Haematological changes among construction workers exposed to cement dust in West Bengal, India

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ABSTRACT

Purpose: This study measured haematological parameters in construction workers exposed to cement dust, silica and other hazardous materials. This was done in order to identify a simple, readily available, and cost effective screening test that could help to identify the presence of disease and its severity in workers potentially related to their work space.

Materials and methods: The study was composed of 150 construction workers and 52 participants in an unexposed control group, with ages ranging from 15-60 years. Blood samples were collected from each participant and percentage of haemoglobin, total RBC count, WBC count, platelet count, and different RBC indices were analyzed.

Results: The haemoglobin concentration, PCV, and MCV decreased significantly, but the MCHC and eosinophil counts increased significantly in comparison to the control group, though the increase in the monocyte count was not significant. No significant changes in haematological parameters with a year of exposure have been found. However, the percentage of prevalence of anaemia on the basis of haemoglobin concentration and PCV value were higher in construction workers in comparison to members of the control group.

Conclusion: This study recommends that construction workers working in hazardous environments must support health education and should regularly use protective devices in their workplace. They must also have regular medical checkups, which might help detect disease in early stages.

Key words: Construction workers, haemoglobin, PCV, platelet count, WBC count, RBC indices.

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Received: 20.12.2013
Accepted: 09.05.2014
Progress in Health Sciences
Vol. 4(1) 2014 pp 88-94

INTRODUCTION

Construction work is known to be long term hazardous to the respiratory system. Tasks such as abrasive blasting, emptying bags of cement, cutting woods and masonry, painting, gluing, cleaning with solvents, wielding, handling of sand, i.e. silica dust, using diesel-powered heavy equipment all produce air pollution by emission of silica and asbestos. High concentration or prolonged inhalation of cement dust or both can provoke clinical symptoms and inflammatory response that may result in functional, structural as well as other abnormalities [1]. As most of the construction projects is unorganized in nature, workers are often not guided by the legislations made for maintaining the health and welfare of the workers. As dated most of the studies on the construction workers has been tended to focus on the respiratory system. The respiratory abnormalities like pneumo-coniosis, pulmonary tuberculosis, bronchiectasis, chronic bronchitis can increase some basic hematological parameters like ESR and Total Leucocyte Count (TLC) which may reflect a secondary response to some disease process or toxin [2].

The human hematopoietic system is extremely sensitive to some environmental influences because of rapid synthesis and destruction of cells with consequent heavy metabolic demand [3]. Toxic effects of airborne pollutants on human include damage of eyes, respiratory and nervous systems and a number of teratogenic, carcinogenic and mutagenic effects [4]. Jude et al. [3] studied and reported that cement dust caused indirect haematological damage resulting in abnormal blood cell count. From this study, we have been inspired to study the hematological parameters of construction workers exposed to hazardous environment.

Therefore, the purpose of the present study is to assess, evaluate and predict the risk of hematological abnormalities of construction workers. The idea was to identify a simple, readily available and cost effective screening test that would help in identifying the presence of disease, its severity in the construction workers potentially related to their workplace.

MATERIALS AND METHODS

The study was undertaken in 150 male subjects employed in building construction work like masonry, mixing the concrete materials, plastering, grill fitting, carrying bricks, floor making, etc. having their age ranging from 15 to 60 years. These workers worked for at least eight hours a day without any rest day. They were selected randomly. 52 healthy male control subjects were selected randomly from college employees, van driver, auto driver, carpenter, etc. of same socio economic background.

Exclusion Criteria:

Subjects with clinical abnormalities like diabetes mellitus, hypertension, pulmonary tuberculosis, bronchial asthma, emphysema, drug addicts, history of acute or chronic infections or recent hospitalization.

All the subjects completed a questionnaire, and verbal consent was taken from each worker as well as a labour contractor. The study design was approved by Human Ethical Committee of this college.

Questionnaire includes age, salary, smoking habit, job duration, educational status, exposure time per day and history of infectious disease or allergy in construction workers as well as of the control group.

Blood samples:

Blood samples of 150 construction workers of age range 15 to 60 years were collected from different areas of Hooghly district of West Bengal in the different construction site. Construction workers were undertaken with mostly migrant workers who were residing within the construction site. Blood sample was collected at least two hours after taking meal.

