Pulmonary Function Test in Cement Workers in Iraq

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ABSTRACT:

BACKGROUND:

Exposure to cement dust has long been associated with the prevalence of respiratory symptoms and decline in pulmonary function.

OBJECTIVE:

This study assessed the effect of exposure to cement dust on lung function in cement factory workers in Iraq , by measuring Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV1), FEV1/FVC ratio and Forced Expiratory Flow 50% (FEF50%).

PATIENTS AND METHODS

180 workers enrolled in the study , 171 , are male (93.44%) and only 12 are female(6.56%). and 100 workers controls (non exposed) were selected.The age of the subjects ranged between 20-50 years. Both groups were smokers and non smokers, had no chronic pulmonary diseases or symptoms during the time of study. Spirometeric study was used to measure FEV1, FVC, FEV1/FVC ratio and FEF50% .

RESULTS:

Statistically, significant reduction in FEV1 and the FEV1/FVC ratio were found in exposed workers when compared to control. Lung function indices were found to be not affected with increasing duration ofexposure to cement dust nor with smoking.

CONCLUSION:

Exposure to Portland cement dust may result in reduction in the pulmonary function and may lead to respiratory diseases.Implementing measures to control dust and providing adequate personal respiratory protective equipment for the production workers are highly recommended.

***KEY WORDS*:** lung function, cement dust workers

INTRODUCTION:

Anyone living or working in a dusty environment is exposed to dust, especially particles less than 10 micrometer, Exposure even of healthy persons to the pollutants may result in reductions in pulmonary performance[1].

The health risks posed by inhaled dust particles are influenced by the deposition pattern of the particles in the various regions of the respiratory tract and by the biological responses exerted by the deposited dust particles. Cement dust irritates the skin, the mucous membrane of the eyes and the respiratory system[2].

Inhaled particles can penetrate and deposit in different parts of the human respiratory system, from the nose and mouth, to the bronchi and alveoli of the lung[3].

Cement is typically produced by heating a homogenous blend of limestone and clay, which is then adjusted to a suitable content of calcium, silicon, aluminum and iron in a kiln[4].

The resulting exposure to cement dust has led to impairment of respiration and a prevalence of respiratory symptoms amongst workers[5] and varying degrees of airway obstruction and reduction in lung function[1].The severity of the impairment of respiratory function has been shown to depend on years of Exposure[6]

However there are reports that contradict this , these reports suggest that cement dust exposure may neither increase the morbidity of respiratorydiseases [7,8], nor be associated with the prevalence of respiratory symptoms among workers.[9]

The sections in the cement production process include crusher, crane, raw mill, kiln, cement

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mill and packing[2]. Exposure to cement dust may occur at most stages of the manufacturing process [5].and higher dust concentrations have been reported in the crusher and packing sections than in other sections [10].

Workers in developing countries are often from lower socioeconomic classes and are frequently hired without appropriate training and deployed atwork sites without proper personal protective equipment or ventilation [5].

MATERIALS AND METHODS:

The study population comprised those working in three cement factories in Baghdad and Al-Dewania goverments.180 workers enrolled in the study .Spirometric test was done by the staff of National Center for Occupational Health and Safety in the cement factory for the workers who visited these center factories for routine examination . They had been exposed to cement dust for a period of 1-40 years.

An unexposed (control) group consisted of 100 persons who were not exposed to dust who visited of National Center for Occupational Health and Safety for routine checkup (as the teachers and clerks), belonged to the same age groups.

Data collection was effected by way of an interviewer-administered structured questionnaire, to determine the name , age ,gender ,duration of exposure ,smoking, history of past disease(s).

Workers with history of chronic respiratory diseases or symptoms during the time of study, and those with history of ex smoking, were excluded from the study.

Lung function tests were carried out with a vitalograph spirometer for both the exposed and control groups. The procedures were carefully explained and demonstrated to each subject and then the tests were carried out. Forced vital capacity(FVC), forced expiratory volume in 1 second(FEV1),the ratio of FEV1/FVC, and forced expiratory flow 50% (FEF50%) were measured using a vitalograph spirometer. The recording was done with each subject standing, with using nose clips, and with the lips firmly applied around the disposable mouthpiece. The subject inspired maximally and then expired as forcefully and rapidly as possible into the vitalograph. Three attempts were made and the best of the three spirogram was selected

Statistical analysis

Statistical analysis was performed with the statistical package for social sciences (SPSS) Version 19 and Microsoft Excel 2010 for configuration of data, tables and figures.

