

Comparative study of pulmonary functions in cement factory workers of Bagalkot

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Abstract

Background: The cement plant workers are exposed to fine cement dust, which irritates the mucous membranes of the respiratory airways, and leads to reduction in pulmonary functions among exposed workers.

Hypothesis: The study is based on the hypothesis that cement dust affects the pulmonary functions

Aim: To record and compare the pulmonary functions among the subjects exposed to cement dust directly with that of non exposed subjects taken from general population of Bagalkot.

Methods: A total of 132 apparently healthy age and sex matched subjects 66 cement factory workers who were directly exposed to cement dust and 66 subjects from general population of Bagalkot were selected. Forced expiratory spirometers were recorded by Helios 401 hand held portable computerized spirometer [M/s Recorders & Medicare Systems Ltd. India]. Parameters such as Forced Vital Capacity [FVC], Forced Expiratory Volume in 1st second [FEV₁], the ratio of FEV₁/FVC, Forced Expiratory Flow in the middle half of FVC [FEF_{25-75%}] and Peak Expiratory Flow Rate [PEFR] were assessed and statistically analysed using students 't' test and ANOVA.

Result: Statistically significant reduction in FVC, FEV₁, and PEFR was found in exposed workers as compared to the non-exposed. Although FEV₁/FVC ratio and FEF_{25-75%} was less in exposed workers, the difference was found to be insignificant.

Keywords: cement dust, pulmonary functions, cement factory workers.

Introduction

The world wide community, especially the people in developing countries, are facing increasing risks of developing respiratory diseases due to the production of smoke and dust in different occupational and industrial sectors. The health risks posed by inhaled dust particles are influenced by the biological responses exerted by the particles [1]. Cement industry though being involved in the development of the structure of this advanced modern world, it generates dust during its production, and its workers are exposed to dust at various production points such as crusher, rotary kiln, cranes, mills, storage silos and packing sections [2,3,4]. Portland cement dust is a mixture of calcium oxide, silicon oxide, aluminium trioxide, ferric oxide and magnesium oxide. Cement factory workers are exposed to fine cement dust measuring 0.05 to 5.0 µm in diameter [2]. These particles are

respirable in size, consequently occupational exposure to cement dust in these workers can cause numerous health hazards including the onset of acute or chronic respiratory diseases and deficit in pulmonary functions.

Although ample number of foreign studies are available in this regard, but very few studies are seen in Indian population. So the present study was undertaken for the first time in the town of Bagalkot to record and compare the pulmonary functions [FVC, FEV₁, FEV₁/FVC, PEFR, FEF_{25-75%}] among the subjects exposed to cement dust directly in the cement factory and unexposed subjects taken from general population and, there by studying the risk associated with the cement dust exposure.

Methods

After obtaining approval from the institutional ethical committee, the present study was taken up to

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record the pulmonary functions among the subjects exposed to cement dust directly in the cement factory and unexposed, and study the risk associated with exposure. The study was carried out in the Department of Physiology, S.Nijalingappa Medical College hospital, Bagalkot on 66 male employees [cases] aged more than 20 years who were directly exposed to cement dust for 2 yrs or more in Bagalkot cement & Industries Ltd. Age and sex matched equal number of apparently healthy attenders of patients attending the outpatient department of the S.Nijalingappa Medical College hospital, Bagalkot were chosen as [controls]. Following subjects were excluded from the study

1. Employees belonging to the age group of less than 20 years.
2. Employees working in the office of the factory.
3. Employees with a past history of any respiratory disorder before joining the factory.
4. Employees with any history of systemic illnesses like diabetes, epilepsy and cardiac disease.

