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Association of Plasma Lead with Iron Indices and Complete Blood Count among Male Bricklayers in Ibadan, Oyo State

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Authors' contributions

This work was carried out in collaboration between all authors. Author OTO participated in the conception and design of study, data analysis and interpretation, drafting of manuscript, review of the manuscript for substantial content. Author FAF participated in the conception and design of study, review of the manuscript for substantial content. Authors OOO and AA participated in the conception and design of study, data analysis and interpretation, review of the manuscript for substantial content. Authors JIA, POO and WAS participated in the conception and design of study, review of the manuscript for substantial content. All authors read and approved the final manuscript.

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ABSTRACT

Background: Analysis of cement dust by various investigators has revealed that its contents include mercury (Hg), copper (Cu), chromium (Cr), cadmium (Cd), Nickel (Ni), Manganese (Mn) and lead (Pb). Few studies done among cement factory workers in Nigeria showed conflicting results in haematological parameters which could not be related to any particular heavy metals. This necessitated the need for this study.
Objective: This study aims to relate lead level with iron indices and complete blood count among bricklayers.
Methods: Comparative cross sectional study among 45 bricklayers and 45 age and sex matched tailors. Questionnaire was administered to find out occupational practice. Plasma was analyzed for lead by Atomic Absorption spectrometer (AAS) while serum was analyzed for ferittin and iron by ELISA and photometric method respectively. Total Iron Binding Capacity (TIBC) and percentage Transferin saturation (%TFS) were derived by calculation while complete Blood Count (CBC) was determined using a Sysmex Kx21 auto-analyser.
Results: Eighty seven percent of the bricklayers practice their profession without protective coverings. There was a significant increase in the plasma level of lead (p=.00) but decrease in ferrittin among bricklayers compared with controls (p=.00).
Bricklayers with blood lead level above acceptable level (5 µg/dl) had significantly reduced ferittin (p=0.04).
Conclusion: In this study showed a relatively lower serum ferritin level among bricklayers which was more pronounced with increasing lead level. This may suggest depletion of iron store with increasing lead level. The use of protective measures such as gloves, facemasks and protective garments when in contact with cement and regular medical checkups to prevent depletion of iron store and its consequences are hereby suggested.

Keywords: Lead; iron indices; Bricklayers; complete blood count.

1. INTRODUTION

Various studies have shown high levels of heavy metals in cement dust such as Hg, Cu, Cr, Cd, Ni, Mn and Pb [1,2]. Bricklayers are exposed to cement dust and fumes in the process of emptying the cement content, mixing it for use and disposing of the bags. Most of the workers are uneducated about the toxic metals to which they might be exposed to, thereby paying little attention to protecting themselves from possible inhalation, dermal absorption or ingestion of such various toxic substances, including lead. These toxic substances may get stuck to the hands of these workers who often use their hands to eat and thereby ingested with food [3,4]. These toxic substances when present in the body may disturb iron homeostasis. Lead is a particularly pernicious element to iron metabolism, as it is taken up by the iron absorption machinery, and secondarily blocks iron through competitive inhibition [5]. Furthermore, it interferes with a number of important iron dependent metabolic steps such as heme biosynthesis [6,7].

Chronic lead exposure may cause anaemia, basophilic stippling and decreased haemoglobin synthesis [8]. Neurological effects have also been observed such as fatigue, sleep disturbance, headache, irritability, lethargy, slurred speech, convulsions, muscle weakness, ataxia, tremors and paralysis [9]. Cardiovascular and/or renal toxicity may also arise following chronic lead exposure. Hepatic damage has been reported only in a few cases following occupational exposure to lead [10].

Lead toxicity lead to anaemia by perturbing iron metabolism by several mechanisms, one of which is that it competes with iron for Divalent Metal Transporter-1 (DMT-1) in the intestine thereby inhibiting iron absorption [6].When lead is absorbed from the gastrointestinal tract; it binds to both caeruloplasmin and transferrin, thereby affecting transfer of iron to erythroblast [11]. Lead also has an inhibitory effect on aminolevulinic acid dehyratase (ALAD) and ferrochelatase and thereby impairs the chain reaction that leads to the formation of haem; this impairment results in anaemia [7].

