Effect of Cement Dust Exposure on Total and Differential Count of WBC of Cement Factory Workers

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Abstract

Background: Cement is an essential component of construction industry in developed world. Cement dust is one of the major air pollutant and its exposure reported various occupational problems. It has deleterious effects on vital organs. Different study revealed alteration of total and differential count of WBC in cement factory workers. This study was designed to assess effect of cement dust on total and differential count of WBC.

Materials and methods: This case control study was conducted in the Department of Physiology, Chittagong Medical College, Chattogram in collaboration with Heidelberg Cement Bangladesh Ltd. Chattogram during the period January 2018 to December 2018. Total 120 male subjects, aged between 20-45 years were included in the study by consecutive sampling method who meets the inclusion criteria. Case group were selected from those who were working at least 2 year in direct contact of cement dust. Control group were selected from office workers of Heidelberg Cement Bangladesh Ltd. and Chittagong Medical College.60 subjects included in each group. A questionnaire along with general information, about present and previous disease, medication and previous job history were filled up by the researcher. Individual's height and weight were measured, BMI was calculatedand general physical examinations were done. Total 3 ml of venous blood was collected from each subject by trained technician under aseptic precaution. Total and differential count of WBC was estimated in the laboratory by haematology auto-analyzer.After compiling data,statistical analyses were done by using SPSS version Windows 25. For continuous and categorical data Unpaired students't test and chi--square test were done respectively as test of significance.

Results: Significant increase ($p<0.001$) in eosinophil count was found in Case group workers comparing Control group.

Conclusion: The results of this study suggest that occupational exposure to cement dust has deleterious effects on haemopoietic system which is evident by increase eosinophil in cement exposed workers.

Key words: Cement dust; Total and differential count of WBC; Eosinophil.

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Introduction

Advancement of a country is measured in terms of urbanization and industrialization.[1] Cement is an important key to economic growth because of its role in construction, housing and infrastructural development.[2] Bangladesh has been experiencing production of large amount of cement domestically over the years as the economy is growing.[3]

The cement sector is the third largest industrial source of air pollution.[4] Cement dust is involved in air pollution and causes occupational hazard.[1] Cement is a gray powder containing mixture of calcium oxide (62-66%), silicon oxide (19-22%), aluminum tri oxide (4-8%), ferric oxide (2-5%) and magnesium oxide(1-2%) and selenium, thallium and otherimpurities.[4,5]

The diameter of cement particles may range from 0.05-5.0 μm.[6] Two classes of particulate (PM) are abundant in cement industry. $PM_{2.5}$ and PM_{10} means particle size less than 2.5 m and10 m in diameter respectively. PM_{10} accumulate in the lung and $PM_{2.5}$ can enter into blood stream. These particles are potential carcinogen.[7] Continuous inhalation or ingestion of even smallest concentration of such toxic element is a concern to health.[8] The effect of exposure to these hazardous substance depend on their concentration, route and duration of exposure.[8]

Exposure to cement is a larger problem in developing countries because of limited use of personal protective equipment.[9] Workers are usually exposed to cement dust through skin, respiration and via gastrointestinal rout.[4] Cement dust via blood reaches to different structures of the body and may affect their anatomical and physiological function.[6] Most frequent clinical features observed in cement mill workers are chronic cough and phlegm production, chest tightness, obstructive and restrictive lung diseases. Skin irritation, conjunctivitis, stomach ache, headache and fatigue were also observed in them.[6] Short term exposure to cement dust may have little or no hazardbut long term exposure to cement dust can provoke clinical symptoms and inflammatory response.[6,10] The pathogenesis is most probably its irritating and sensitizing properties.[8] Human haemopoietic system is very much sensitive to various environmental influences.[11] Age, sex, ethnic background, body build, social factors, nutritional factors and altitude also influences haemopoiesis.[11,12] Heamatological parameters are a sensitive index to see changes in ecological conditions and can constitute an important diagnostic tool in toxicological studies.[11]

Previous studies in different countries have shown changes in total and differential count of WBC in cement factory workers. Cement dust has deleterious effects on humoral immune system.[13] Increased mortality was found in some studies due to inflammation associated with leukocytosis.[1,5,10.14-19] The significant higher level of IgE in cement worker was measured by Divya et al.[13] Persistent allergic response to cement dust results in anaphylactic reaction.[13]

Some researchers found higher level of cytokine and lower percentage of CD25+ and CD69+ lymphocyte in mason. They supposed that this immune dysregulation may progress to systemic proinflamatory state and autoimmune disease which can also occur in haemapoietic system[13].