After taking written informed consent from each subject, the health status of the workers was ascertained through history taking and clinical examination. Physical characteristics like weight (kg) was measured using calibrated weighing machine in light clothing and bare feet, and height (cm) was measured using measuring scale in centimeters which was fixed to the wall. Body mass index was calculated using the formula: $\text{Body weight (kg) / height}^2 \text{ (m)}$. HELIOS 401 hand held portable computerized spirometer [M/s Recorders and Medicare Systems Ltd. India] was used for measuring the lung functions. This spirometer has a mouth piece attached to a transducer assembly which is connected to the computer by a cable. Software of (M/s Recorders and Medicare Systems Ltd. India) was installed in the computer.

Subjects were motivated prior to the start of the maneuver. The pulmonary functions of all the subjects were done in the morning session between 11 am and 1 pm. Each subject was made to rest for 15 min. In standing position, with nose clips and with lips firmly held around the reusable mouth piece, the subject was asked to inspire maximally and then expire forcefully and rapidly into the mouth piece. Three attempts were made and the best of the three spirograms were

selected. The following parameters were studied in each of the spirograms obtained:

FVC, FEV₁, PEFR, FEF_{25-75%}, FEV₁/FVC

Data was expressed in terms of Mean \pm Standard deviation. Analysis of the quantitative variables between two groups was done by students' t' test using SPSS package (Version 16, Chicago). p-value of 0.05 or <0.05 was considered as statistically significant.

Results

The distribution of cases and controls is depicted in graph 1. The physical characteristics are shown in graph 2. Statistically significant reduction in FVC, FEV₁, and PEFR was found in exposed workers as compared to the non-exposed. Although FEV₁/FVC ratio and FEF_{25-75%} was less in exposed workers, the difference was found to be insignificant illustrated in table 1.

Discussion

A significant reduction in the level of FEV₁ and FVC in cement factory workers observed in the present study as compared to their matched controls confirms the earlier studies by Elsewefy et al [5], Oleru UG [6], Alakija et al [7], Yang et al [8], Noor H et al [9], AL-Neami YI et al [10], Meo SA et al [11], Mirzaee R et al [12]. On the contrary Abrons et al [13], Fell AKM et al [14] found no difference in the levels of FEV₁ and FVC among cement factory workers and controls. A probable reason for this difference in the above two reports could be a difference in the selection criteria of subjects. Abrons et al [13] selected blue collar workers as control subjects from machine shops and a machine manufacturing plants, manufacturing electric and electronic equipment. There is a possibility that, these blue collar control subjects are also at the risk of pulmonary function impairment. Fell AKM et al [14] could not include those workers who were really susceptible to adverse respiratory effects from cement dust, as they had quitted work and therefore dropped out of the exposed group.

This significant reduction in both FEV₁, FVC in the cement factory workers of the present study can be attributed to the irritant effect of cement dust on the respiratory apparatus or could be due to structural restrictive change in the lung tissue.

The levels of FEV_1/FVC reduced in the present study, but it was not statistically significant, a similar finding was also reported by Neghab et al [15], Badri OA et al [16]. This could be attributed to the lesser sample size. But levels of FEV_1/FVC reduced significantly in a study reported by AL-Neami YI et al [10], BA Abudhaise et al [17], Mwaiselage J et al [18].

