Evaluation of the Effect of Working Hours on Haematological Parameters among Cement Loaders in Port-Harcourt

ABSTRACT

Cement dust exposures has been reported to result in significant occupational health problems and long term complications and symptoms. This study was aimed at assessing the impact of work hours on haematological parameters of cement workers. 100 cement loaders were selected in a simple random technique from cement site and depot in Port Harcourt who have worked for at least 3months. The subjects were divided into three groups based on work hours: Group 1 which comprised 27 subjects composed of subjects with 1-5 work hours; Group 2 which had 62 subjects were subjects with 6-10 works hours; Group 3 which had 11 subjects were subjects with more than 10 work hours. Blood collected in EDTA using venipuncture method was assayed for full blood count (FBC) using haematology analyzer and Erythrocyte sedimentation rate (ESR) using Westergreen method. The results were statistically compared among the groups for test of significance using ANOVA. ESR levels among the groups were not significant (p=0.9812). WBC levels among the groups were not significant (p=0.1289). RBC levels among the classes were statistically non-significant (p=0.1038). Hb level among the classes was statistically non-significant (p=0.3408). MCV level among the classes was not significant (p=0.6768). MCH level among the classes was not significant (p=0.7109). MCHC level among the classes was statistically non-significant (p=0.9776). PLT level among the classes was not significant (p=0.9776). MPV level among the classes was not significant (p=0.1759). Lymphocyte level among the classes was not significantly different (p=0.5882). Neutrophil level among the classes was not significantly different (p=0.2244). Eosinophil level among the classes was significantly different (p=0.0544). Basophil level among the classes was not significantly different (p=0.2213). Monocyte level among the classes was not significantly different (p=0.9977). This study has shown that working hours does not have any significant effect on haematological parameters among cement loaders in Port Harcourt.

Keywords: *cement exposure, cement loaders, haematological parameter*

1.0 INTRODUCTION

The fact that the human activities on the environment in return have both beneficial and detrimental impact on human health have pointed the interests of many researchers on environmental studies especially, to study the negative impact of certain industrial activities on human health more especially in developing and industrial areas [1,2]. Heavy metal pollution is one area of interest. Researchers have revealed that presence of heavy metal in humans are often due to the interaction of humans with heavy metal exposure in the environment particularly in industrial areas without good waste management and environmental protection policies [3,4,5]. Cement is the product of the combination of limestone with quartz or other sources of silica, iron ore, aluminum, and other additives [6]. The manufacturing process involves the crushing and mixing together of these materials in a rotating kiln together with burning fuels, consisting of coal, natural gas, oil and/or alternative fuels (eg, household waste, car tyres) at a very high temperature (1450°C) [7]. A series of chemical reactions causes the materials to fuse and form

grey nodules known as ‘cement clinker’ which is mixed with gypsum and other additives, and blended to a fine powdery substance known as cement. The four key ingredients required in cement production are Calcium, Silicon, Aluminum, and iron. The main element, Calcium, can be derived from limestone. Silicon can be sourced from sand, while Aluminum and Iron can be extracted using Bauxite and Iron Ore and since a little amount is required [7]. Cements are generally used in the construction of concrete materials, bridges, houses, culverts, and other structures and functions by acting as a glue for the individual elements [8].

The production process of cement which covers the quarrying, grinding and also the blending, packing, and shipping of the cements has been known to generate large amounts of dust [9]. As a result of the nature of the ingredients used in the manufacturing process and the nature of the final product also (fine particulate powder), the cement industry is considered as a major pollution problem because of dust and particulate matter emitted at various steps of the production [10]. Previous studies show that the dust emitted from cement processing to finishing and usage impacts negatively to the health of those exposed to cement dust particles [11]. The component of cement has been shown to cause certain health defects to the subjects exposed to the dust. Findings, the exposure to cement dust brings about lungs dysfunction or damage, persistent lungs ailment, lung cancer and laryngeal cancer [12]. Aluminum (Al), iron (Fe), calcium (Ca), and silicon (Si) exposure in the workplace has been linked to lower lung function indicators in exposed employees. The pathologic processes of cement dust-induced toxicities have been identified as lipid peroxidation, oxidative damage, and immunologic pathways [13]. Cement dust exposures has been reported to result in significant occupational health problems and long term complications and symptoms. Another study reported that occupational exposure to cement dust may have a negative impact on the haemopoietic function with emphasis on the provision and use of appropriate personal protective equipment. The afore mentioned study monitored some haematological parameters namely; Packed Cell Volume (PCV), Haemoglobin (Hb), Erythrocyte Sedimentation Rate (ESR), White Cell Count (WBC) and Platelet (PLC) count of 100 workers (mean age 37.42 ± 10.14 years) who were occupationally exposed to cement dust (mean years of exposure 9.9 ±5.6 years).