Lead has been investigated among cement factory workers focusing mainly on their influence on pulmonary, hepatic and renal functions [3,12].

Only few studies have been conducted relating iron indices and haematological parameters with the lead levels. Some of the few studies done among cement factory workers in Nigeria showed conflicting results in haematological parameters which could not be related to any particular heavy metals [13,14]. To the best of my knowledge there are no studies done among bricklayers who are the end users of cement especially in this sub-region. Hence, the need for this study.

This study assessed the iron profile and complete blood count of bricklayers in order to assess the lead influence on the haematological parameters.

2. MATERIALS AND METHODS

The study was carried out at Ologuneru area of Ibadan, Oyo state, situated in the South West of Nigeria in West Africa. The study population consisted of 45 consecutive consenting bricklayers that were still actively involved in the profession. The controls were 45 age and sex matched consenting tailors from the same locality.

Approximately 10 mls of fasting venous blood was collected aseptically from each participant. Three milliliters of blood sample from each participant was transferred into lithium heparin bottle, while 4 mls of blood sample was put into EDTA bottle and the remaining 3 mls was put in iron-free plain bottle.

Plasma was obtained from Lithium heparin bottle after centrifugation at 3000 rpm for 15 min. The plasma was stored at -20℃ until used for analysis of plasma lead levels. Blood samples in the plain plastic tube were allowed to clot. The serum obtained from it was stored at -20℃ until analyzed for ferritin, iron and unsaturated Iron-Binding Capacity (UIBC).

Plasma lead levels were analyzed quantitatively using an Atomic Absorption spectrophotometer.

Serum Iron and UIBC were determined by photometric method using BQ Kits, San Diego, USA while TIBC was calculated from iron and UIBC, %TFS was calculated from iron and TIBC.

Serum Ferittin was determined by ELISA method using BQ Kits, San Diego, USA.

Complete blood count (CBC) was done using Coulter principle by Automated Haematology Analyser.

Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 17. The results were summarized as mean, standard deviation, ranges, frequencies, percentages proportions and barcharts.

Chi-squared test was used to investigate association between categorical variables. Difference in mean between two groups was compared using the Student's t-test. The inferential analyses were carried out using parametric methods such as Pearson correlation to test for the significance of the relationship and association between variables. Statistical significance was defined as p - value ≤ .05.

Blood lead level was categorized into < 5 µg/dl and ≥ 5 µg/dl based on the acceptable blood lead level (CDC, 2012) [15].

Iron indices were categorized into low, normal and high based on the normal reference ranges [16]. Normal reference ranges are: Ferittin =15-300µg/dl, Iron= 65-175µg/dl (for males), TIBC =250-400µg/dl, %TFS =16-50%.

3. RESULTS

3.1 Socio-demographic Characteristics of the Study Subjects

Ninety (90) participants were selected for the study comprising of 45 bricklayers and 45 tailors as controls. The mean age of the bricklayers was 35.2 ±10.8 years which matched with that of the control with mean age of 37.4 ± 11.6 years (p=.36).The age range for the bricklayers was between 22 years and 59 years while that of the controls was between 20 years and 59 years.

The bricklayers and controls did not differ significantly in marital status, 24 (53.3%) of the bricklayers were married while the other 21 (46.7%) were single. 30 (66.7%) tailors were married while 15 (33.3%) were single (p=0.20) Among the bricklayers, 13 (28.9%) had primary education, 30 (66.7%) had secondary education and only 2 (4.4%) had tertiary education while none of the controls had tertiary education. Among the tailors 12(26.6%) had primary while 33 (73.3%) had secondary education. The bricklayers and controls did not differ in marital status (*P*=0.20) and educational level (*P*=0.81).

3.2 Distribution of Use of Protective Materials among Bricklayers

Majority of the bricklayers (86.7%) did not use protective materials (Fig. 1).