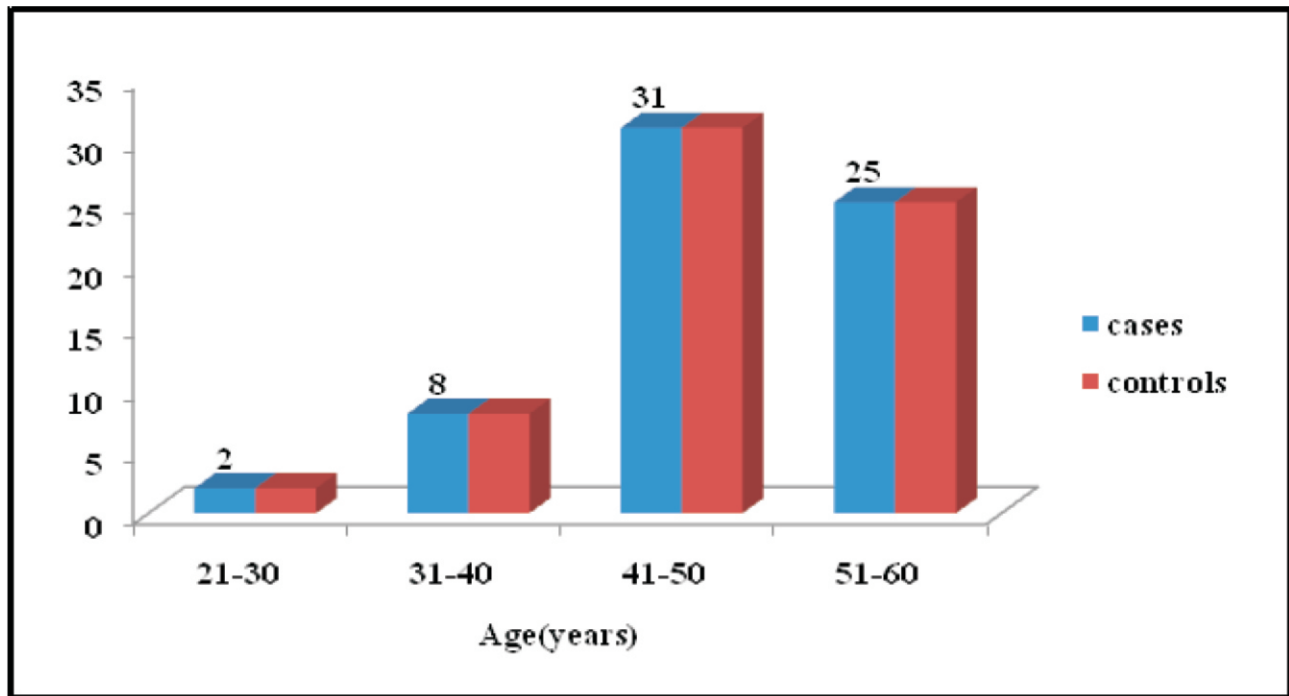
FEV_1/FVC levels remained same in a study done by Fell AKM [14]. This might be due to more vigilant preventive measures used by the cement factory workers. The levels of FEV_1/FVC increased in a study done by Meo SA et al [11] which showed restrictive change in the lung. The insignificant difference in the FEV_1/FVC ratio in the present study indicates that there is less element of obstructive pulmonary disease among the cement factory workers.

