

Original Research Article

Assessment of respiratory morbidity among loading and unloading workers exposed to cement dust

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Received: 12 April 2019

Accepted: 07 May 2019

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ABSTRACT

Background: A higher incidence of occupational diseases has been reported recently compared to the past years. One of the industries where workers are remarkably exposed to dust is cement industry. Several studies have been conducted to evaluate pulmonary functions and biochemical parameters of workers exposed to cement dust in factories and construction sites, but few were concentrated among loading and unloading workers of warehouses. Hence the present study was undertaken to find out the effect of cement dust among loading and unloading workers of cement warehouses.

Methods: This study was conducted among 82 exposed (cement dust) and 82 non-exposed individuals. Frequency of symptoms, biochemical parameters and spirometric values were taken from all subjects. Spirometric parameters recorded were, forced vital capacity (FVC), Forced expiratory volume (FEV1), FEV1/FVC% and Peak expiratory flow rate (PEFR).

Results: Out of exposed group, 51.2% had cough, 46.3% had rhinitis 45.2% had breathlessness. FEV1 and FVC showed significant reduction while FEV1/FVC values were normal. No significant changes were seen in renal function tests or liver function tests. Mean value of erythrocyte sedimentation rate (ESR) was found to be significantly increased.

Conclusions: Compared to normal healthy adults the loading and unloading workers in cement warehouses showed restrictive lung disease and an increase in ESR representing a non-specific inflammatory change. A continuous bio monitoring of health status must be initiated for these employees and awareness campaigns regarding the exposure and use of standardized protective devices must be mandated.

Keywords: Cement dust, ESR, Kidney function, Liver function, Occupational hazard, Spirometry

INTRODUCTION

Morbidity and mortality in occupational diseases, in spite of being preventable one, is increasing worldwide. International Labor Organization, in its report published

in 2013, observes that more than 2.3 million people die of occupational illnesses every year. Construction is an important sector which provides occupation to many and contributes greatly to the economic growth of a nation. The use of Portland cement as a building material for

construction was in practice since BC 25 as observed by Vitruvius Pollio. Portland cement is composed of calcium oxide, silicon dioxide, aluminium trioxide, ferric oxide and chromates.¹ The aerodynamic diameter of cement particles ranges from 0.05 to 10µm, and this dust enters body mainly through inhalation and ingestion.² Portland cement dust as a whole and its individual compounds are classified as chemical hazards.³ People are exposed to cement dust, during its production, transportation or at sites of building construction. It has been proven that chronic cement dust exposure leads to decline in lung function, significant increase in Total Leukocyte Count, chest pain, cough, and eye problems.⁴⁻⁶ A significant increase in erythrocyte sedimentation rate (ESR), aspartate transaminase (AST), alanine transaminase (ALT), serum creatinine and urea were also noted.⁷⁻⁹ Chronic bronchitis often associated with emphysema (COPD) has been reported as the most frequent respiratory disease due to cement exposure, followed by silicosis and mixed dust fibrosis.¹⁰ Microelements in cements like chromium is classified as carcinogenic and a strong association of developing laryngeal carcinoma and cement dust had been established.¹¹ An increased relative risk for the malignancies of lip, stomach, lung, and prostate were recorded among concrete workers.¹² Chronic occupational exposure to cement also leads to increased levels of DNA damage and repair inhibition.¹³ These findings necessitate continuous bio-monitoring of such occupational groups in order to assess their health status.

Spirometry is considered as an invaluable screening test to assess respiratory health.¹⁴ Various spirometric studies have already been done among workers exposed to cement dust.¹⁵⁻¹⁷ A study conducted among loading workers in Nigeria concludes that chronic exposure to cement dust can cause a decrease in hemoglobin content.¹⁸ Apart from this, no studies have been conducted among loading and unloading workers of cement warehouses, who are exposed to cement dust considerably. No scientific document, evaluating association of exposure to cement dust with pulmonary functions among such workers of cement warehouses, is available. In view of this, it was thought necessary to assess the respiratory morbidity among the above mentioned group exposed to cement dust.