3.3 Comparison of Lead, Iron Indices and Haematological Parameters between Bricklayers and Controls

The bricklayers had significantly higher plasma lead levels. Serum iron level, TIBC and %TFS did not differ significantly between the two groups. However, the controls had significantly higher mean ferritin than bricklayers (P=0.000). The values of haematological parameters were similar in both bricklayers and control (Table 1).

3.4 Distribution of Ferritin, Iron, TIBC and %TFS among Bricklayers and Controls

The mean estimates of serum ferritin were within normal range in both bricklayers and the controls; however a higher proportion of bricklayers had ferritin in the 1st quartile (*P*=0.001) (Fig. 2). The mean serum iron, TIBC and %TFS were within normal range in most bricklayers (86.7%, 93.3% and 77.8% respectively) and the controls (91.1%, 97.8% and 80%) as shown in Table 2.

3.5 Relationship of Plasma Lead Levels with Iron Indices and Haematological Parameters in Bricklayers

Ferritin, iron and %TFS showed non-significant negative correlation with plasma lead (r = 0.22, -0.19, -0.14; p = 0.15, 0.22 and 0.37 respectively). TIBC showed non-significant positive correlation with lead (r = 0.08; p = 0.58). Lead showed non-significant negative correlation with Hct, MCV, MCH and MCHC (r = -0.23, -0.00, -0.11, -0.13; p = 0.12, 0.98, 0.46, and 0.39 respectively). WBC, granulocytes, lymphocytes and mid showed non-significant positive correlation with lead (r = 0.19, 0.08, 0.23, 0.16; p = 0.21, 0.60, 0.13 and 0.29 respectively). PLT also showed a weak positive non significant correlation with lead (r = 0.17; p = 0.27).

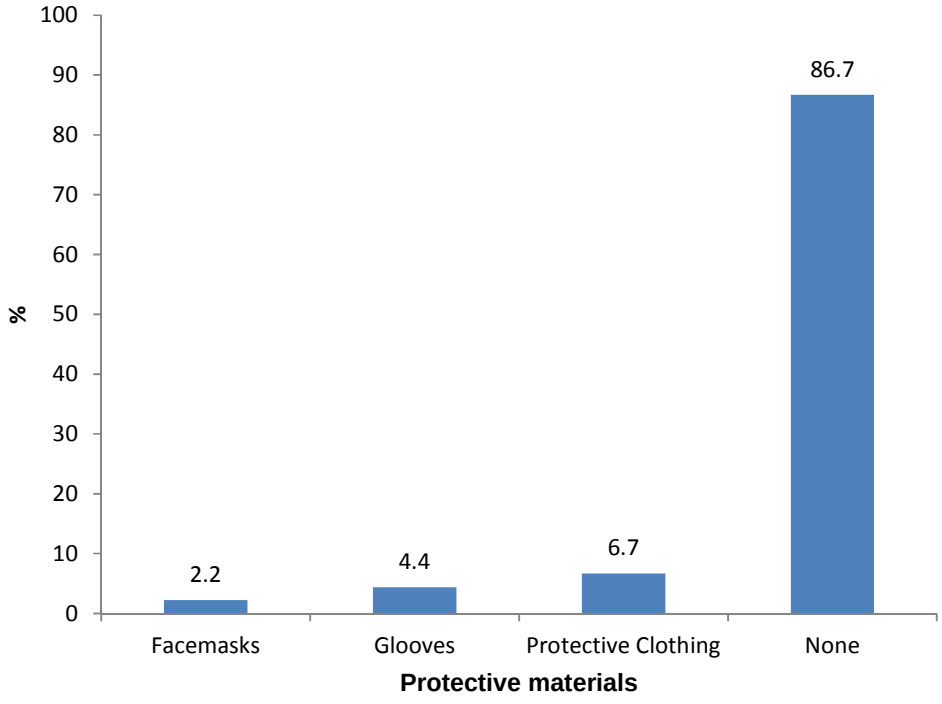

Fig. 1. Frequency distribution of usage of protective materials among bricklayers

Table 1. Comparison of plasma lead level, iron indices and haematological parameters between bricklayers and controls