Numerical data were described as mean, standard error, also, comparison among more than two groups was done using analysis of variance (ANOVA) and independent sample t-test for comparison between two groups.

Categorical data were described as frequency and percentage; comparison done by Chi -square test.

P-value of 0.05 was used as the level of significance.

RESULTS:

Table 1 showed the gender of exposed and control groups , the total number of exposed group is183 , 171one , are male (93.44%)and only twelve are female(6.56%).While the control group was one hundred ,sixty four of them were male(64%) and thirty six were female(36%).

Table 2showed the Comparisn between exposed and control groups in abnormal PFT in which there is statistically significant difference in FEV1 between exposed and control groups ($p \leq 0.05$),and highly statistical significant in the ratio of FEV1/FVC($p \leq 0.001$).while the FVC,FEF50% did not differ significantly between the exposed and the control groups .

Table 3showed the Comparisn between duration of exposure and abnormal PFT inwhich there is no statistically significant difference in FVC, FEV1, the ratio of FEV1/FVC, and FEF 50% among the three groups of duration (1-9 years,10-19 years,20 years and more) .

Table 4 showed the Comparisn between smoker and abnormal PFT in which there is no statistically significant difference in FVC, FEV1 , the ratio of FEV1/FVC, and FEF50% between the smokers and non smokers groups .

Table 1: Gender of exposed and control groups.

		Study groups			
		Exposed group		Control group	
		Count	Percentage	Count	Percentage
Gender type	Male	171	93.44%	64	64.00%
	Female	12	6.56%	36	36.00%
	Total	183	100.00%	100	100.00%

p≤0.001.

Table 2: Comparisn between exposed and control groups in abnormal PFT

	Study groups				
	Exposed group		Control group		p value
	Mean	Std. Error	Mean	Std. Error	
FEV1	89.85	1.21	93.79	1.60	0.050*
PVC	88.17	1.10	89.77	1.32	0.371^{NS}
Ratio	101.78	0.64	96.51	0.80	0.001**
FEF 50%	88.10	1.90	92.02	3.28	0.269^{NS}

NS= not statistically significant (p>0.05).
* = statistically significant (p≤0.05).
**= highly statistical significant (p≤0.001).

Table 3: Comparisn among duration of exposure and abnormal PFT

		N	Mean	Std. Error	Sig.
FEV1	1-9 years	103	88.42	1.33	0.356^{NS}
	10-19 years	39	90.67	3.02	
	≥20 years	41	92.66	3.16	
PVC	1-9 years	103	86.22	1.57	0.095^{NS}
	10-19 years	39	92.05	1.99	
	≥20 years	41	89.39	2.13	
Ratio	1-9 years	103	102.38	0.83	0.565^{NS}
	10-19 years	39	100.85	1.50	
	≥20 years	41	101.15	1.38	
FEF 50%	1-9 years	103	86.99	2.08	0.797^{NS}
	10-19 years	39	89.92	4.72	
	≥20 years	41	89.17	5.03	

NS= not statistically significant (p>0.05).

Table 4 : Comparisn between smoker and abnormal PFT

	Study groups							
	Exposed group				Control group			
	Smokers		Non-smokers		Smokers		Non-smokers	
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
FEV1	90.10	2.18	89.64^{NS}	1.32	94.95	2.51	93.48 ^{NS}	1.92
PVC	90.45	1.41	86.33 ^{NS}	1.61	89.48	2.16	89.85 ^{NS}	1.58
Ratio	100.30	0.92	102.97^{NS}	0.88	95.14	1.39	96.87 ^{NS}	0.95
FEF 50%	86.17	2.97	89.67^{NS}	2.46	92.57	8.03	91.87 ^{NS}	3.59

NS= not statistically significant (p>0.05).

DISCUSSION:

In this study the results of pulmonary function showed that there is significant difference between exposed to cement dust and control groups in FEV1 .

