IOSR Journal Of Pharmacy and Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 20, Issue 4 Ser. 3 (July. – August. 2025), PP 05-09
www.Iosrjournals.Org

Study of Repeated Susceptibility to Cement Dirt Exposure And Its Persistent Consequences on Allergic and Inflammatory Markers Among Male Cement Handlers at Dalmia Bharat Cement Plant

Zamiruddin Ansari*[1], Jairam Jaiswal[1], Shahbaz Uddin Ansari[2]
[1]Department Of Biochemistry, Shyamlal Chandrashekhar Medical College, Khagaria-851205, Bihar, India
[2]M.E (Health, Safety And Environment Engineering), Chandigarh University, Chandigarh, India

Abstract
Background: *According to the current study, cement male handlers at Dalmia Bharat Cement Plant had persistent effects of cement dirt exposure on certain allergic and inflammatory markers. The study found that repeated and protracted exposure, depending on sensitivity and duration; have led to environmental health risks, detrimental health conditions specifically allergic hypersensitivity reactions, inflammatory harm among factory workers due to toxic cement dirt exposure.*
Materials and Methods: *The study involved a total of 120 participants. Among participants, 60 were workers directly exposed to cement dirt, referred to as Cement Handlers (CH), due to their job responsibilities over the past eight years. The remaining 60 participants, who had no exposure to cement dirt, served as controls and were classified as Non-Cement Handlers (NCH), consisting of office staff within the same factory. Cement handlers were susceptible to cement dirt for about 8 hours each day, weekly 6 days. Blood specimens were collected by paramedical staff at the plant and were transferred to vacationers and quickly sent to a clinical laboratory for analysis, where allergic and inflammatory markers namely total serum Immunoglobulin E (IgE), highly sensitive C-reactive protein (hs-CRP) in serum along with total and differential count of white blood cells (WBCs) in whole blood was determined.*
Results: *Results of current study unveiled environmental pollution mediated occupational health risk potentially triggering an immune response as well as inflammatory reactions that had been significantly associated with increase in total serum immunoglobulin E (IgE) and eosinophil's (allergic response) along with increase in total and differential count of white blood cells and high sensitive C-reactive protein (inflammatory markers) among cement handlers (CH) when compared with non-cement handlers (NCH) as persons control of Dalmia Bharat Cement Plant. Cellular indicators of persistent tissue inflammation are thought to be WBCs.*
Conclusion: *The study's conclusion finds positive association of cement dirt exposure with allergic consequences, IgE mediated hypersensitivity reaction and inflammatory nemesis among cement handlers (CH) when compared with non-cement handlers (NCH) as persons control of Dalmia Bharat Cement Plant.*
Key Word: *Cement dirt, Environmental pollution, Allergic inflammatory markers, Factory workers.*

Date of Submission: 03-08-2025 Date of Acceptance: 13-08-2025

I. Introduction

An intolerable number of health problems, have always been caused by environmental pollution important lytoxic cement dirt. Due to persistently high levels of construction development activity, the emerging market has seen an increase in demand for cement manufacturing [1–3]. The cement industry contributes to pollution in the environment [4]. The many stages of cement manufacture, such as clinker cooling, raw material grinding, rotating kilns, packaging facilities, and storage units, produce dirt and other airborne particles [5–6]. Lime, silica, alumina, and iron oxides make up the majority of the basic ingredients required to make cement [7]. Silica exposure can cause acute silicosis; can trigger inflammatory reactions and other detrimental effects on many bodily organs from occupational exposures [8]. Exposure to cement dirt has been a growing issue and is the cause of allergic consequences, respiratory disorders [9–10]. Additionally, toxic cement dirt damages many human organs through inflammation. Cement dirt enters our bodies by eating, inhalation, and epidermal exposures, to a lesser degree. Dirt susceptibility is linked to immunoglobulin (IgE) mediated hypersensitivity reactions [11]. Cement dirt has deleterious effects on humeral immune system. Increased mortality was found in some studies due to inflammation associated with leukocytosis. The significant higher level of IgE in cement workers was measured [12]. Persistent allergic response to cement dust

results in anaphylactic reaction. Cement dust irritates the respiratory system, the skin, and the mucous membranes of the eyes [13]. It affects the oral cavity as well as the eyes. Inflammation of the gums, the development of Dental caries, calculus and pockets, and non-carious tooth surface loss are the most often reported symptoms in the oral cavity of cement industry workers [14]. A key strength of this research is its novel approach in assessing the long-term and detrimental effects of cement dust exposure, an area that has not been sufficiently explored.