However in Bangladesh adequate data is not available on this topic. These measures would help to identify susceptible workers in due time and preventive measures can be taken.[20] It will decrease the risk of occupational hazards, decrease medical costing and increase productivity in the cement industry.[4] The present study is designed to evaluate the effects of cement dust on total and differential count of WBC.

Materials and methods

This case control study was conducted in the Department of Physiology, Chittagong Medical College, Chattogram, with collaboration of Heidelberg cement factory Ltd. Chattogram, during the period of January 2018 to December 2018 after ethical approval and permission of Chittagong Medical College and Heidelberg cement factory authority. Male cement factory workers and some office workers of Chittagong Medical College, aged between 20-45 years were selected as subjects. Cement factory workers directly exposed to cement dust for more than 2 years, working for 8 hours/day for 6 days per week were selected as Case group. Age and socioeconomic status matched Control group were taken from office workers of Heidelberg Cement Bangladesh Ltd. and Chittagong Medical College those who were not in direct contact of cement dust.They were explained about the aims, objectives and detail procedure of the study. They were encouraged for voluntary participation and allowed freedom to withdraw from the study anytime.They were also ensured that collected data will be used only for research purpose and informed written consent was taken from each individual.

On the basis of inclusion and exclusion criteria subjects were selected by consecutive sampling method. On the day of data collection information about age of workers, duration of job, site and position at workplace and use of safety gadget, drug history and physical condition were taken.

Subject having history of haematological disorder, diabetes mellitus, hypertension, cardiopulmonary disease, bronchial asthma, tuberculosis, liver disease, malignancy, recent history of acute or chronic infection and hospitalization, cigarette smoker, tobacco chewerwere excluded from the study.Those who were in drug like dapson, methyldopa, quinidine, heparin, warfarin etc.were also excluded from the study.

Height and weight were measured and BMI was calculated by following formula

BMI= Weight in kg/ Height in m^2.

General physical examination were done and blood pressure, temperature, pulse, respiratory rate was recorded.Auscultation of heart and lung were done to find any pathology.To exclude diabetes mellitus RBS was measured by glucometer

(One touch ultra, USA, AW-O61-566-O1A). After analysis of case record forms and general physical examination total 120 subjects were selected and divided into two groups, Case group and Control group. 60 workers were included in each group.

3 ml of venous blood was collected in vacuette tube containing anticoagulent EDTA (Ethylene-di-amine-tetraacetic acid) from antecubital vein of each subject by trained technician.Samples were collectively transported to the laboratory within 4 hours of collection in each day in a cold box with minimum vibration.

After reaching laboratory, total and differential count of WBC were measured by laboratory technician immediately on the same day by haematology auto-analyzer (Sysmex XN 1000, Japan).

After getting data statistical analysis were done by SPSS version Windows 25. Between groups comparison of these variables were done by unpairedstudent st-test.Categorical data were expressed as frequencyand percentages and comparison were done by chi-square test between groups. p value <0.05 was accepted as level of significance.