Significant reduction in the level of PEFR is

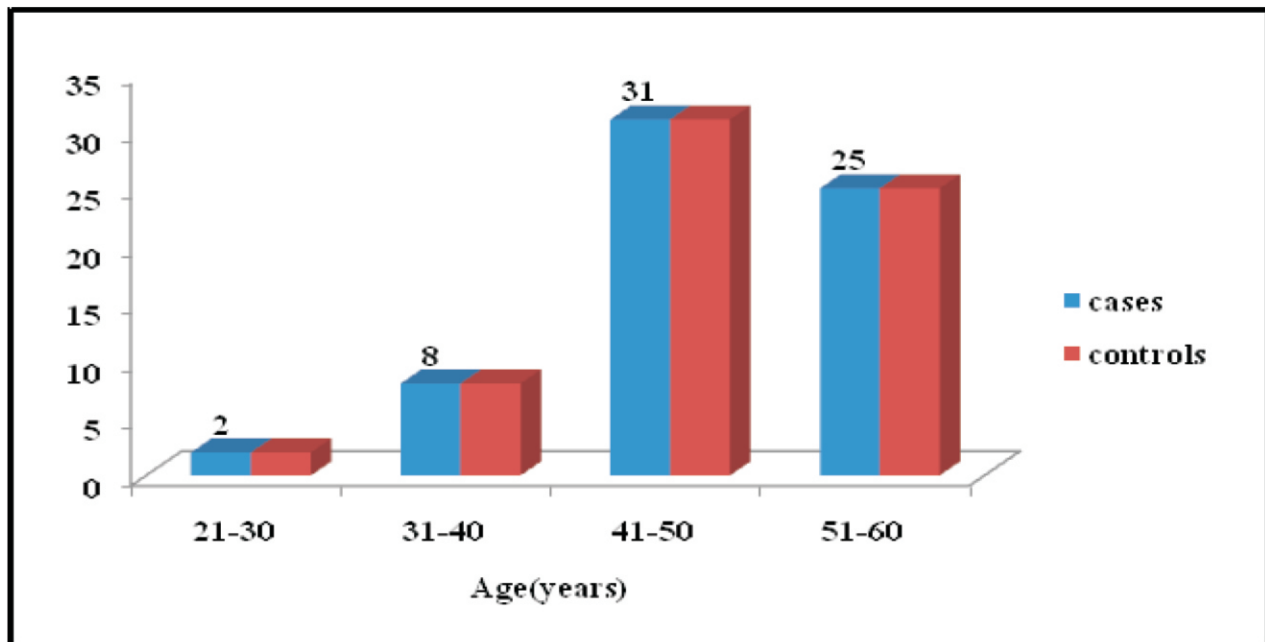
similar to the report of Alakija et al [7], Badri OA et al [16], Hussain et al [19], Mengesha YA et al [20]. The significantly reduced PEFR levels in the present study might be due to bronchoconstriction caused by cement dust during the workshift of the workers [19]. $FEF_{25-75\%}$ indicates the patency of small airways, which is reduced in cement factory workers as compared to their counter parts in the present study, but this reduction was not statistically significant, a similar finding was reported by Meo SA et al [11]. While the reports of Mengesha YA et al [20] showed significant reduction in the level of $FEF_{25-75\%}$. This could be due to the exposure of the cement factory workers to different type of dust such as yarn, cigarette smoking apart from cement dust. Therefore significantly reduced FEV_1 , FVC, PEFR implies that exposure to Portland cement dust could result in restrictive and obstructive pulmonary disease.

Table 1. Comparison of pulmonary functions between cases and controls

Variable	Group	N	Mean	Standard Deviation	t*	P-value	Significance
$FEV_1(L)$	Cases	66	1.45	0.74	10.23	< 0.001	HS
	Control s	66	2.52	0.43			
FVC(L)	Cases	66	1.75	0.60	9.65	< 0.001	HS
	Control s	66	2.78	0.62			
FEV_1/FVC (%)	Cases	66	82.67	32.41	1.65	0.10	NS
	Control s	66	89.73	12.37			
PEFR(L/s)	Cases	66	5.64	1.91	7.17	< 0.001	HS
	Control s	66	7.83	1.59			
$FEF_{25-75\%}$ (L/s)	Cases	66	3.22	1.48	1.58	0.12	NS
	Control s	66	3.54	0.79			



Graph 1. Age wise distribution of cases and controls



Graph 2 . Physical characteristics between cases and controls

Conclusion

Our results suggest that factory workers within few years of cement dust exposure develop reduction in pulmonary functions and these effects might worsen on continued exposure, so we recommend the cement factory management to safeguard the health of workers by conducting health education on hazards of exposure to cement dust, adapt safety precautions, encouraging usage of protective gadgets, periodic monitoring of cement dust level in and around the factory environment and proper dust emission by the use of dust filters.