Variables	Bricklayers n=45	Controls n=45	*P* value
	Mean±SD	Mean±SD	
Lead (µg/dL)	6.29±2.32	4.80±1.47	0.00
Ferritin (µg/L)	67.99±9.22	75.43±8.39	0.00
Iron (µg/dL)	109.96±34.56	121.13±38.00	0.15
TIBC (µg/dL)	345.84±36.33	331.60±38.00	0.07
%TFS (%)	32.47±11.52	37.18±11.92	0.07
Hct (%)	42.56±3.62	42.99±2.91	0.54
MCV (fL)	85.22±6.72	87.00±3.86	0.13
MCH (pg)	26.09±2.01	26.50 ±1.65	0.30
MCHC (g/dL)	30.42±1.06	30.50±0.89	0.74
WBC ($x10^9$/L)	6.06±1.69	5.93±1.47	0.69
Granulocytes ($x10^9$/L)	2.32±0.81	2.41±1.10	0.65
Lymphocytes ($x10^9$/L)	3.15±1.02	2.98±0.92	0.40
Mid ($x10^9$/L)	0.57±0.19	0.54±0.20	0.46
Platelet ($x10^9$/L)	211.58±66.73	211.38±72.08	0.99

µg/dL- microgram per deciliter, µg/L- microgram per liter, %- percentage, fL-femtoliter, pg-picogram, g/dL- gram per deciliter, Hct- Haematocrit, MCV- Mean Corpuscular Volume, MCH- Mean Corpuscular Haemoglobin, MCHC- Mean Corpuscular Haemoglobin Concentration

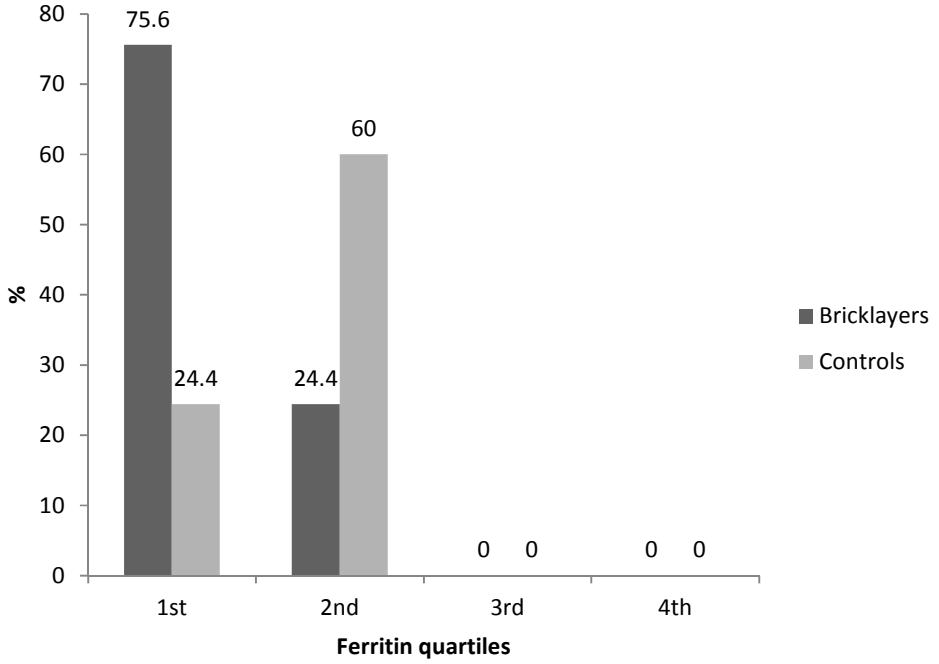

Fig. 2. Frequency distribution of quartiles of ferritin among bricklayers and controls (p=0.001)

Table 2. Frequency distribution of Iron, TIBC, %TFS among bricklayers and controls

	Iron(µg/dL)			TIBC(µg/dL)			%TFS		
	<65	65-175	>175	<250	250-400	>400	<16	16-50	>50
Bricklayers	3(6.7%)	39(86.7%)	3(6.7%)	Nil	42(93.3%)	3(6.7%)	4(8.9%)	35(77.8%)	8(18.3%)
Controls	1(2.2%)	41(91.1%)	3(6.7%)	Nil	44(97.8%)	1(2.2%)	2(4.4%)	36(80%)	7(15.6%)