Results

Table I showing demographic characteristics such as education level, salary, marital status, residency of study subjectsand no significant difference (p>0.05) were observed regarding socioeconomic status in both group (Table I). Table II showing mean (±SD) of age, height, weight, BMI, systolic blood pressure, diastolic blood pressure of Control group was 35.87±7.35 years, 164.20±5.78 cm, 60.25±5.58 kg, 22.06±1.17 kg/m^2 119.83±10.16 mm of Hg, 78±4.80 mm of Hg and among Case group was 35.87±7.21 years, 166.10±5.61cm, 59.58±4.20kg, 22.06±1.09kg/m^2, 122.67±9.72 mm of Hg, 76.50±5.77 mm of Hg.No significant difference (p>0.05) were found between two group (Table II). It indicates subject selection was similar in both group. Table III showing mean (±SD) of total count of WBC in Control group was 9058±2095 /mm^3 and in Case group was 9395±1953 /mm^3 of blood which was statistically non-significant (p>0.05)(Table III). Regarding differential count of WBC mean (±SD) of neutrophil, lymphocyte, monocyte and basophil count in Control group was 52.28±7.06%, 37.25±6.7%,6.07±1.42% and 0% respectively and in Case group was 51.32±8.35%, 38.43±7.85%, 5.68±1.35 and 0% respectively. There was no significant difference (p>0.05) between Case and Control (Table III). Eosinophil count was 3.56±1.59% in Control group and 5.01±2.89% in Case group. Significant increase (p<0.001) in eosinophil count was found in Case group workers comparing Control group (Table III).

Table I Demographic profile of Control and Case Groups (n = 120)

Attributes		Control group (n=60)	Case group (n=60)	p value (χ^2 value)
Educational Level	Graduate	23	14	0.075 ns
	Undergraduate	37	46	(3.165)
Salary (taka)	Grade–I	36	43	0.178 ns
	Grade–II	24	17	(1.815)
Marital Status	Married	46	50	0.361 ns
	Unmarried	14	10	(0.833)
Residency	Resident	36	40	0.449 ns
	Non-resident	24	20	(0.574)

Statistical analysis done by Chi-square test, n = number of subject, values in parenthesis indicate percentage. ns = not significant (p 0.05) Grade - I= Income (20000-30000) taka per month, Grade II= Income (30000-40000) taka per month.

Table I shows no significant difference in socioeconomic status between Control group and Case group.

Table II Age, height, weight, BMI and blood pressure between Case and Control group (n=120)

Attributes	Control group (Mean±SD) (Range) (n=60)	Case group (Mean ±SD) (Range) (n=60)	p value (t value)
Age (Years)	35.87±7.35 (20-45)	35.87±7.21 (22-45)	1.00 ns (.000)
Height (cm)	164.20±5.78 (152-177)	166.10±5.61 (149-177)	0.070ns (1.83)
Weight (Kg)	60.25±5.58 (50-71)	59.58±4.20 (52-70)	0.461ns (0.739)
BMI (Kg/$m^{2)}$	22.06±1.17 (19.5-25.9)	22.06±1.09 (19-25.2)	0.968 ns (0.04)
SBP (mm of Hg)	119.83±10.16 (100-130)	122.67±9.72 (100-130)	0.121ns (1.56)
DBP (mm of Hg)	78±4.80 (60-80)	76.50±5.77 (60-80)	0.124 ns (1.55

Statistical analysis done by Unpaired student's 't'-test. Data expressed as Mean ± SD (Standard Deviation) n = number of subject, ns = not significant (p =0.05) values in parenthesis indicate range, SBP=Systolic Blood Pressure, DBP=Diastolic Blood Pressure.

Table II shows no significant difference in age, height, weight, BMI, systolic and diastolic blood pressure between Control and Case group.

Table III Comparison of total and differential count of WBC between Control and Case group (n=120)

Attributes	Control group (Mean±SD) (Range) (n=60)	Case group (Mean ±SD) (Range) (n=60)	p value (t value)
TWBC (/mm^3)	9058±2095 (5030-14190)	9395±1953 (5940-14370)	0.365 ^{ns} (0.91)
Neutrophil (%)	52.28±7.06 (37-67)	51.32±8.35 (31-73)	0.495 ^{ns} (0.685)
Lymphocyte (%)	37.25±6.7 (23-50)	38.43±7.85 (22-59)	0.378 ^{ns} (0.886)
Monocyte (%)	6.07±1.42 (4-10)	5.68±1.35 (3-11)	0.133 ^{ns} (1.52)
Eosinophil (%)	3.56±1.59 (1-7)	5.01±2.89 (1-15)	<0.001** (3.41)
Basophil (%)	00	00	00

Statistical analysis was done by Unpaired student's 't'-test, Data expressed as Mean ± SD (Standard Deviation), n = number of subject, ns = Statistically not significant (p=0,05) ** = Statistically significant (p<0.001) values in parenthesis indicate range, TWBC= Total count of WBC.