References

1. Meo SA, AL-Drees MA, AL-Masri AA, AL RouqF, Azeem MA. Effect of Duration of exposure to Cement dust on Respiratory function of Non-Smoking Cement mill workers. *Int. J. Res. Public Health*.2013;10:390-398
2. Akinola MO, Okwok NA, Yahaya T. The Effects of Cement Dust on Albino Rats (*Rattus norvegicus*) A Portland Cement Factory in Sagamu, Ogun State, Nigeria. *Res.J.Toxicol*.2008;2: 1-8
3. Meo SA. Chest Radiological Findings in Pakistani cement mill workers. *Saudi Med J*.2003;24(3): 287-90
4. FBO Mojiminiyi, IA Merenu, CH Njoku, MTO Ibrahim. Regression Formula for Predicting Hematologic and Liver Functions From years of Exposure to Cement Dust in Cement Factory Workers in Sokoto, Nigeria. *African Journal of Biomedical Research*.2007; 10:235-240
5. AZ.El-Sewefy, S.Awad, M Metwally. A. Z. Spirometric measurements in an Egyptian port-land cement factory. *J Egypt. Med Assoc.* 1970; 53 (2): 179-186
6. Oleru UG. Pulmonary function and symptoms of Nigerian workers exposed to cement dust. *Environ Res.* 1984; 33(2):379-85
7. W. Alakija, VI Iyawe VI, LN Jarikre, JC Chiwuzie. Ventilatory function of workers at Okpella cement factory in Nigeria. *West Afr J Med*.1990; 9(3):187-192
8. CY Yang, CC Huang, HF Chiu, JF Chiu, SJ

- Lan, YC Ko. Effects of occupational dust exposure on the respiratory health of Portland cement workers. *J Toxicol Environ Health*.1996; 49(6):581-8
9. Noor H, Yap CL, Zolkepli O, Faridah M. Effect of Exposure to Dust on lung Function of Cement Factory Workers. *Med J Malaysia*. 2000; 55(1):51-7
10. AL-Neami YI, Gomes J, Lloyd OL. Respiratory illnesses and Ventilatory function among workers at a cement factory in a rapidly developing country. *Occup.Med*.2001; 51(6):367-373
11. Meo SA, Azeem MA, Ghorri MG, Subhan MMF. Lung Function and Surface Electromyography of Intercostal Muscles in cement mill workers. *Int J Occup Med Environ Health*.2002; 15(3):278-286
12. MirZae R, Kebriaei.A, Hashemi .SR, Sadeghi.M, Shahrakipour.M. Effects of exposure to Portland cement dust on lung function in Portland cement factory workers in Khash, Iran. *Iran.J. Environ. Health.Sci.Eng*.2008; 5(3):202-206.
13. Abrons HL, Petersen MR, Sanderson WT, Engelberg AL, Harber P. Chest Radiography in Portland cement Workers. *J Occup Environ Med*.1997; 39(11):1047-54
14. FellAKM, Thomassen TR, Kristensen P, Egeland T, Kongerud J. Respiratory Symptoms and Ventilatory Function in Workers Exposed to Portland cement Dust. *J Occup Environ Med*. 2003; 45:1008-14
15. Neghab M, Choobineh A. Work-related Respiratory Symptoms and Ventilatory Disorders among Employees of a Cement Industry in Shiraz, Iran. *J Occup Health*.2007; 49:273-8
16. Badri OAEL, Saeed AM. Effect of exposure to cement dust on lung function of workers at Atbara Cement Factory. *Kharoum Medical Journal* 2008; 1(2):81-4.
17. BA AbuDhaise, AZ Rabi, MA al Zwairy, AF el Hader, S el Qaderi. Pulmonary manifestations in cement workers in Jordan. *Int J Occup Med Environ Health*. 1997; 10(4):417-28

18. Mwaiselage J, Bratveit M, Moen B, Yost M. Variability in Dust Exposure in a Cement Factory in Tanzania. *Ann. Occup. Hyg.* 2005; 49(6):511-519.
19. Hussain S, Mohiuddin M, Shakeel-Ur-Rehman M, Rafiq A, Ashfaq Ahmed M. PEFr in cement pipe factory workers. *Indian J Physiol Pharmacol.* 1999; 43(3):405-6
20. Mengesha YA, Bekele A. Relative Chronic effects of different occupational dusts on respiratory indices and respiratory health of workers in three Ethiopia factories. *Am. J. Ind. Med.* 1998; 34:373-380.

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