METHODS

This study was conducted under the auspices of Dept. of Anatomy, Jubilee Mission Medical College, Thrissur as part of research work, "Genetic studies in workers occupationally exposed to cement dust". Study population was loading and unloading workers of cement warehouses in Thrissur, Kerala.

Criteria for inclusion in the study group were males having minimum one year continuous exposure to cement dust as loading and unloading worker in a cement warehouse and were considered as exposed group. People

with habits of smoking, alcohol consumption, pan or tobacco chewing, having known systemic diseases, people under medication, recent X-ray exposure and females were excluded from the study. An equal number of people residing in the same geographical location with similar age frequency, sex, socio economic status, social habits and without present or past exposure to cement dust were selected as controls (Non-exposed). Duration of study was 2 years. The study was approved by the Institutional ethical committee of Jubilee Mission Medical College and Research Institute, Thrissur

Methodology

After obtaining an informed consent, 82 male workers with minimum of one-year exposure to cement dust as loading and unloading worker, were included in this study. Subjects were grouped based on their years of exposure to cement dust to Group1 (≤ 15 years), Group2 (> 15 years). All participants underwent spirometry by using Cosmed microquark portable spirometer, Omnia 2.1A. Three technically satisfactory maximal forced exhalations were recorded and the best predicted values of Forced expiratory volume in one second (FEV1), Forced vital capacity (FVC), FEV1/FVC and Peak expiratory flow rate (PEF) were taken into account for statistical analysis. Spirometry was performed according to European respiratory society guidelines by an experienced technician and the evaluation of values gained was based on Gold criteria.^{14,19} 5ml peripheral blood was collected from each subject to analyze blood urea, creatinine, AST, ALT and ESR. Symptoms such as cough, breathlessness, itching, eye irritation, rhinitis were noted among exposed group by physician.

Statistical analysis

To evaluate the significance of means between exposed and non-exposed groups Student's 't' test for parametric values and Mann Whitney test for non-parametric values were performed. Univariate analysis of spirometric values was performed using Pearson Chi-Square test. SPSS version 19 was used to analyze the results.

RESULTS

Sociodemographic features

The median (IQR) age of exposed group was 44 (12) and non-exposed group was 44.5 (13) and there was no significant statistical difference between them ($P > 0.05$). The average BMI was 24.63 (± 3.21) and 25.91 (± 2.62) respectively. The average years of exposure to cement dust among exposed group was 13.78 (± 7.85).

Biochemical parameters

The hematological parameters analyzed among the groups are represented in Table 1. A slight increase in serum urea among exposed group 23(5.25) compared to

non exposed group 22(6) and significant increase in ESR among exposed 14(4) compared to non exposed group 11(2), ($p < 0.05$) is observed. Serum creatinine, AST and

ALT remained non-significant among the groups ($p > 0.05$).

Table 1: Biochemical parameters among exposed and unexposed groups.

Parameters analysed	Exposed (N1=82) median (IQR)	Non exposed (N2=82) median (IQR)	U statistic	P value
Blood urea-mg/dl	23 (5.25)	22 (6)	2592.50	0.011*
Creatinine mg/dl	1.07 (0.15)	1.06 (0.14)	3074.00	0.343
AST-U/L	27 (13.50)	28 (7.25)	2975.50	0.203
ALT- U/L	30 (25.50)	31 (10)	3302.00	0.843
ESR mm 1 st hour	14 (4)	11 (2)	674.50	<0.001*

IQR = Interquartile range, U=Mann Whitney value (Non parametric test), *Significant

Lung parameters

FVC percentage of the predicted were significantly ($p < 0.05$) reduced among exposed groups 82(10.25) compared to non-exposed 87(9). Whereas FEV1/FVC percentage of the predicted and PEF rates were non-

significant among the groups. The values are represented in Table 2. Mean (SD) of FEV1 % was noticed as 79.18 ± 1.18 and 83.35 ± 0.92 among exposed and non-exposed groups respectively and is significantly reduced (Figure 1). Symptoms noticed among the cement exposed groups are mentioned in Figure 2.