A study on Biochemical and Haematological Profile in Nigerian Cement Factory Workers John and Olubayo (2011) was performed in forty-five cement factory workers and thirty control office workers. The result revealed that haemoglobulin, haematocrit concentration, Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin Concentration (MCHC), Mean Corpuscular Hemoglobin (MCH), lymphocytes and eosinophils were significantly higher in exposed group compared with controls while neutrophils were significantly lower in cement factory workers. Higher haematological profile probably support the report that cement mill workers are exposed to metals that enhance haematopoietic system other variables did not differ significantly. The study by a researcher in Ogun State, Nigeria states an increase in some haematological values and this corresponds to the work that has been carried out previously. The haematological determination of rats exposed to cement dust demonstrated reduced indices for PCV, HB, RBC, WBC as well as some proteins [14].

A research by Rahman, [11] finalized that the exposure to cement components as well as inhalation leads to problems of the respiratory system and over time can not only bring about destruction in the epithelium but also can be a source of inflammation if allowed to build up.

Exposure to cement particles in form of dust has been reported to result in various occupational health problems and long term complications [15].

2.0 MATERIALS AND METHODS

2.1 Study Design

The research design used for this study was a cross sectional study design. Convenient sampling method was used and sample size of 100 was considered. All subjects were healthy males working as cement loaders at various cement sites in Port Harcourt. The study sample was divided into three groups on the basis of working hours. Subjects who worked between 1-5hours daily for at least 3months were in group 1. Subjects who worked between 6-10hours daily for at least 3months were classified as group 2 while subjects with more than 10 working hours daily for at least 3months were categorized as group 3.Their haematological parameters were compared.

2.2 Study Area

The study area was Port Harcourt. Port Harcourt is the capital of Rivers State. It is a metropolitan city and one of the leading economically vibrate city in Nigeria. Port Harcourt, Rivers State is captured in the south-south geopolitical zone of the country.

2.3 Study Population

This study involved 100 cement loaders who worked in cement depots and shops. Subjects were classified into three groups. Group 1 had 27 subjects, Group 2 had 62 subjects and Group 3 had 11 subjects. This grouping was based on working hours of the subjects who in this case are cement loaders.

2.4 Eligibility

Inclusion Criteria

Inclusion criteria include; subjects were between 20-60years of age. Subjects gave their consent to participate in the study. Subjects were apparently health subjects after clinical assessment by trained health professional. Subjects have worked in the site for at least 3months.

Exclusion Criteria

The following were the exclusion criteria; Non-loading cement workers. Workers exposed to other kinds of toxicants. Smokers were excluded from the study

2.5 Informed Consent and Ethical Clearance

Ethical clearance to carry out this study was given by Rivers State Health Research Ethics Committee. In addition to that, prospective participants gave their consent before recruitment into the study.

2.6 Sample Collection, Transportation, Processing and Preservation

Venipucture method was used according to Cheesbrough, [16] descriptionfor sample collection. Venous blood sample of 3ml was drawn into a vacutainer blood sample container of 0.5 ml of 1.2 mg/ml ethylene diamine tetra-acetic acid (EDTA) and properly mixed for the assessment of ESR and full blood count to assay haemoglobin count, white blood cell count and white cell

indices, platelet count, platelet indices. To the laboratory for analysis, all samples were transported via cold chain.

2.7 Sampling Technique

To ensure equal sampling opportunity, simple random sampling method was adopted and subjects were selected without bias.

2.8 Sample Analyses

The study samples for complete blood count were all assayed with the use of automated machine (Mythic 22 fully auto-haematology analyzer, Kobe, Japan. Model No: MX-21N) while ESR samples were assayed using westergreen method.

