RESEARCH ARTICLE

Evaluation of some haematological, liver, and renal function biomarkers in different job categories at Kufa cement factory workers: a cross-sectional study

Farah Shaker Abdel Wahed, Zaid Makki Mohammed Al-Hakkak

Abstract

Objective: To evaluate the workplace health-related environment of workers in various job categories at a cement factory.

Method: The cross-sectional study was conducted at the Kufa Cement Factory, Najaf, Iraq, from November 12, 2021, to January 12, 2022 and comprised adult male non-smoking factory workers in group A, and healthy, unexposed non-smokers in control group B. Subjects in group A were subdivided into factory, kiln and packing workers. All the participants were subjected to blood tests for liver and kidney functions. Data was analysed using SPSS 27.

Results: Of the 90 subjects, 45(50%) were each of the 2 groups. The mean age of group A workers was 46.581±1.559 years and they had a mean duration of exposure 15.953±0.873 years. There were 15(33.3%) factory workers and as many kiln and packing workers. Group A subjects worked for at least 7-8 hours per day. The subjects in control group B had a mean age of 45.01±8.17 years and were matched for gender. There was significant elevation in total leukocyte count, alkaline phosphatase, aspartate aminotransferase and alanine aminotransferase in group A compared to group B ($p<0.05$). Neutrophils were significantly high in factory workers than controls and packing workers ($p<0.05$), while total bilirubin level was significantly high in factory and kiln workers than controls ($p<0.05$). There was no significant difference in the mean serum creatinine level between the groups ($p>0.05$).

Conclusion: Workplace exposure to cement particulate in a factory environment was found to have a harmful impact on health.

Key Words: Alanine Transaminase, Alkaline Phosphatase, Creatinine, Neutrophils, Liver, Leukocyte, Aspartate Aminotransferases, Hematologic, Bilirubin, Kidney

(JPMA 74: S237 (Supple-8); 2024) **DOI: https://doi.org/10.47391/JPMA-BAGH-16-53**

Introduction

Cement particulates floating in the environment of cement plants as a result of various industrial processes directly affect the health of workers as well as of the community at large owing the passive inhalation of pollutants in the air, especially dust pollutants and gaseous pollutants that include sulphur oxides (SOx), nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons and fumes[1].

Studies have revealed that increased exposure to cement particulates can lead to inflammatory reactions, oxidation damage, as well as damage to liver, kidney and lungs [2,3]. A study noted the toxic effects of cement particulates on blood and liver in workers at a cement plant, and found that silica and chromium components of cement induced inflammatory responses and affected the immune system, the respiratory system, skin and liver[4,5].

Inhalation of cement dust caused lung defects, fibrosis and inflammatory response[6]. High exposure to cement particulates leads to phlegm production and cough, chest tightness, decreased lung function, lung disease, fibrosis, and lung carcinoma[7].

The current study was planned to assess the impact of cement dust exposure on blood parameters, liver and kidney functions among cement plant workers.

Subjects and Methods

The cross-sectional study was conducted at the Kufa Cement Factory, Najaf, Iraq, from November 12, 2021, to January 12, 2022, Kufa Cement Factory in Iraq. After approval from the local ethics central committee, University of Kufa, the sample size was calculated using G*power version 3.1.9.2.[8] The sample was raised using convenience sampling technique. Those included were adult male non-smoking factory workers in group A, and healthy, unexposed non-smokers in control group B. Subjects in group A were subdivided into factory, kiln and packing workers. After taking consent from the participants venous 5ml blood samples were collected; 2ml was put in ethylenediaminetetraacetic (EDTA) acid tubes for the measurement of haematological

Department of Ecology and Pollution, University of Kufa, Kufa, Iraq.

Correspondence: Zaid Makki Mohammed Al-Hakkak

Email: zaid.alhakkak@uokufa.edu.iq

parameters, while 3ml was placed in another tube for testing liver and kidney functions. The latter tubes were centrifuged for 5 minutes at 3000rpm to separate the serum that was kept in fresh tubes, and divided into portions before being stored at -20˚C for the evaluation of liver and kidney functions.