3.6 Plasma Lead, Iron Indices and Haematological Parameters in Relation to Length of Time of Exposure

Comparison of plasma lead level, iron indices and haematological parameters in relation to duration of exposure as bricklayers to cement dust showed that Bricklayers who had worked for more than 5 years exhibited significantly higher plasma lead level than those who had put in 5 years or less in the job (*P*= 0.04). There was no significant difference in the iron indices and haematological parameters with the duration of occupation as bricklayer.

3.7 Iron Indices and Haematological Parameters According to Plasma Lead Levels among the Bricklayers

The ferritin level was significantly lower in bricklayers with plasma lead level ≥ 5 µg/ dL than those with lower values (65.93±8.62 vs 71.62±9.11) P-value = 0.04. The other iron indices, serum iron and %TFS were also lower in bricklayer with plasma lead level ≥ 5 µg/ dL (105.10±32.06 vs 118.75±38.17 and 31.07±11.59 vs 35.00±11.31 respectively) though not statistically significant. The haematological parameters were similar in bricklayers who had plasma lead level ≥ 5µg/ dL and < 5 µg/ dL.

4. DISCUSSION

In this study, the blood lead level in the bricklayers was higher than that found in the control. This is similar to previous report by Babalola et al. [13] among cement factory workers in Abeokuta. Similar report has also been documented among exposed individuals in Port-Harcourt [17] but in contrast with the findings of Al-Malki et al. [18] who did not find any difference in lead level among fire fighters in Saudi Arabia. The variation in lead levels among different groups might be accounted for by the concentration of lead to which they are exposed and the use or non-use of protective materials. The index study showed that only 2.2% of the bricklayers used facemasks, 4.4% used gloves and 6.7% used protective garment respectively. The lead level was higher in workers exposed for over 5 years compared to those exposed for less than 5 years. This may imply cumulative toxicity with increase duration of exposure.

In this study, there was no significant difference in iron levels as majority of the bricklayers and the controls have iron level within the reference range (86.7% and 91.1% respectively). This is in keeping with findings of Al- Malik et al. [18] among Saudi Arabia firefighters but at variance with Kim et al. [19] who found a lower iron among lead workers in Iran. However, 6.7% of the bricklayers had lower iron level than normal as compared with only 2.2% of the controls which is not statistically significant. Plasma lead level was inversely correlated to serum iron level but was not significant.

There was no significant difference in TIBC and %TFS of the bricklayers compared with controls as majority of the bricklayers had TIBC and %TFS within the reference range. In many people with mild iron deficiency, values of iron and TIBC are normal [20]. The proportion of bricklayers with iron indices suggestive of iron deficiency is higher than in control as suggested by low TFS observed in 8.9% compared to 4.4% of the control.

The serum ferritin level among the bricklayers was significantly lower than that of controls. This is further underscored by the lower serum ferittin which is worsened in those with blood lead level ≥ 5 µg/dl, suggestive of iron storage depletion probably due to iron malabsorption. This may be due to competitive action of lead against DMT I on absorption of iron from GIT or excessive loss from skin or urine due to intense nature of their job. It has been established that low serum ferritin (<12 µg/L) is diagnostic of iron deficiency [21], this index study showed that all the participants had normal ferritin but significant proportion of the bricklayers had lower ferritin in the first quartile of reference range. This might suggest possible gradual depletion of ferritin which in a matter of time will result in iron deficiency. Blood lead had inverse correlation with serum ferritin level but was not significant.

There was no significant difference found in the haematocrit of the bricklayers compared to controls which is in agreement with the finding by Jude et al. [22]. The finding in this study was in contrast to finding of Ogunbileje & Akinosun [23] who found significantly higher value of haematocrit. It is also at variance with reports by Erhabor, et al. and Guguloth et al. among cement factory workers in Sokoto and Pradesh respectively who recorded a lower value of haematocrit [14,24]. Anaemia may evolve at blood lead level of 50 µg/dL [25]. The highest

level of lead in this study was 12 µg/dL. Concentration of the toxic metals in the cement to which the bricklayers are exposed to may be lower than that of cement factory workers. Plasma lead had inverse correlation with Hct level but was not significant.