Determination of Full Blood Count

Principle of the Test

The instrument performs its blood cell count function by DC detection technique. Here, blood sample was aspirated, evaluated to a predetermined degree, diluted at the precise ratio, and fed into every transducer. The chamber of the transducer has a little hole known as aperture. On either areas of the aperture, are electrodes through which direct current flows. Blood cells trapped in the diluted sample pass between this aperture and these results to a change in direct current resistance amid the electrodes. As these changes occur, the size of the blood cell is determined as electric pulses. Blood cell values are analyzeded by counting and analyzing the pulses. Then by evaluating the pulse sizes, the histogram of blood cell sizes are plotted. Through the determination of histogram, different data analyses are achieved.

The full blood count indices which were analysed are: red blood cell counts, white blood cell counts, packed cell volume, haemoglobin concentration, red cell indices (mean cell volume, mean cell haemoglobin and mean cell haemoglobin concentration), and importantly, platelet count and platelet indices (platelet distribution width and mean platelet volume).

Procedure

Here, the blood sample to be assayed was mixed up with a vortex mixer then the lid of the sample bottle was turned open and the sample inserted into the Mythic auto-analyser through the machine probe. The results of the analysis were displayed on the machine screen and were printed out after the analysis was run by the machine.

Determination of ESR using Westergreen method

Principle

When an anticoagulant is introduced to blood and the well-mixed venous blood is positioned in a vertical tube, the erythrocytes drop to the bottom, leaving pure plasma at the top. The erythrocyte sedimentation rate is the rate at which red blood cells settle in a given amount of time.

Procedure

0.4ml of trisodium citrate solution was added into a westergreen bucket, 1.6ml of blood was added to the zero “0” mark. It was stood vertically undisturbed and free from vibration for 1hour

in the Westergreen stand after which the levels of the red cell was read and results recorded in mm/hr.

2.9 Statistical analysis

From data generated from this study, descriptive statistics and ANOVA was analyzed using SPSS version 23. P-values ≤0.05 were considered significant.

RESULTS

Comparison of the Effect of Working Hours on Haematological Parameters of Control Subjects

In **Table 1**working hours were divided into three classes: 1-5hours, 6-10hours and >10hours. Changes in haematological parameters were compared among the classes. ESR level among the classes was not significant (p=0.9812) with mean value of (20.63 ±13.68; 20.40 ±13.94 and 21.27 ±13.45) respectively. The mean value for WBC level among the classes were (5.39 ±1.24; 3.84 ±1.95 and 5.52 ±2.69) but are not significant different (p=0.1289). RBC level among the classes was statistically non-significant (p=0.1038) with mean values of (5.31 ±0.74; 5.19 ±0.81; 4.68 ±1.10). Hb level among the classes was statistically non-significant (p=0.3408) with mean values of 14.60 ±1.91; 14.85 ±1.45 and 14.14 ±0.78. MCV level among the classes was not significant (p=0.6768) but has mean value of 83.57 ±4.81; 83.31 ±6.86 and 85.17 ±7.25. MCH level among the classes was not significant (p=0.7109) but has mean values of 83.57 ±4.81; 83.31 ±6.86 and 85.17 ±7.25. MCHC level among the classes was statistically non-significant (p=0.9776) the mean values for MCHC are 34.64 ±4.41; 33.97 ±5.15 and 34.25 ±1.82 respectively. PLT level among the classes was not significant (p=0.9776). MPV level among the classes was not significant (p=0.1759) with mean value of 10.76 ±0.98; 10.47 ±1.06 and 11.04 ±1.09 respectively. Lymphocyte level among the classes was not significantly different (p=0.5882) but has mean vale of 44.59 ±19.75; 37.40 ±17.96 and 37.18 ±17.51. Neutrophil level among the classes was not significantly different (p=0.2244) with mean value of 49.56 ±18.62; 67.02 ±12.06 and 54.91 ±18.98. Eosinophil level among the classes was significantly different (p=0.0544) with mean value of 3.13 ±2.30; 2.78 ±2.07 and 4.58 ±3.05 respectively. Basophil level among the classes was not significantly different (p=0.2213) with mean value of 0.93 ±0.66; 1.27 ±0.18 and 0.70 ±0.40. Monocyte level among the classes was not significantly different (p=0.9977) but has mean value of 20.40 ±13.94; 3.45 ±2.65 and 3.38 ±3.21 respectively.

