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Study Of Repeated Occupational Cement Dirt Exposure And Its Persistent Consequences On Hematological Health Markers Among Male Cement Handlers At Dalmia Bharat Cement Plant

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Abstract
Background: *According to the current study, cement male handlers at Dalmia Bharat Cement Plant had persistent effects of toxic cement dirt exposure on selected hematological health markers. Many previous studies focused on correlation between cement dirt exposure and pulmonary functions in factory workers but few studies are available on the toxic effect of cement dirt on hematological markers. The present study found that repeated and protracted exposure of toxic cement dirt, depending on sensitivity and duration; have led to occupational health risks, adverse impact on hematological parameters mainly hemoglobin (Hb), packed cell volume (PCV), mean corpuscular hemoglobin concentration (MCHC) but not on mean corpuscular hemoglobin (MCH) in the blood of cement dirt exposed factory workers.*
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 EDTA (Ethylene Diamine Tetraacetic Acid) vacutainers, mixed well and quickly sent to the hematological laboratory for analysis, where Hb, PCV, MCH and MCHC hematological parameters in blood of cement plant workers was determined.*
Results: *Results of current study unveiled significant association of environmental pollution mediated occupational health risk with changes in hematological health markers in blood of cement dist exposed workers the cement handlers (CH) when compared with unexposed non cement handlers (NCH) as persons control of Dalmia Bharat Cement Plant. In this research the levels of Hb, PCV($P < 0.05$) and MCHC($P < 0.001$) were significantly reduced in cement handlers significantly but MCH did not show statistically significant change among cement handlers.*
Conclusion: *The study's conclusion depending on sensitivity and duration; finds cement dirt exposure has detrimental impact on important hematological health markers that can be helpful to diagnose harmful switch prior to any permanent damage in body occurs. Such alterations may hamper hemolysis, heme synthesis, and inflammatory switch in the body among cement handlers (CH) occupationally exposed to this dirt when compared with non-cement handlers (NCH) as persons control of Dalmia Bharat Cement Plant.*
Key Word: *Cement dirt, Environmental pollution, Hematological health, Cement factory workers*

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I. Introduction

An intolerable number of occupational health complications, have always been caused by environmental pollution importantly toxic cement dirt among factory workers. Cement dirt often brings about irreversible inflammatory switch and injury to human body as it contains toxic components [1-2]. Due to persistently high levels of construction, infra-structure development activity, the emerging market has seen an increase in demand for cement manufacturing demand rising world-wide particularly in developing countries like India that is 12% to 23% more in coming 30 years[3–4]. 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]. Transition metals like cadmium, lead, hexavalent chromiumare the components of toxic cement dirt. These metals facilitate inflammation, compete with iron absorption, inhibit heme synthesis, and cause reactive oxygen specie's formation [7]. Cement dirt exposure is connected to chronic inflammation, oxidative stress and feasible suppression of bone marrow that may influence hematological indices [8-10].

Apart from this chronic exposure to harmful component of cement dirt may cause iron deficiency, hampers the body from producing hemoglobin by disrupting heme synthesis enzymes pathway's, upraising the risk for causing anemia [11].Cement dirt enters our bodies by swallowing, inhalation, and epidermal exposures, to a lesser degree [12]. The hemoglobin concentration per liter of blood is represented by mean corpuscular hemoglobin concentration (MCHC) [13].In course of time ,research has emerged that are concerned with clinical application of MCHC; it's with malady like acute myocardial infarction, hepato-renal syndrome, and pulmonary disease [14]. The grim diagnosis of lung carcinoma is being linked withed pressed MCHC [15]. In recent studies, parameters related to hemoglobin are reported to vary in pneumoconiosis patients [16]. The hematopoietic system of human is a good indicator of toxicology research since it shows marked sensitivity to variations in the surrounding environment in which increasing metabolic demands rapid cellular production and breakdown [17].Few studies have observed alteration in hematological parameters on cement dirt exposure in blood sample of factory workers in India excluding Bihar [18]. However, the changes in the concentration of MCH and MCHC of factory workers having contact with cement dirt remain unclear. This research aims to note the MCH and MCHC alterations in those exposed to dirt among cement handlers at Dalmia Bharat Cement Plant at Kalyanpur, Banjari, Bihar state of India. A key strength of this research is its novel approach in assessing the long-term and detrimental effects of cement dirt 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 and urine specimens were collected by paramedical staff at the plant. Total of 5 ml of whole 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 immediately to an EDTA vacutainer, mixed well and quickly sent to a hematological laboratory where Hb, PCV, MCH and MCHC by fully automated hematology cell counter (Nihon Kohden MEK- 7300).

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 Board and Ethical Committee of Shyamlal Chandrashekhar Medical College and hospital, Khagaria, Bihar, India, fully authorized the protocol.[ERB/2015/17, Reference No.: DRB-AKU/SCMCH]. Research performed in compliance with the ethical criteria that are comparable to the "1964 Declaration of Helsinki" and its later revisions [19]. In Kalyanpur, Banjari, Bihar, the Dalmia Cement Bharat Cement Plant management authority's prior consent obtained. 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 filled using 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 [20]. 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. Result

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.