II. Material And Methods

The study involved a total of 120 participants from the Dalmia Bharat Cement Plant located in Kalyanpur, Banjari -821303, Bihar, India. Among participants, 60 were workers directly exposed to cement dirt, referred to as cement handlers (CH), due to their job responsibilities over the past eight years. The remaining 60 participants, who had no exposure to cement dirt, served as controls and were classified as non-cement handlers (NCH), consisting of office staff within the same factory. The participants had been employed in the cement industry for an average of 94.15 months (±3.85 months), which is approximately 7.85 years. Cement handlers were susceptible to cement dirt for about 8 hours each day, weekly 6 days. Blood specimens were collected after clotting by paramedical staff at the plant. Total of 5 ml of blood was drawn from each participant during fasting state, between 7:00 and 9:00 AM, using the vein-puncture technique. These blood samples were transferred to vacationers and quickly sent to a clinical laboratory for analysis, where allergic and inflammatory biomarkers were assessed. Total and differential count of White blood cells (WBCs in whole blood were measured based on flow cytometry method by fully automated hematology cell counter (Nihon Kohden MEK-7300, Japan). Total serum IgE and high sensitivity (hs-CRP) was determined using ELFA (Enzyme Linked Fluorescence Assay) method by fully automated immunoassay system (Biomeriex, France).

Exclusion criteria: Workers with a history of blood transfusions, alcohol use, cigarette and shisha smoking, anemia, asthma, cardiovascular illness, or cancer were not allowed to work. In order to lessen the impact of obesity, workers with a BMI exceeding 30 kg/m² were excluded from the study. Participants in this study were also excluded if they had ever worked in any other business that emits dirt or fumes.

Ethical clearance: The Department of Research and Development's Ethical Committee and Review Board of Chandigarh University in Chandigarh fully authorized the protocol. Researched performed compliance with the ethical criteria that are comparable to the "1964 Declaration of Helsinki" and its later revisions [15]. [ERB/2015/17, Reference No.: DRB-PUC.] In Kalyanpur, Banjari, Bihar, the Dalmia Cement Factory's management authority obtained prior consent. Every participant was informed of the goal of the study. Every participant completed an informed consent form and willingly participated in the study. Researchers assured them of the confidentiality of their personal information, and coding was completed thereafter.

Statistical analysis: Full filledusing ANOVA or the Student's paired t-test to compare two groups based on paired data at different significance levels. The data of determinations were expressed using mean ± S.E. A probability value that was statistically significant ($p < 0.05$) was taken into consideration.

Data collection: This is case-referent study; information was obtained from employees through in-person interviews that were conducted in both their native tongue and English. Employees who met the inclusion criteria were informed about the research objectives, and then they submitted necessary data to full fill survey [16]. Workers participating in tasks such as bagging, loading, grinding, and crushing were exposed to the greatest quantities of cement dirt in their immediate area.

III. Results

The anthropometric index (BMI, Weight& Height) and mean age of the cement dirt exposed cement handlers (CH) assigned as test groups and non-cement handlers (NCH) assigned as control groups were shown in Table no 1.

Tableno1: The socio-demographic profiles of 120 individuals, consisting of Cement Handlers (CH) and Non-Cement Handlers (NCH) at Dalmia Bharat Cement Plant, were examined.

Variables	NCH (n=60) (Range)	CH (n=60) (Range)	P – Value
Age (Year)	34.07 ± 2.89	38.94 ± 2.89	> 0.05*
	(22.0 - 42.0)	(27.0 – 47.0)	
Weight (Kilogram)	59.57 ± 2.40	62.08 ± 5.2	< 0.05
	(48.0 – 69.0)	(50.0 – 70.0)	
Height (Centimeter)	159.70 ± 5.71	164.60 ± 4.97	< 0.05*
	(142.0 – 178.0)	(146.0 – 169.0)	

BMI (meter/Kilogram^2)	24.05 ± 1.99	22.55 ± 2.05	< 0.05*
	(20.5 – 24.5)	(18.5 – 24.5)	
Ratio of Waist to Hip (centimeter)	79.8 ± 3.05	90.2 ± 3.60	< 0.05*
	(<94.0)		

Note: * Significant at p < 0.05; ** Significant at p < 0.01; values are given as Mean ± S.E.
Abbreviation: BMI = Body Mass Index.