Haematological parameters were analysed at the laboratory of Al-Sadder Hospital using a fully automated haematology analyser (Mythic 18, Ringelsan Co., Turkey).

Liver function parameters, such as alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total protein, serum albumin and total serum Bilirubin, as well as kidney function parameters, such as creatinine and urea, were analysed using a fully automatic analyser (Ds-261, Sinnowa Medical Sciences & Technology Co. Ltd., Jiangsu, China) at the Al-Safeer Laboratory.

Data was analysed using SPSS 27. T-test with analysis of variance (ANOVA) were used. Data was expressed as frequencies and percentages as well as mean ± Standard error of mean (SE). P<0.05 was considered significant[9].

Results

Of the 90 subjects, 45(50%) were each of the 2 groups. The mean age of group A workers was 46.581±1.559 years and they had a mean duration of exposure 15.953±0.873 years. There were 15(33.3%) factory workers and as many kiln and packing workers. Group A subjects worked for at least 7-8 hours per day. The subjects in control group B had a mean age of 45.01±8.17 years and were all males.

There was significant elevation in total leukocyte count (TLC) in group A compared to group B (p<0.05). Neutrophils were significantly high in factory workers than controls and packing workers (p<0.05). There was significant elevation in lymphocytes and monocytes in factory workers compared to controls (p<0.05), while there were significantly lower eosinophils and basophils in group A compared group B (Table 1).

Table-1: Total and differential counts of leukocytes in the study groups and subgroups.

Parameters	Control subjects (n=45)	Cement workers (n= 45)			
		Cement mill workers (n=15)	Cement kiln workers (n=15)	Cement packing workers (n=15)	Normal values
	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	
Total leukocytes count (cell/mm^3)	5.616±0.0477	11.36±0.665^a	7.908±0.111^{ab}	7.536±0.182^{ab}	4000-11000
Neutrophils (%)	58.02±1.479	65.12±1.476^a	58.12±1.04	52.78±0.997^{ab}	50-70
Lymphocytes (%)	36.6±1.693	40.613±0.96^a	39.38±1.02	33.846±0.213^{abc}	25-35
Monocytes (%)	5.353±0.411	6.8±0.208^a	6.26±0.131^a	5.44±0.182	4-6
Eosinophils (%)	3.6±0.558	2.506±0.22^a	2.053±0.225^a	2.033±0.201^{ab}	1-3
Basophils (%)	0.9±0.06	0.626±0.068^a	0.473±0.058^{ab}	0.506±0.064^{ab}	0-1

SEM: Standard error of the mean. a: Statistically significant compared to controls, b: Statistically significant compared to cement factory workers, c: Statistically significant compared to kiln workers.

Table-2: Liver functionality in the study groups and subgroups.

Parameters	Control subjects (n=45)	Cement workers (n= 45)			
		Cement mill workers (n=15)	Cement kiln workers (n=15)	Cement packing workers (n=15)	Normal values
	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	
Alkaline phosphatase (U/L)	89.86±1.95	194.61±3.29^a	146.09±6.79^{ab}	119.60±3.92^{abc}	45-115
Aspartate aminotransferase (U/L)	24.2±1.002	57.57±1.73^a	43.08±1.405^{ab}	32.04±0.938^{abc}	8-48
Alanine aminotransferase (U/L)	23.146±1.385	75.96±5.633^a	36.94±0.71^{ab}	33.958±1.317^{abc}	7-55
Total bilirubin (mg/dL)	0.706±0.033	3.51±0.19^a	2.66±0.057^{ab}	1.34±0.11^{abc}	0.0-1.4

SEM: Standard error of the mean. a: Statistically significant compared to controls, b: Statistically significant compared to cement factory workers, c: Statistically significant compared to kiln workers.

Table-3: Mean kidney function test (KFT) indices of the study groups and subgroups.

Parameters	Control subjects (n=45)	Cement workers (n= 45)			
		Cement mill workers (n=15)	Cement kiln workers (n=15)	Cement packing workers (n=15)	Normal values
	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	
Serum creatinine (mg/dL)	0.853±0.046	0.94±0.036	0.853±0.013	0.766±0.012	0.7-1.5
Serum urea (mg/dL)	32±2.181	33.02±0.739	28.6±0.955	26.26±0.679^{abc}	13-45
Uric acid (mg/dL)	4.64±0.109	7.146±0.322^a	6.12±0.038^{ab}	4.587±0.0533^{bc}	3.5-7

SEM: Standard error of the mean. a: Statistically significant compared to controls, b: Statistically significant compared to cement factory workers, c: Statistically significant compared to kiln workers.