The red cell indices- MCV, MCH and MCHC did not defer significantly between bricklayers and the controls, which is similar to findings in previous study [23]. Even though iron store seem distorted by the metals, plasma iron level is still adequate to support haemopoeisis. Plasma lead had inverse correlation with red cell indices but was not significant.

Higher white cell and lymphocyte counts observed among the bricklayers were not statistically significant. Platelet count follow similar pattern. These findings are similar to reports by previous studies [23,26] but at variance with Mojimoniyi et al. [27] who found a significant higher value for WBC and PLT among those exposed to cement dust. This might be due to lower number of subjects in this study as opposed to 100 individuals in Mojimoniyi's study. Lead had non-significant positive correlation with WBC, WBC differential and PLT.

This study established that the bricklayers were at risk of having high level of lead which could predispose them to low iron store and could be heighten by duration of exposure.

5. CONCLUSION

A relatively lower serum ferritin level was found among bricklayers which were pronounced with increasing blood lead level. This may suggest depletion of iron store by increase in lead level.

6. LIMITATION OF THE STUDY

Limitations of the study may include inability to determine serum transferrin receptor and bone marrow assessment for iron store. Inability to assess Aminolevulinic acid and basophilic stippling in red cells which is an indicator of lead poisoning. Also, inability to assay other acute phase reactants to discard inflammatory process that can affect ferritin level.

7. RECOMMENDATION

1. The use of protective measures such as gloves, facemasks and protective garments when in contact with cement is recommended for bricklayers to protect them from toxic effect of lead in cement.
2. Iron profile of bricklayers should be monitored to avoid iron deficiency.
3. It is recommended that iron status of bricklayers be determined when considering blood donation as they might require iron supplement after blood donation.

CONSENT

Informed written consent was obtained from all the participants.

ETHICAL APPROVAL

Ethical approval from the University of Ibadan/ University College Hospital (UI/UCH) ethics committee (UI/EC/14/0042).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Gbadebo AM, Bankole OD. Analysis of potential toxic metals in airborne cement dust around Sagamu, South Western Nigerian. Journal of Applied Sciences. 2007;7(1):35-40.
2. Ogunbileje JO, Sadagoparamanujam VM, Anetor JI, Farombi EO, Akinosun OM, Okorodudu AO. Lead, mercury, cadmium, chromium, nickel, copper, zinc, calcium, iron, manganese and chromium (VI) levels in Nigeria and United States of America cement dust. Chemosphere. 2013;90(11): 2743-2749.
3. Benner A, Almehdi AM, Alwash R, Al-Neamy FR. A pilot survey of blood lead levels in various types of workers in the United Arab Emirates. Environmental International. 2001;27(4):311-314.
4. Higemengist AG, Dejene AT, Argaw A. Elevated blood lead levels among unskilled construction workers in Jimma, Ethiopia. Journal of Occupational Medicine and Toxicology. 2014;9:12-22.