Blood (5 ml) was drawn from anti cubetal vein in 5cc disposable syringe of which 2.5 ml was dispersed in a 5 ml sterile glass test tube containing 3.75mg of dipotassium salt of EDTA as an anti coagulant for the analysis of different hematological parameters. These samples were transported to the laboratory within 45 minutes in the cool box with minimum vibration. The blood samples were centrifuged for 30 minutes.

The various haematological parameters, such as haemoglobin (Hb) concentration, total red blood cells (TRBC) count, total white blood cells (TWBC) count, different count of WBC, platelet count, packed cell volume (PCV), mean corpuscular volume MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), were determined according to the procedures given in Dacie and Lewis [5]. Haemoglobin was estimated according to Van Kampen and Zijlstra [6].

Statistical analysis

All data are expressed as mean ± SD. The data are subjected to independent `t' test by SPSS package (version16. 0) in order to determine the significant differences where $p < 0.05$ is considered as significant.

RESULTS

Table 1 presents mean ± SD values of different physical and haematological parameters of construction workers (exposed) and Control (unexposed) workers with P values. It is found that control group workers are significantly ($p<0.001$) higher in age, body weight and BMI values than construction workers. Besides, Haemoglobin concentration, neutrophil count, PCV, MCV values are significantly ($p<0.05$) lower in construction workers, but MCHC value is significantly ($p<0.001$) higher in construction workers. Eosinophil count increases significantly in construction workers while lymphocyte count increases insignificantly.

Table 1. Mean ± SD values of physical and haematological parameters of construction workers and the control group.

Parameters	Construction workers	Control	P value
Age (yrs)	27.09 ± 10.54	37.06 ± 9.25	<0.001
Ht (cm)	160.20 ± 5.74	161.27 ± 6.92	NS
Wt (kg)	51.53 ± 7.15	59.13 ± 10.08	<0.001
BMI (kg/m^2)	19.93 ± 2.95	22.66 ± 3.40	<0.001
[Hb] (gm/dl)	13.82 ± 1.35	14.39 ± 1.60	<0.01
TRBC(million/mm^3)	4.78 ± 0.59	4.86 ± 0.29	NS
TWBC (mm^3)	8132.00 ±1042.93	8146.15±781.77	NS
Neutrophil (N) %	61.31 ± 4.95	62.29 ± 3.31	NS
Eosinophil (E) %	4.31 ± 2.63	3.44 ± 1.51	<0.01
Besophil (B) %	0.00	0.00	NS
Lymphocyte (L) %	33.26 ± 4.52	32.96 ± 3.25	NS
Monocyte (M) %	1.13 ± 0.64	1.31 ± 0.61	NS
Platelets(X10^4/mm^3)	1.96 ± 0.28	1.99 ± 0.28	NS
PCV (%)	42.61 ± 4.15	44.63 ± 3.24	<0.01
MCV (fl)	89.86 ± 3.26	91.63 ± 2.59	<0.001
MCH (pg)	29.06 ± 1.26	28.85 ± 1.53	NS
MCHC (%)	32.45 ± 0.95	31.86 ± 0.86	<0.001

Table 2 presents the haematological parameters of higher and lower age group smoker workers with the control group (smoker). The physical parameters i.e. body weight and BMI values are significantly higher in both higher and lower age group smoker and nonsmoker control group workers in comparison to the exposed construction workers. Total WBC (TWBC) count and eosinophil count and MCHC are significantly higher in construction workers than the control group except TWBC count whereas PCV and MCV show significantly lower values in construction workers in comparison to control group. The difference in platelet count is not statistically significant.

In the non-smoker group of workers, no higher age group construction workers have been found, and it is observed that MCV and MCHC values are significantly lower in lower age group construction workers in comparison to control group.

But when as a whole smoker and non-smoker construction workers are compared with the control group (Table 3), significantly higher body weight and BMI values have been found in the control group along with MCH and MCHC values, but PCV and MCV values are significantly lower in construction workers than the control group.

Neutrophil count decreases in higher and lower age group smoker construction workers whereas non-smoker lower age group workers show an increasing pattern of neutrophil count. Lymphocyte count of smoker higher age group workers increase insignificantly whereas non- smoker lower age group workers show a significant decrease in lymphocyte count.

Monocyte count of smoker and non smoker construction workers of both lower and higher age group indicates a reduced pattern in comparison to the control group, but the difference is significant in case of lower age group smoker construction workers in comparison to the control group.