An analysis of anthropometric measurements performed. Significant differences (P < 0.05) were seen in BMI and waist-to-hip ratio (WHR) between cement handlers and non-cement handlers. In order to assess long term allergic and inflammatory response to cement dust among exposed factory workers total serum immunoglobulin E (IgE) and high sensitive C-reactive protein (hsCRP) were assessed in blood samples from cement handlers and non-cement handlers. The levels of IgE and hsCRP mere significantly higher (P<0.05) in cement dust exposed worker when compared with corresponding levels in controls. The data is seen as in Table no. 2.

Table no. 2 Impact of exposure of cement dust on Total Serum IgE and hsCRP among non-cement handlers (NCH) and cement dust exposed CH with varying times spent in contact with cement dust at Dalmia Bharat Cement Plant.

Parameters	**NCH (Range) (n=60)**	**CH (Range) (n=60)**	**P – Value**
Total Serum IgE (IU/mL)	**411.90 ± 107.94 (150 - 300)**	**703.64 ± 154.49***	**< 0.05**
hsCRP (mg/L)	**5.12 ± 0.79 (< 6-8)**	**9.92 ± 1.08****	**< 0.05**

Note: * Significant at p < 0.05; ** Significant at p < 0.01; values are given as Mean ± S.E. **Abbreviation: IgE** = Immunoglobulin E**, hsCRP =**.highly sensitive C-reactive protein.

Results demonstrated substantially increased levels of total and differential count of WBCs mere significantly higher (P<0.05) in cement dust exposed worker when compared with corresponding levels in controls. The data is seen as in Table no. – 3 and 4.

Table no.3. Impact of exposure of cement dust on test on Total WBC count among non-cement handlers (NCH) and cement dust exposed CH with varying times spent in contact with cement dirt at Dalmia Bharat Cement Plant

Parameters	**NCH (Range) (n=60)**	**CH(Range) (n=60)**	**P – Value**
Total WBC Count (x 10^3/µL)	7.62 ± 1.79	9.57 ± 3.02***	<0.001

Note: With significance set at p less than 0.05, the results are shown as Mean ± S.E. *; ** indicates significance at p less than 0.01; and *** indicates significance at p less than 0.001.**Abbreviation:** WBC = White blood cells.

Tableno. 4. Impact of exposure of cement dirt on test on Differential count of WBC count among non-cement handlers (NCH) and cement dust exposed CH with different durations of exposure to cement dirt at Dalmia Bharat Cement Plant.

Parameters	**NCH (Range) (n=60)**	**CH (Range) (n=60)**	**P - Value**
Neutrophil (%)	55.24 ± 11.61 (37 - 67)	56.78 ± 7.81	> 0.05 (NS)
Lymphocyte (%)	35.60 ± 7.11 (23 – 50)	41.08 ± 10.50**	< 0.01
Monocyte (%)	3.37 ± 1.16 (4 – 10)	3.98 ± 2.00	> 0.05 (NS)
Eosinophil (%)	4.21 ± 2.11 (1 – 7)	5.94 ± 2.79***	< 0.001
Basophil (%)	0.0 ± 0.00 (0 - 0)	0..0 ± 0.00 (0 - 0)	

Note: With significance set at p less than 0.05, the results are shown as Mean ± S.E. *; ** indicates significance at p less than 0.01; and *** indicates significance at p less than 0.001.**Abbreviation:%** = Percentages.

