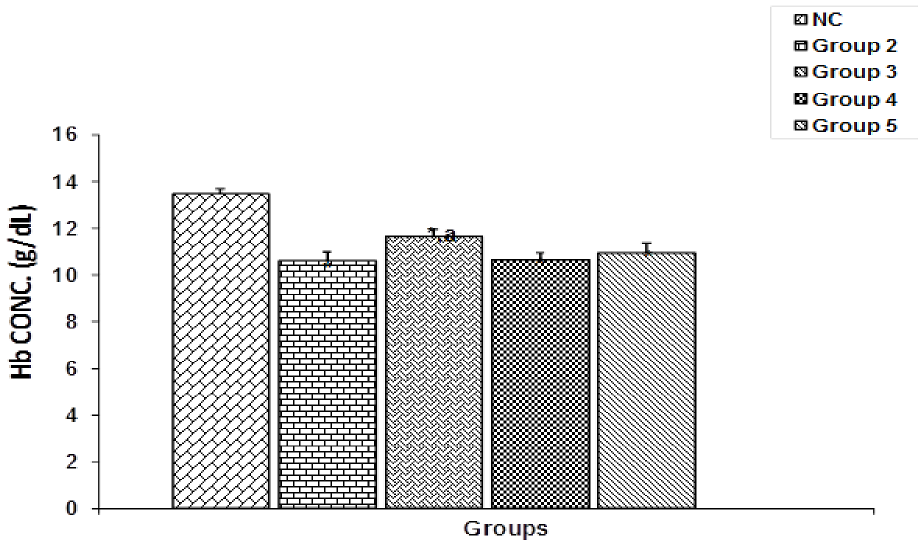

Figure 2.0: Comparison of haemoglobin concentrations in the different experimental groups.
Values are expressed as mean ± SEM, n =4.
*= significantly different from NC at p<0.05.

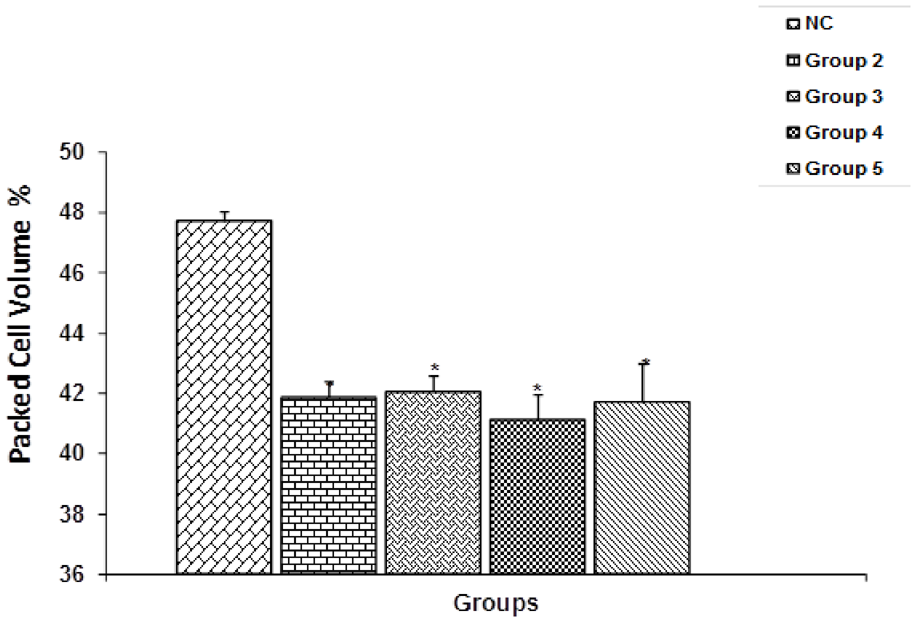

Figure 3.0: Comparison of packed cell volume in the different experimental groups.
Values are expressed as mean ± SEM, n =4
*significantly different from NC at p<0.05.

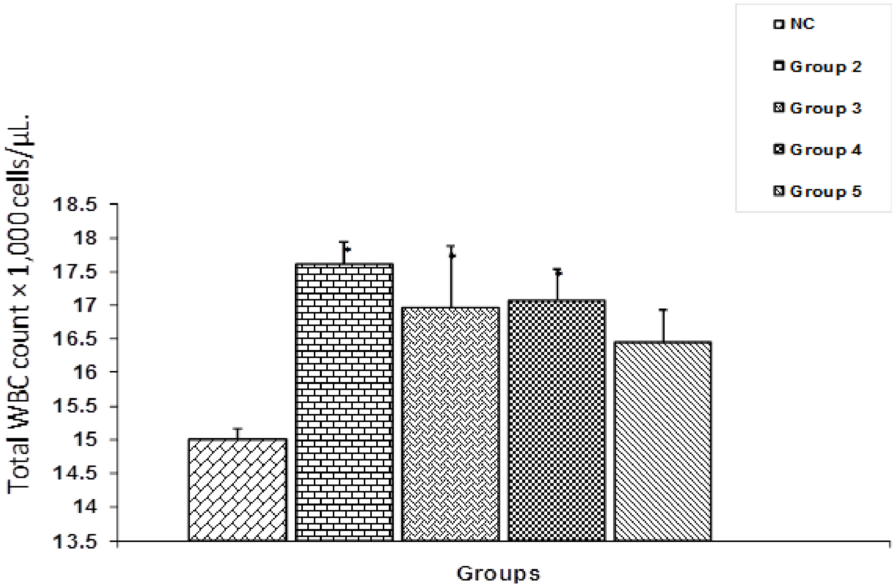

Figure 4.0: Comparison of Total white blood cells concentrations in the different experimental groups. Values are expressed as mean ± SEM, n = 4. * = significantly different from NC at p<0.05.

DISCUSSION

The study was conducted to investigate the acute effects of dust exposure on blood cells. In the present study, it was observed that red blood cell count of the control were significantly higher than that of the test groups. Also, haemoglobin content of the control were significantly higher than that of the test groups. It was also observed that the packed cell volume of the control were significantly higher than that of the test groups. The white blood cell count was significantly lower in the control than in the test groups. Haematological parameters are sensitive to changes in ecological conditions and can be used as an important diagnostic tool in toxicological studies. Decrease in RBC, HB and PCV may suggest that cement dust may have a deleterious effect on the bone marrow (Mojiminiyi *et al*., 2008), which is indicative of anaemia. An increase in WBC may be as a result of immune response triggered by the inhalation of dust into the lungs (Mojiminiyi *et al*., 2008), and as such, it is indicative of leukocytosis.

CONCLUSION

The results from this study has shown that occupational exposure to cement dust has significant effects on some haematological parameters.

Recommendations

Employees should be provided with and required to use personal protective equipments like nose masks and face shields. Also, routine medical checkups should be encouraged.

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