Table 1 : Comparison of the Effect of Working Hours on Haematological Parameters of Exposed Subjects

Subjects	**Parameters**													
Working hours/weekly	ESR (mm/hr)	WBC ($x10^9$/L	RBC ($x10^{12}$/L)	Hb (g/dL)	MCV (fl)	MCH (pg)	MCHC (g/dL)	PLT ($x10^9$/L)	MPV (fl)	NEUT (%)	LYMP (%)	EOS (%)	BASO (%)	MONO (%)
1-5 (n=27)	20.63 ±13.68	5.39 ±1.24	5.31 ±0.74	14.60 ±1.91	83.57 ±4.81	28.46 ±3.16	34.64 ±4.41	219.20 ±75.59	10.76 ±0.98	49.56 ±18.62	44.59 ±19.75	3.13 ±2.30	0.93 ±0.66	20.40 ±13.94
6-10 (n=62)	20.40 ±13.94	3.84 ±1.95	5.19 ±0.81	14.85 ±1.45	83.31 ±6.86	28.53 ±2.76	33.97 ±5.15	216.70 ±93.23	10.47 ±1.06	67.02 ±12.06	37.40 ±17.96	2.78 ±2.07	1.27 ±0.18	3.45 ±2.65
>10 (n=11)	21.27 ±13.45	5.52 ±2.69	4.68 ±1.10	14.14 ±0.78	85.17 ±7.25	29.25 ±2.10	34.25 ±1.82	222.40 ±77.76	11.04 ±1.09	54.91 ±18.98	37.18 ±17.51	4.58 ±3.05	0.70 ±0.40	3.38 ±3.21
F value	0.0190	2.093	2.319	1.088	0.3920	0.3425	0.1928	0.0227	1.770	0.5335	1.518	3.001	1.532	0.0023
P value	0.9812	0.1289	0.1038	0.3408	0.6768	0.7109	0.8249	0.9776	0.1759	0.5882	0.2244	0.0544	0.2213	0.9977
Remark	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

DISCUSSION

Cement dust has brought about huge threat to exposed cement loaders at risk over the years. It is a grimy process which has affected the health of lives in and around the production sites. One of the main income generating jobs for little-income, strong-bodied men, is cement loading [12]. Thus so many ailments have been linked to cement dust exposure according to a research carried out on exposed cement workers in Enugu, Nigeria. Haematological changes can be brought about by the duration of cement dust exposure to cement factory workers at risk and also by the concentration of cement dust [12].

This study assessed the effect of working hours per day on the haematological parameters. There were no significant differences in the haemtologic parameters among the hourly exposure classification. This observation is in agreement with the work of [17]. The results on the effects of duration of exposure did not also give significant differences in the parameters except for WBC ($p = 0.0002$), in which the duration of 1 – 5years had significantly raised WBC counts compared to the other duration ranges. This observation may be due to immune response to the presence of irritant cement particles in the lungs [18] for the exposed subjects within that duration of exposure. Conversely, this finding is in disagreement with the work conducted by Emeka and his team who pointed that duration of exposure has an effect on haematological parameters. The concentration of cement dust on plants and animals as well as the duration of exposure determines the level or progress of damage caused. According to some research, hematological indices have proven to demonstrate significant variations based on periods and life stages [19].

Generally, exposure to dust causes alteration in blood cell counts. This can be due to allergic reactions and inflammation. This has been observed even from dust generated from Rice mill [20] A study showed that neurtrophil, eosinophil and lymphocyte count among haematological indices were significantly increased in exposed individuals compared with control group. Patil and his team thus posit that high level of dust exposure has deleterious effects on blood and tissues due to high oxidative stress [20].

It is on record that persistent aluminium exposure to cement loaders and cement factory workers at risk to cement dust can lead to anaemia but this report was not in consonance with the finding from this work which may have resulted due to sampling issue. In this study, the number of subjects in the various hours of exposure classification was not uniform or approximately the same, therefore the inequality in the number of subjects per group may have contributed to why there was no effect. Also, the degree of exposure considered in this study was on hourly basis. There will be need to assess the duration effect on long duration period such as day, weeks, months and years. At this level of exposure, there may be some degree of haematological changes since most changes and diseases are manifested over a long period of time.

CONCLUSION

This study evaluated the effect of working hours on haematological parameters among cement loaders in Port-Harcourt. The outcome revealed that there was no significant difference in the heamatologic parameters.

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