Table III shows significant increase in eosinophil count in Case group then that of Control group (p<0.001).

Discussion

In this study no significant difference was observed between Case and Control group in respect of sociodemographic characteristics,age, height, weight, BMI and blood pressure. It indicate that the subject selection were same in both groups.

Present study showed, no significant difference (p > 0.05) regarding total count of WBC between Case and Control group. This study finding simulate with some previous studies.[21,22]

According to some author's chronic exposure to irritating material might lead to adaptive changes which resist inflammation resulting in normal leukocyte count in their study.[21,22] In this study most of the Case group workers were working for at least 10 years and similar adaptation might occur that resulting in normal leukocyte count.

Studies in different countries suggested that, cement dust has deleterious effects on haemopoietic system.[5,10,11,18,19,23] in cement exposed workers in their study. They supposed that, inflammatory reaction to cement dust were the leading cause of leukocytosis.[10,18,19]

We reported significant increase in eosinophil count in Case group workers relative to Control group (p<0.001). This finding is consistent with the observation of some researchers.[1,23,24] According to Emmanual et al. chromium present in cement dust may cause allergic reaction.[10] In a study in India, Divya et al. supposed that persistent allergic response to cement dust might result in anaphylactic reaction.They also observed higher level of IgE in cement worker.[13] Hypersensitivity reaction to cement dust might be the cause of high eosinophil count in Case group workers in this study. According to Mandal et al. eosinophilia may be associated with parasitic infestation.[25] In present study history regarding helminthiasis was not taken and routine examination of stool was not done. So chance of parasitic infestation cannot be excluded.

In previous studies, some researchers observed normal eosinophil count and some found eosinopenia in cement factory workers in their study.[10,11,18,21]

In current study neutrophil, lymphocyte, monocyte and basophil count were within normal range and no significant difference was observed between groups.These findings simulates with the some previous studies.[1,1018,19] According to them it might be due to chronic exposure to dust that lead to adaptation.[17,18]

Our results disagree with some previous results that reported neutrophilia (Okonkow) lymphocytosis andmonocytosis in cement workers.[19,10,11,17,24,26,27] According to them increase in granulocyte, monocyte and lymphocyte count represent inflammation or immune reaction due to chronic cement dust exposure.[11]

Cement dust can also impair both phagocytic function and number of polymorphoneuclear neutrophil and increase infection susceptibility which was evidend by neutropenia.[10,20,27,28]

Calistus et al showed significant fall in monocyte their study whichmight be due to increased self-destruction or phagocytosis.[11]

It was observed in current study that the workers were using PPE during their working hour, but the face mask and gloves was not appropriate.Cement factory authority should maintain dust control system on regular basis and provide proper personal protective equipment to ensure adequate protection of the workers. Periodical assessment of haematological profile including total and differential count of WBC can help in diagnosis and treatment of any cement dust associated complication in initial stage. These measures can reduce the ill health of the cement factory workers.

Limitation

Though optimal care had been tried by the researcher in every steps of the study but there were few limitation.Sample size was small and subjects were selected from a selective area. Sampling was done by consecutive sampling, so chance of bias.In addition history of helminthiasis was not taken and routine examination of stool was not done.

Conclusion

The result of this study concluded that, cement exposure significantly increase high eosinophil count. It may be due to ineffective and improper use of protective equipment by the workers and higher level of suspended matters than the standard level in their working place.

Recommendation

If further study can be done with large sample size including subjects from more area.Factory authority can be advised for pre-employment and periodical health checkup at. Training about proper use of PPE should be provided to the workers and limiting the dust level by adequate dust filtration system in the working area to reduce the complication related to cement dust.

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Contribution of authors

AD-Conception, design, acquisition of data, drafting and final approval.
RC-Interpretation of data, data collection, manuscript writing and approval.
MB- Interpretation of data, design, critical revision and final approval.
SA-Conception, critical revision, manuscript writing and final approval.
MA-Design, data collection, data analysis and final approval.

Disclosure

All the authors declared no competing interest.

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