Table 4 presents the mean ± SD values of physical and haematological parameters of construction workers based on the year of exposure. Here body weight and BMI values are significantly higher ($p < 0.01$ and 0.05) in 6 – 10 years exposed workers in comparison to <5 years of exposure but 11 – 20 years and >21 years exposed workers also show insignificantly higher values of the above-mentioned parameters in comparison to <5 years exposed workers. Besides, neutrophil count of 6 – 10 years and 11 – 20 years exposed workers reflects higher values in comparison to <5 years of exposure, but the difference is significant only in case of 6 – 10 years exposure group. Lymphocyte count decreases in 6 – 10 years and 11- 20 years of exposure in comparison to <5 years exposure but in case of >21 years of exposure the value increases insignificantly. Monocyte count also tends to decrease with an increase in the year of exposure except 11- 20 years of exposure whereas the value remains almost same as that of <5 years of exposure. PCV, MCH and MCHC values remain almost same except PCV value of >21 years of exposure where the value tends to increase. Platelet count decreases, but MCV values increase significantly with a year of exposure except > 21 years of exposure.

Table 4. Mean ±SD values of physical and haematological parameters based on the year of exposure.

parameters	**< 5 years**	**6-10 years**	**11-20 years**	**>21 years**
	n=69	n=34	n=35	n=12
age	21.39 ± 7.41	25.65 ± 6.11 ***	32.46 ± 7.41 ****	49.17 ± 7.80 ****
Ht	159.47 ± 6.24	161.12 ± 4.96	161.17 ± 5.32	158.53 ± 5.16
Wt	49.78 ± 7.02	53.71 ± 7.12 ***	52.17 ± 7.03	52.92 ± 6.86
BMI	19.52 ± 2.40	20.67 ± 2.68 *	20.07 ± 2.59	19.53 ± 6.08
[Hb]	13.76 ± 1.22	13.72 ± 1.34	13.90 ± 1.58	14.03 ± 1.49
TRBC	4.76 ± 0.42	4.69 ± 0.46	4.90 ± 0.94	4.83 ± 0.50
TWBC	8120.30 ± 1087.30	8097.10 ± 937.27	8171.40 ± 1176.38	8150 ± 692.16
N	60.36 ± 5.44	62.26 ± 3.94 *	62.34 ± 5.03	60.33 ± 3.17
E	4.52 ± 2.95	3.85 ± 2.20	4.29 ± 2.48	4.25 ± 2.60
L	33.96 ± 4.63	32.82 ± 4.22	32.20± 4.98	34.33 ± 2.60
M	1.16 ± 0.68	1.06 ± 0.65	1.17 ± 0.62	1.08 ± 0.51
Platelets	2.01 ± 0.35	1.93 ± 0.13	1.90 ± 0.20 *	1.87 ± 0.20
PCV	42.50 ± 4.21	42.35 ± 3.95	42.66 ± 4.22	43.25 ± 4.52
MCV	89.19 ± 4.06	90.45 ± 2.36 *	90.66 ± 2.15 **	89.48 ± 1.96
MCH	29.02 ± 1.25	28.98 ± 1.86	29.22 ± 0.68	29.01 ± 0.23
MCHC	32.56 ± 1.00	32.43 ± 0.93	32.26 ± 0.94	32.43 ± 0.61

*=p<0.05, **= p<0.02, ***= p<0.01, **** =p<0.001

Figure 1 presents the percentage prevalence of anaemic and non anaemic based on Haemoglobin concentration and PCV values [7].

It is found that construction workers show a higher percentage of anemia based on Haemoglobin concentration and PCV values in comparison to the control group.

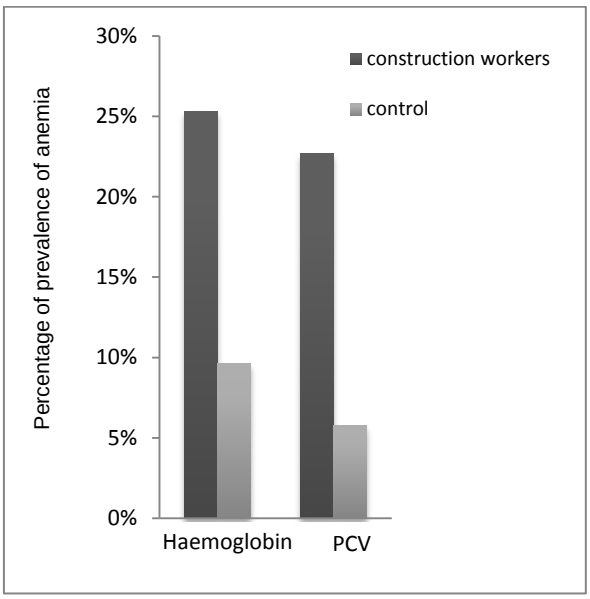

Figure 1. Percentage prevalence of anaemia among construction workers and the control group.