Table 2: Spirometric analysis among exposed and unexposed groups.

	Exposed (n=82) Median (IQR)	Non- exposed (n=82) Median (IQR)	Test statistic	P value
FVC % of predicted	82.00 (10.25)	87.00(9)	1903.00 ^a	0.0001
Fev1/FVC % of predicted	99.50 (17.25)	93.00 (14.3)	2780.00 ^a	0.056*
PEF	7.69 (2.47)	7.43 (1.80)	3353.50 ^a	0.98*

IQR = Interquartile range, a=Mann Whitney value (non-parametric test), b= t value (parametric test), *Not significant

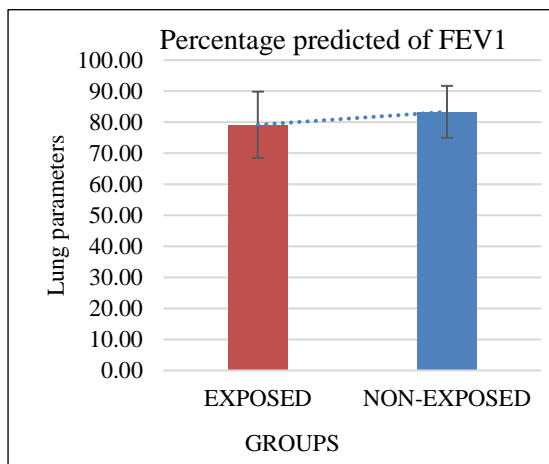


Figure 1: Mean±SD of predicted value of FEV1% among exposed and non-exposed groups (t=2.78, P<0.05).

Among the exposed groups (n=82) 32.9% of subjects demonstrated FVC<80%, 53.7% had FEV1<80% and

2.4% had a reduced FEV1/FVC%. FVC% and FEV1% of the exposed subjects in comparison to non-exposed groups showed an 8 fold and 4 fold increase in reduction of lung volumes (<80%) respectively. The univariate analysis of the lung function values is represented in Table 3. A high prevalence was noticed in reduction of FEV1 and FVC (<80%) as the year of exposure to cement dust increased (Table 4).

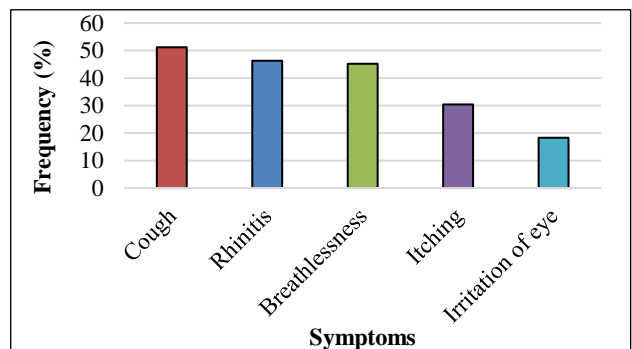


Figure 2: Symptoms observed among exposed group.

Table 3: Univariate analysis of spirometric values (n=82).

	FVC (predicted %)				FEV1 (predicted %)				FEV1/FVC (predicted %)			
	<80%	≥80%	OR	95%CI	<80%	≥80%	OR	95%CI	<80%	≥80%	OR	95%CI
Exposed	32.9	67.1			53.7%	46.3%			2.4%	97.6%		
Non-exposed	6.1	93.9	7.56	2.74 - 20.86	25.6%	74.4%	3.363	1.74- 6.50	3.7%	96.3%	0.658	0.107- 4.047
P value	<0.001				<0.001				0.650*			

*NS- Not significant, OR-Odd ratio, CI- Confident interval

Table 4: Univariate analysis of spirometric values based on years of exposure (n=82).