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 consequences of cement dirt exposure on selective hematological markers ;hemoglobin (Hb), packed cell volume (PCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC)were estimated in whole blood samples from cement handlers and non-cement handlers. Levels of Hb, PCV ($P<0.05$) and MCHC($P < 0.001$) mere significantly reduced in cement handlers significantly but MCH did not show statistically significant change among cement handlers when compared with corresponding levels in controls. The data is seen as in Table no 2.

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

Table no 2: Impact of exposure of cement dust on tests on selected hematological health markers among non-cement handlers (NCH) and cement dust exposed CH at Dalmia Bharat Cement Plant.

Serum Parameters		NCH (Range) (n=60)		CH (Range) (n=60)	P – Value
Hb (g/dL)		13.9 ± 1.21 (12.0– 16.0)		13.3 ± 1.19	< 0.05*
PCV (%)		41.7 ± 2.21 (40.0 – 50.0)		37.4 ± 2.07	< 0.05*
MCH(pg)		27.9. ± 1.95 (26.0 – 32.0)		27.2 ± 2.19	>0.05*
MCHC(g/dL)		32.2 ± 0.22 (32.0 – 36.0)		- 31.7 ± 0.20	< 0.001**

Note: *Significant at p less than 0.05, **Significant at p less than 0.01; values given as Mean ± S.E., **Abbreviation:Hb** = hemoglobin, **PCV** = packed cell volume,**MCH**= mean corpuscular hemoglobin **MCHC** =mean corpuscular hemoglobin concentration.

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 (about 8 years) and potential effects of occupational exposure of cement dirt with the levels of hemoglobin (Hb), packed cell volume (PCV), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular hemoglobin (MCH) hematological health parameters. Between exposed and unexposed conditions, the values of Hb, PCV and MCHC demonstrate notable difference. Our results show significant reduction of Hb, PCV ($P < 0.05$) and MCHC($P < 0.001$) in cement dirt exposed cement handlers. Studies show cement dirt exposure leads to chronic inflammation, impaired erythropoiesis, oxidative stress; these ultimately cause hemolysis and can results in anemia [21]. Reduced PCV mirrors Hb reduction since PCV is directly proportional to RBC mass thus suggestive of anemia of chronic disease in prolonged cement dirt exposure [22].MCH reduction may results due to impaired Hb synthesis in RBCs and MCHC reduction indicates hypochromia possibly due to chronic exposure stress. [23]. Present research revealed Hb, PCV($P < 0.05$) and MCHC($P < 0.001$) were significantly reduced but MCH did not show statistically significant reduction among cement handlers. Such alterations in MCHC may suggest the impact of inflammatory changes on the hematological system and may be used to detect early changes due to inflammation in the body. Early detection of inflammation is necessary to prevent irreversible damage to the health of factory workers [24] and in addition, awareness needs to be developed among these workers concerning the harmful effects of being in contact with toxic cement dirt. The similarly finding was obtained in earlier studies [25]. It is noticeably different when comparing the people who were not exposed to cement dirt. This might be due to exposure effect of cement dirt components on hemopoetic system [26]. Studies are available on exposure effect of toxic cement dust on hematological parameters but most of them were done without taking the long-term duration response impact into account with exposed workers age correlation [27]. However present research revealed that the prolonged exposure of occupational cement dirt exposure had significant impact on hematological health parameters and hematological system especially among cement dust exposed cement handlers when compared with control subjects at Dalmia Bharat Cement Plant. The present study discloses that prolonged and recurrent exposures, based on the length of time, degree of exposure, and personal sensitivity, hazardous cement dirt significantly influenced blood parameters hemoglobin (Hb), packed cell volume (PCV), mean corpuscular hemoglobin concentration (MCHC)among workers in the cement industry internationally.

I.

V. Conclusion

The current research endeavor sought to examine the prolonged, uncontrolled and repeated exposure of cement dirt on selected occupational hematological health parametersamong Dalmia Bharat Cement Plant workers. Continuous inhalation, ingestion and dermal occupational contacts make even the minor concentration of toxic cement dirt a major concern and may have damaging and often irreversible negative impacts. Present study revealed that persistent and prolonged toxic cement dirt exposures, contingent on the sensitivity and length of time of factory workers have significantly influenced the hematological parametersamong cement handlers when compared totheir counterpart non-cement handlers. The current research work has explored that the toxic cement dirt pollutants are significantly associated with alterations in hemoglobin, packed cell volume, mean corpuscular hemoglobin levels in occupationally exposed group. These selected parameters are said to be the sensitive index that could be useful as an indirect predictive or distinctive tool in assessing the toxicity of cement dirt. The health-related complications might exacerbate if the exposure to cement dirt among cement handlers are not early detected and controlled.

Conflict of interests

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

VI. Acknowledgment

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