With regard to liver functions, ALP, AST, ALP and total bilirubin levels were significantly raised in group A compared to group B, while within group A, the levels were significantly higher among factory workers compared to kiln and packaging workers (Table 2)

There was no significant difference in the mean creatinine and urea levels between the groups (p>0.05), but uric acid level of factory and kiln workers were significantly elevated compared to group B controls (Table 3).

Discussion

The current study found a significant increment in TLC between the groups, and the finding agreed with earlier results[10] reporting that exposure to cement particulates caused an increment in the white blood cells (WBCs), which might be attributed to airway inflammation. Also, elevated WBCs may be due to the reaction of the irritating cement particulates settled in the lung[11]. The exposure to wheat flour dust also causes airway inflammation[12].

Concerning differential leukocyte count, a significant increment was noted in neutrophils in the workers compared to the controls. Similar findings were recorded earlier which concluded that excessive exposure to components that are toxic to particulate cement (crystalline silica, hexavalent chromium, calcium oxide, aluminium) induce inflammatory response, leading to the collection of neutrophils, macrophage and lymphocytes in the lungs [13,14].

The current study also recorded significantly high lymphocytes and monocytes in the workers compared to the controls. This finding agreed with earlier studies[15,16]. Inhalation of cement causes immune responses and reactions that may have led to lymphocytosis in the cement workers[17]. The current findings suggested that occupational exposure to cement may lead to allergic reactions because cement dust contains allergens that may cross-react. The basic functions of eosinophils are disintegration, detoxification and removal of foreign particles.

The current study found a significant increment in ALP, AST and ALT levels in group A compared to control group B. Similar results were reported for ALP and ALT catalase in cement plant workers[18]. The increase in AST and ALT catalase indicated that workers were more sensitive to liver injury, which harms the liver[19]. The study suggests that excessive exposure to particulate cement impairs blood and hepatic cell membrane.

The current study noted no significant change in the mean serum creatinine in cement plant workers compared to the controls. Significantly higher serum creatinine suggests kidney overload and failure[20]. Exposure to silica causes an elevation in urea and creatinine concentrations, suggesting that cement particulate lead to a nephrotoxic effect[21]. Particulates of cement have cause negative impact on neurological symptoms, lung, heart, liver and spleen[22]. Increased total bilirubin, or hyperbilirubinemia, in cement workers may result from increased bilirubin production from haemolysis. Also, the increment in plasma bilirubin level could lead to liver portal necrosis[23].

Moreover, exposure to heavy metals causes significantly increased kidney function parameters, such as blood urea, serum uric acid and serum creatinine, and that may lead to slight nephrotoxicity.

Conclusion

Exposure to high concentrations of cement particulates in the workplace of different sections of the cement plant was found to have a negative impact on the health of cement factory workers.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. Shanshal SA, Al-Qazaz HK. Spirometric Outcomes and Oxidative Stress Among Cement Factory Workers: Results From a Cross-Sectional Study. J Occup Environ Med 2020;62:e581-5. doi: 10.1097/JOM.0000000000001991.
2. Richard EE, Augusta Chinyere NA, Jeremaiah OS, Opara UC, Henrieta EM, Ifunanya ED. Cement Dust Exposure and Perturbations in Some Elements and Lung and Liver Functions of Cement Factory Workers. J Toxicol 2016;2016:6104719. doi: 10.1155/2016/6104719.
3. Emmanuel TF, Ibiam UA, Okaka AN, Alabi OJ. Effects of cement dust on the hematological parameters in Obajana cement factory workers. Eur Sci J 2015;11:256-66.
4. Sameen AM. Study the effect of cement dust exposure on liver and kidney parameters in some cement field workers in Al-Ramadi City. Journal of University of Anbar for Pure Science (JUAPS) 2013;7:1-5.
5. Omini IO, Akpgomeh BA. The Effect of Limestone, Crush Rock and Asbestos/Cement Dust Particles on the Ventilatory Function Parameters of Chronically-Exposed Workers in Calabar Municipality and Akamkpa Local Government Areas of Calabar, Cross River State, Nigeria. J Med Lab Sci 2007;16:46899. DOI: 10.4314/jmls.v16i1.46899.
6. Meo SA, Azeem MA, Arian SA, Subhan MM. Hematological changes in cement mill workers. Saudi Med J 2002;23:1386-9.
7. Baccarelli AA, Zheng Y, Zhang X, Chang D, Liu L, Wolf KR, et al. Air pollution exposure and lung function in highly exposed subjects in Beijing, China: a repeated-measure study. Part Fibre Toxicol 2014;11:51. doi: 10.1186/s12989-014-0051-7.
8. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. Behav Res Methods 2009;41:1149-60. doi: 10.3758/BRM.41.4.1149.
9. Daniel WW. Biostatistics: Basic Concepts and Methodology for the