Years of exposure	FVC (predicted %)				FEV1 (predicted %)			
	<80%	≥80%	OR	95%CI	<80%	≥80%	OR	95%CI
>15yrs	60.0%	40.0%	10.25	3.44-30.53	65.7%	34.3%	2.37	0.96-5.86
≤15yrs	12.8%	87.2%			44.7%	55.3%		
P value	<0.001				0.059*			

*NS- Non-significant, OR-Odd ratio, CI- Confident interval

DISCUSSION

This study was done to observe the effects of cement dust on the pulmonary function of loading and unloading workers of cement warehouses. Total number of study population was 164 (82 exposed and 82 non-exposed). All members of groups were males. Since there was no significant statistical difference between the age distributions of exposed and non-exposed populations, both groups were found to be matching ($p>0.05$).

Out of 82 subjects 51.2% had cough as their principal symptom related to respiratory system. Next was rhinitis in 46.3%, and breathlessness in 45.2%. Symptoms related to other systems were mainly itching over skin of forearm and hand (30.4%) and irritation of eyes (18.29%). These values are significantly higher than the distribution of these symptoms in general population. Breathlessness for 45.2% of study group is markedly high, when compared to the 10-15% of the general population.²⁰ This is in agreement with the study conducted by Nordby et al, in which number of workers with airway symptoms were more among exposed group, (OR-2.6).²¹

When pulmonary functions were analyzed, it was found that both FEV1 and FVC were significantly decreased in exposed group compared to the unexposed group. These observations are in line with the findings of Noor et al; for Malaysian cement workers, Alakija et al, for workers of Nigeria and Al-Neaimi et al, for workers of Arab.²²⁻²⁴ At the same time the ratio between FEV1 and FVC remained comparable without much significant difference. This points to the fact that the abnormality produced by the cement dust is of restrictive nature. This is in total agreement with the results of an Indian study by Majumdar et al, in which 28% of higher age group workers and 19% of lower age group workers had restrictive abnormality.²⁵

The damaging effect of cement dust was reinforced by the fact that workers with longer duration of exposure had severe decline in lung function compared to workers with lesser duration of exposure. When the subjects were divided into two groups based on duration of exposure (>15yrs and <15yrs), >15yrs group had 10.25 times higher chance of affecting their FVC while <15yrs group had only 2.3 times of affecting their FVC. One more revelation from this analysis was, rate of decline in FVC with duration of exposure was more than the rate of decline in FEV1. This once again proves the restrictive nature of damage by exposure to cement dust. These results are in agreement with the study done by EI Badri et al.²⁶

Contradictory reports are available on the effect of cement dust exposure on liver and kidney function parameters. Ezeji for and Mba reported that there is no effect on hepatic parameters in cement dust exposure.²⁷ Whereas Sameen observed nephrotic effect has indicated by increased serum urea and creatinine values.⁹ In the present study we observed a slight increase in serum urea levels but no such effect was seen in creatinine levels. Hence it can be concluded that cement dust exposure has no significant nephrotic effects. Sameen and Richard et al, reported significant increase in hepatic parameters (AST and ALT) in subjects exposed to cement dust.^{9,28} The present study showed no significant change in AST and ALT levels in cement exposed subjects when compared to unexposed subjects.

Previous studies showed that the ESR which is a non-specific inflammatory marker is significantly higher in subjects exposed to cement dust as compared to controls. In the present study a statistically significant increase was observed in ESR in cement dust exposed group compared to control group. The differences observed in biochemical and hematological parameters in various studies may be

attributed to the study population, duration of exposure and also ethnic variations.

CONCLUSION

A decreased lung function representing a restrictive lung disorder was noticed among loading and unloading workers of cement warehouses and found to be directly proportional to the duration of exposure. This could be due to the toxic components of cement dust. A continuous biomonitoring of health status must be initiated, for those who are occupationally exposed to such a toxic compound. Awareness campaigns regarding the exposure and standardized protective devices must be mandated. Proper training of using such devices should be necessitated in concern to the above findings. This would benefit them with a better working and healthy conditions in such occupational environments.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee (51/14/IEC/JMMC and RI)

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Cite this article as: Krishna L, Pandarikkal JR, Sreedharan R, Sampson U, Annamala PT, Unni KM. Assessment of respiratory morbidity among loading and unloading workers exposed to cement dust. *Int J Res Med Sci* 2019;7:2422-7.