IV. Discussion

As best to knowledge, this solitary conducted in Bihar, state in India, that investigates pollution of air and environmental health maladies among Dalmia Bharat cement plant workers, focusing on linking prolonged workplace exposure dirt susceptibility with occurrence of allergic as well as inflammatory diseases as the few available studies were carried out in Indian states excluding Bihar. The significant higher total serum IgE suggests allergic consequences of these workers to cement dirt, which if persistent may result in systemic anaphylactic reaction. Inflammation is indicated by a high level of CRP in the blood. High CRP level can however signal inflammation in the heart's arteries, which can lead to an increased risk of CAD [17]. Crystalline, Silica -a major constituent of cement dust has been documented to function as an adjuvant that raises the production of antibodies and inflammation. According to the results of our investigation, cement handlers' immune systems may be impacted by cement dirt. The present study also exhibits a significant elevation ($P<0.05$) of CRP in cement handlers compared with the control group. C-reactive protein is one of the acute phase proteins synthesized by hepatocytes. Acute stages of a variety of disorders linked to inflammation and tissue damage are marked by a rise in the blood concentration of CRP. Toxic chemicals included in cement dirt can cause inflammatory changes in organs such as the skin, lungs, heart and liver. Research has been done on the hazardous components of cement dirt and their systemic effects [18]. Blood leucocytes include neutrophils, basophils, eosinophils, monocytes, macrophages, dendritic cells, and lymphocytes (B and T cells). Blood leucocytes have the ability to both stimulate and repress the immune system. The immune system's alteration of the blood WBC image serves as a signal for systemic inflammation. Leucocyte recruitment occurs during inflammation due to the production of cytokines, lipid mediators, and vasoactive amines. The recruited cells release nitrogen and reactive oxygen species, which damages tissue if left unchecked [19]. The observed elevated mean counts of white blood cells, lymphocytes, and eosinophil's ($P<0.01$) in cement workers might potentially be attributed to chronic inflammation occurring in the lungs and other critical organs such the heart , spleen, pancreas, liver, and kidneys as a result of recurrent exposure to heavy metal-containing dirt crystalline silica-alumina [20] Because particle exposure caused an inflammatory response that led to eosinophil buildup, **i**n this study, the eosinophil count increased statistically significantly [21]. Similar results were noted in prior research [22].When the body reacts adaptively to dust that contains silica, CD4+ is released. Pulmonary inflammation is largely influenced by regulatory T (Treg) cells and helper cells [23]. The pro-inflammatory cytokine interleukin 17 is secreted by T-helper 17 subsets of lymphocytes [24]. Ours results align to previous studies [25] that prolonged and recurrent exposures, based on the length of time, degree of exposure, and personal sensitivity cause significant occurrence of allergic manifestations as well as hazardous cement dirt causes inflammatory harm to several bodily parts in workers in the cement industry internationally.

V. Conclusion

The current research endeavor sought to examine the prolonged, uncontrolled and repeated exposure of cement dirt on-hematological counts of WBCs, and its differentials along with allergy and inflammatory markers such as serum total IgE and high sensitive C – reactive protein among Dalmia Bharat Cement Plant workers.Significant higher total serum IgE suggests allergy response exposed to cement dirt, which if persistent may result in systemic anaphylactic reaction. Cement dirt exposure induces deleterious inflammatory reactions, as seen by elevated total and differential WBC counts. The study exhibit significant elevation of serum CRP suggests inflammatory response to cement dirt exposure among cement handlers compared with control group. The health-related complications might exacerbate if the exposure to cement dirt among cement handlers is not controlled.

Conflict of interests

There are no conflicts of interest pertaining to the publishing of this research, according to the authors.

Acknowledgment

I, Zamiruddin Ansari would like to thank the workers of Dalmia Bharat Cement Plant at Kanyanpur, Banjari, District Rohtas, Bihar, India who voluntarily participated along with phlebotomists , laboratory technicians of biochemistry department, Narayan Medical College, Jamuhar, District Rohtas, Bihar, India for their valuable and timely support during the present study.

References

[1] Ahmad, R., Shamima, Q., And Haque, M. Occupational Cement Dust Exposure And Inflammatory Nemesis: Bangladesh Relevance. J. Inf. Res. 2021; 14: 2425 – 2444.

[2] EL – Abssawy, A. A., Etal. Health Risk Assessment Of Workers Exposed To Heavy Metals In Cement Kiln Dust (CKD). J. Am. Sci. 2011; 7 (3): 308 – 316.