5. Amal AH, Mana MZ, Manal AA, Amal AM, Raya AS. Relation between anemia and blood levels of lead, copper, zinc and iron among children. BioMed Central Research Notes. 2010;3:133.
6. Bannon BI, Abounader R, Lees PSJ, Bressler JP. Effect of DMT1 knockdown on iron, cadmium, and lead uptake in Caco-2 cells. American Journal of Physiology Cell Physiology. 2003;284(1):C44-C50.
7. Patrick L. Lead toxicity Part II: The role of free radical damage and the use of antioxidants in the pathology and treatment of lead toxicity. Alternative Medicine Review. 2006;11(2):114-127.
8. Orisakwe OE. Environmental pollution and blood lead levels in Nigeria: Who is un-exposed. International Journal of Occupational and Environmental Health. 2009;15(3):315-317.
9. Worwood M, Hoffbrand AV. Iron metabolism, iron deficiency and disorders of haem synthesis. In: Hoffbrand AV, Catovsky D, Tuddenham EGD editors. Postgraduate Haematology. 6th ed. Oxford; UK. Blackwell Publishing Ltd; 2006.
10. Needleman H. Lead poisonining. Annual Review of Medicine. 2004;55:209-222.
11. Keramati MR, Nemai-Ghasemi M, Balali-Mood M. Correlation between iron deficiency and lead intoxication in the workers of a car battery manufacturer. Journal of Birjand University of Medical Sciences. 2009;16(1):51-58.
12. Gbadebo AM, Bankole OD. Analysis of potential toxic metals in airborne cement dust around Sagamu, South Western Nigerian. Journal of Applied of Applied Sciences. 2007;7(1):35-40.
13. Babalola OO, Babajide SO. Selected heavy metals and electrolyte levels in blood of workers and residents of industrial communities. African Journal of Biochemistry Research. 2009;3(3):037-040.
14. Ogunbileje JO, Akinosun MO. Biochemical and haematological profile in nigerian cement factory workers. Research Journal of Environmental Toxicology. 2011;5:133-140.
15. Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP). CDC. May 2012. Retrieved 18 May 2012.
16. Worwood M, Alison M. Iron deficiency and iron overload. In Bain BJ, Bates I, Laffan MA, Lewis SM, editors. 10th ed. Practical Haematology. Churchill Livingstone, UK: Elsevier; 2012.
17. Alasia DD, Emem-Chioma PC, Wokoma FS. Occupational and environmental lead exposure in Port Harcourt, Nigeria: Analysis of its association with renal function indices. Nigerian Medical Journal. 2010;19(4):407-414.
18. Al-Malki AL. Serum heavy metals and hemoglobin related compounds in Saudi Arabia firefighters. Journal of Occupational Medicine and Toxicology. 2009;4:18-23.
19. Kim HS, Lee SS, Hwangbo Y, Ahn KD, Lee BK. Cross-sectional study of blood lead effects on iron status in Korean lead workers. Nutrition. 2003;19(7-8):571-576.
20. Higgins T, Eckfeldt JH, Barton JC, Doumas BT. Haemoglobin, iron and bilirubin. In Burtis CA, Ashwood ER, Bruns DE. Tietz Textbook of clinical Chemistry & Molcular Diagnostics. W.A. Saunders Company; 2012.
21. Fairbarks VF, Klee GG. Biochemical aspect of haematology. In: Burtis CA, Ashwood ER, editors. Tietz Fundamentals of Clinical Chemistry. WB Sauders Company; 2006.
22. Jude ALC, Sasikala K, Kumar RA, Sudha S, Raichel J. Haematological and cytogenetic studies in workers occupationally exposed to cement dust. International Journal of Human Genetics. 2002;2(2):95-99.
23. Erhabor O, Kebbe BI, Isaac IZ, Yakubu A, Marafa Y, Okwesili AN, et al. Effect of occupational exposure of cement dust on some haematological parameters of workers in a cement company in Sokoto, Nigeria. International Journal of Medical Sciences and Health Care. 2013;1(7):21-25.
24. Guguloth MR, Sambanaik A, Srinivasnaik L, Mude J. The effect of cement dust exposure on haematological parameters of cement factory workers in Nalagonda, Andhra Pradesh. International Journal of Advancements in Research & Technology. 2012;1(5):1-7.
25. Kosnett MJ. Lead, In Brent J, Critical care toxicology: Diagnosis and management of the critically poisoned patient, Gulf Professional Publishing; 2005.
26. Dler MS, Sirwan MM, Loqman OHS. Some biochemical and hematological parameters among petroleum and cement factory

workers in Sulaimaniyah City/Kurdistan/ Iraq. Chemistry and Materials Research. 2014;6(8):29-32.

27. Mojiminiyi FB, Merenu IA, Ibrahim MT, Njoku CH. The effect of cement dust exposure on haematological and liver function parameters of cement factory workers in Sokoto, Nigeria. Nigerian Journal of Physiological Sciences. 2008; 23(1-2): 111-114.

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