Health Sciences. 9th ed. John Wiley & Sons Ltd; 2009.
10. Emmanuel TF, Ibiam UA, Okaka AN, Alabi OJ. Effects of cement dust on the hematological parameters in Obajana cement factory workers. Eur Sci J 2015;11:256-66.
11. Ali NK, Ali IS, Abdullah AH, Abass KS. Estimation of some hematological parameters among cement factory workers in Kirkuk City. Eurasian J Biosci 2020;14:4575-9.
12. Farheen A, Hazari MA, Khatoon F, Sultana F, Qudsiya SM. Hematological parameters are acutely effected by cement dust exposure in construction workers. Ann Med Physiol 2017;1:31-5.
13. Okonkwo CO, Ugwu CE, Anakor AC, Dike CC, Nwobodo E. The effects of cement dust on hematological parameters of cement workers in Asaba, Delta State, Nigeria. IOSR J Environ Sci Toxicol Food Technol 2015;9:5-8.
14. Schwartz J, Weiss ST. Host and environmental factors influencing the peripheral blood leukocyte count. Am J Epidemiol 1991;134:1402-9. doi: 10.1093/oxfordjournals.aje.a116045.
15. Al Salhen KS. Assessment of oxidative stress, haematological, kidney and liver function parameters of Libyan cement factory workers. J Am Sci 2014;10:58-65.
16. Malekirad AA, Rahzani K, Ahmadi M, Rezaei M, Abdollahi M, Shahrjerdi S, et al. Evaluation of oxidative stress, blood parameters, and neurocognitive status in cement factory workers. Toxin Rev 2021;40:1128-34.
17. Jude AC, Sasikala K, Kumar RA, Sudha S, Raichel J. Haematological and cytogenetic studies in workers occupationally exposed to cement dust. Int J Hum Genet 2002;2:95-9.
18. Ogunbileje JO, Akinosun OM, Arinola OG, Akinduti PA. Immunoglobulin classes (IgG, IgA, IgM and IgE) and liver function tests in Nigerian cement factory workers. Researcher 2010;2:55-8.
19. Steenland K, Rosenman K, Socie E, Valiante D. Silicosis and end-stage renal disease. Scand J Work Environ Health 2002;28:439-42. doi: 10.5271/sjweh.696.
20. Ansari FA, Bihari V, Rastogi SK, Ashquin M, Ahmad I. Environmental health survey in asbestos cement sheets manufacturing industry. Indian J Occup Environ Med 2007;11:15-20. doi: 10.4103/0019-5278.32459.
21. 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. Niger J Physiol Sci 2008;23:111-4. doi: 10.4314/njps.v23i1-2.54945.
22. Dongre NN, Suryakar AN, Patil AJ, Rathi DB. Occupational Lead Exposure In Automobile Workers In North Karnataka (India): Effect On Liver And Kidney Functions. Al Ameen J Med Sci 2010;3:284-92.
23. Akinola MO, Okwok NA, Yahaya T. The effects of cement dust on albino rats (Rattusnorvegicus) around West African portland cement factory in Sagamu, Ogun state, Nigeria. Res J Environ Toxicol 2008;2:1-8.