[3] Krishna, L., Etal. Assessment Of Respiration Morbidity Among Loading And Unloading Workers Exposed To Cement Dust. Int. J. Res. Med. Sci. 2019; 7(6): 2422 – 2427.
[4] Mousavi, Z., Etal. Assessment Of Particulate Matter (PM) Emitted By Cement Industry: A Case Study In Shahroud. Res. J. Environ. Sci. 2014; 8: 155 – 160.
[5] Gupta, R. K., Etal. 2012. Particulate Matter And Elemental Emission's From A Cement Kiln. Fuel. Process. Technol., 104: 343 – 351.
[6] Uddin, M.T. And Chaudhary, I.M. 2021. Sustainable Development Of Concrete Construction Material In Bangladesh: 1st IUT International Seminar On Sustainability, Recycling And Durability Of Concrete, Department Of Civil And Environmental Engineering, Islamic University Of Technology (IUT). March 17.
[7] Al Salhen, K. S. 2014. Assessment Of Oxidative Stress, Hematological, Kidney And Liver Function Parameters Of Libyan Cement Factory Workers. J. Am. Sci., 10:58 – 65.
[8] 8. Ansari, S And Arora, N 2023. Study Of Uncontrolled Cement Dust Exposure AndIts Prolonged Effects On Glycemic Status And Renal Function Markers Among Male Cement Handlers At Dalmia Cement Factory. J. Chem. Health. Risks., 13(6), 1090-1095 | ISSN: 2251-6727
[9] OSHA Report. 2018. Silica, Crystalline. Washington, DC, USA: Occupational Safety And Health Administration. March 2, 2018.
[10] Murugadoss, S., Etal. 2017. Toxicology Of Silica Nanoparticles: An Update. Arch Toxicol., 91(9): 2967 – 3010.
[11] Mayeux, J. M., Etal. 2018. Silicosis And Silica – Induced Autoimmunity In The Diversity Out Bred Mouse. Front. Immunol., 9:874 – 877.
[12] Divya Priya S, Suja S. 2012. The Effect Of Cement Dust Exposure On Hematological And Cytogenetic Studies Of Cement Workers. Res J Pharma Bio Chen Sci. 3 (1): 615–620.
[13] Truong-Minh, P., Yoshihisa, F., Kei, N., Koji, S., Yoshiyuki, W., Yutaka, I., Kazuo, T., Akiko, T., And Takesumi, Y. (2009). Asian Pacific Journal Of Cancer Prevention. 10: 69-73
[14] Ansari FA, Bihari V, Rastogi SK, Ashquin M, Ahmed I. Environmental Health Survey In Asbestos Cement Sheets Manufacturing Industry. Indian J Occup Environ Med 2007; 11:15-20
[15] Carlson RV, Boyd KM, Webb DJ.2004. The Revision Of The Declaration Of Helsinki: Past, Present And Future. Br J Clin Pharmacol. 2004 Jun; 57(6):695-713.
[16] Basey, I.E., Etal. 2017. Cardiovascular Disease Risk Factors And Cardiac Markers Among Male Cement Workers In Calabar, Nigeria. J. Chem. Health. Risks., 7(2): 85 – 94.
[17] Ansari, Z., Nehal, M. And Padmadeo, S.R. Effects Of Fractionated Bitter Melon (*Momordica CharantiaLinn*.) Seeds Extract On Normolipidemic And Hepatoprotective Status In Type – I Diabetes Rats, J. Pharm. Bio. Sci. 2020; 15(6): 43 – 49.
[18] Ahmad R, Akhter QS, Haque M. Occupational Cement Dust Exposure AndInflammatory Nemesis: Bangladesh Relevance. J Inflamm Res. 2021 Jun 9; 14:2425-2444.
[19] Villeneuve DL, Landesmann B, Allavena P, Et Al. Representing The Process Of Inflammation As Key Events In Adverse Outcome Pathways. Toxicol Sci. 2018; 163(2):346–352.
[20] Pollard KM. Silica, Silicosis, And Autoimmunity. Front Immunol. 2016; 7:97.
[21] Abdelhamid H, Mohammed MN, Alrazig SA, Et Al. Assessment Of Allergy Marker Leucocyte (Eosinophil) Count And Other Blood Cell Parameters Among Workers At Berber Cement Factory, Berber Governorate, River Nile State, Sudan, 2017. Global J Med Res: C MicrobiolPathol. 2017; 17(1):1–3.
[22] Divya Priya S, Suja S. The Effect Of Cement Dust Exposure On Hematological And Cytogenetic Studies Of Cement Workers. Res J Pharma Bio Chen Sci. 2012; 3(1):615–620.
[23] Matsuzaki H, Hayashi H, Lee S, Et Al. Alteration Of Immune Cells In Silicosis: Roles In Development Of Autoimmunity And Lung Fibrosis. Ann Mens Health Wellness. 2017; 1(1):1002.
[24] Lin S, Wu H, Wang C, Xiao Z, Xu F. Regulatory T Cells AndAcute Lung Injury: Cytokines, Uncontrolled Inflammation, And Therapeutic Implications. Front Immunol. 2018; 9:1545.
[25] Mojiminiyi FBO, Merenu IA, Njoku CH, Ibrahim MTO. Regression Formulae For Predicting Hematologic And Liver Functions From Years Of Exposure To Cement Dust In Cement Factory Workers In Sokoto, Nigeria. African J Biomed Res. 2007; 10(3):235–240.