DISCUSSION

Blood is an excellent indicator of metabolic disorder in the body. Construction workers constantly exposed to cement dust and hazardous toxic metals in cements and paints. Haematological parameters also constitute an important tool in the toxicological study. Functional state of many tissues can be assessed by analyzing changes in haematological parameters [8].

In the present study, no significant change in erythrocyte count of construction workers has been observed, but haemoglobin concentration is lower than control group workers. This might be due to compensatory mechanism of the body in stressful condition to keep the total erythrocyte count normal which can increase immature erythrocyte in circulation. This condition is reflected as indicated by significantly low haemoglobin concentration and low PCV. A similar result has been reported by Liaquat et al. [8] for textile workers and Kokila et al. [9] for zinc electroplating industry workers.

A significant decrease in PCV values in age specific and exposure specific comparison indicates anaemic condition of the body. It is also evident by significant low haemoglobin concentration in the exposed group in comparison to the control group [3]. A significant decrease in haemoglobin concentration might be due to decrease in synthesis haemoglobin in bone marrow or decrease concentration of haemoglobin within the cell[10] .Similar findings were reported by Singhi et al. [11] and Liaquat et al. [8]. An increased MCHC value of construction workers of present study is in agreement with Divya Priya and Suja [12]. A decrease neutrophil count of a higher age group smoker construction worker leads to high rate of destruction of neutrophils and makes the body more vulnerable to infection [13]. Meo et al. [14] reported significant decrease in phagocytic activity of polymorphonuclear Neutrophils in cement workers compared to control group. Significant increase in eosinophil count has been found in both smoker and non-smoker workers of higher and lower age group. This raised level of eosinophils has been associated with parasitic infections and allergic responses [15]. Significantly higher number of eosinophils has been reported in patients positive for nerve growth factor which plays an important role in allergies and respiratory diseases [16,17]. Lymphocyte count of smoker and non-smoker workers has been changed due to altered immune response resulting in lymphocytosis in exposed workers [3,18]. Again, Jude et al. [3] and Tulinska et al. [19] reported an increase in lymphocytes in exposed silica workers.

Although in our study smoker construction workers show significantly ($p<0.01$) decreased neutrophil count and significantly ($p<0.01$) increased lymphocyte count among WBC, this significant decrease in WBC count among smoker and non-smoker may be attributed to the agonist action of smoking with cement dust, toxic metal exposure and exposure to voc paints. High MCH level in smoker than non smoker construction workers indicates an additive effect of smoking on hematopoietic system which corroborates with the finding of Ali [20] and Nieters et al. [21].

In the present study, lumphocyte and monocyte count changes with a year of exposure but other haematological parameters remain almost same with regard to the year of exposure except MCV (shows increasing pattern)and platelet count (shows decreasing pattern). However, Mojiminiyi et al. [22] found a decreasing pattern of haemoglobin concentration, PCV and total WBC count and increasing pattern of platelet count with a year of exposure among Nigerian cement factory workers. These differences might be due to very low sample size of Nigerian workers in comparison to our study. A study involving 36 – 65 years of exposure to cement dust might bring out significant haematological changes, as suggested by Guguloth et al. [23].

Again, Redlich [24] reported that various occupational exposures cause lung injury and initiate a chronic inflammatory process that may either progress to initiate fibrosis or result in repair. Alternatively, chronic exposure to irritating material might lead to adaptation process, which resists

inflammation and leukocytosis. Hanser et al. [25] suggested that adaptation process, to a certain extent, may be responsible for the non significant rise in total WBC count with regard to the period of exposure.

From the study, it can be concluded that construction workers exposed to cement dust, silica and other toxic substance showed significant haematological changes (haemoglobin, PCV, MCV) and high prevalence of anaemia which indicated toxicant contamination of working environment. As such in order to prevent the development of malignant diseases, periodic CBC test is required to detect the diseases in early stage.

Thus, we recommend that construction workers working in cement dust, and other hazardous environments should regularly use personal protective equipments like apparel, mask, and goggles in their workplace and gets a periodic medical checkup which might help detect the diseases in initial stage and must support health education.

Conflicts of interests

The author declared that they had no conflicts of interest with respect to the authorship and/or publication of this article**.**

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