This result is also in agreement with Mwaiselag *et al* [11], Meo *et al*[12] who observed significant difference in Forced Expiratory Volume in the first second (FEV1) in workers who were in closer contact with cement dust . However it has been suggested that the reduced FEV1% in cement factory workers may be due to reflex bronchospasm triggered by inhaled irritant cement dust or as a result of type 1 hypersensitivity reaction [6].

Also in this study the ratio of FEV1/FVC was significantly difference (increase) between exposed and control groups, this is due to the reduction in both FEV1 and FVC in the exposed group ,in spite of that the reduction in the FVC was not significant between the exposed and the control groups. Ali et al [13] and Al-Neaimi et al[5] reported significant reduction in FEV1/ FVC ratio in exposed workers when compared to control that is because the reduction in their studies was more in FEV1 than in FVC.

Also a report suggests that cement dust exposure may decrease lungandthoracic compliance by impairing intercostal muscles performance[12]. These effects of cement dust may account for the observed impairment of lung function observed in this study.

This study also failed to show a significant difference in FVC ,FEF50%, In contrast Yang *et al*[14] observed significant reductions of ventilatory capacity (FVC, FEF50) in dust-exposed Portland cement workers than in the control workersThis difference may be related to the inability to measure the particle size fractions in this study .

The relationship between duration of exposure and abnormal respiratory function in this study showed no significant difference, Marko et al[15] study suggests that the decrement in ventilatory indices with time is greater in cement workers than in controls but the difference is not Statistically significant. This indicate that the effect of cement on the lung function parameters affected be by other factors like worker susabtability, the concentration of the dust .

The differences in the ventilatory function between the exposed smokers and non smokers and the unexposed smokers and non smokers did not achieve statistical significance ,this was in agreement with the similar result of Al-Neaimi [5]who also did not show statistical significance in the ventilatory function between the exposed and the unexposed smokers. Smoking was not quantified as how many pack per year, and this may have contributed to the non significant effect of smoking status on ventilatory function. However, the smokers among the exposed workers were observed to have lower ventilatory function(FEV1,FEV1/FVC ,FEF50%)compared with the unexposed smokers but no statistically significant ,suggesting that smoking may further exacerbate the damage torespiratory epithelium by cement dust. This assumption agrees with the observation made by AbuDhaise et al [16].

CONCLUSION:

This study of cement workers with controls, has shown that Exposure to cement dust in a cement factory in Iraq is associated with decreased ventilatory lung function of the workers.Therefore,
there is an urgent need for the management embark on safety training in work environment and conduct health education on hazards of exposure to cement dust, safety.
They should acquire effective protective measures. Also there should be regular/periodic monitoring of cement dust level in and around the factory environment, and containment of dust emission by the use of dust filters

REFERENCES:

1. Noor H,Zolkepli O , Faridah M**,** et al .Effect of Exposure to Dust on Lung Function of Cement Factory Workers**.**Med J Malaysia 2000;55:51-57.
2. Bente E M ,Magne B, Zeyede K. A cross shift study : Cement dust exposure and acute lung function. *BMC Pulmonary Medicine* 2010:10:19.
3. Vincent JH.Particle size-selective criteria for fine aerosol fractions.In:Aerosol Sampling. Science, Standards, Instrumentation, and Applications Chichester, 2007:255–87.
4. Nordby K, FellA.K., Notó H.et al. Exposure to thoracic dust and symptoms and lung function in cement production workers, airway.EurRespir J 2011;38:1278–86.
5. Al-Neaimi YI, Gomes J, Lloyd OL **.**Respiratory illnesses and ventilatory function among workers at a cement factory in a rapidly developing country.Occup Med 2001;51:367 -73.
6. Alakija W, Iyawe VI, Jarikre LN, Chiwuzie JC. : Ventilatory function of workers at Okpella cementfactory in Nigeria. West Afr.JMed.1990;9:187-92.
7. Vestbo J, Rasmussen FV .Long-term exposure to cement dust and later hospitalization due to respiratory disease.Int Arch Occup Environ Health 1990;62:217-20.
8. Fell AK, Thomassen TR, Kristensen P, Egeland T, Kongerud J. Respiratory symptoms andventilatory function in workers exposed to Portland cement dust. J Occup Environ Med. 2003; 45:1014-8.
9. Yang CY, Huang CC, Chang IC, Lee CH, Tsai JT, Ko YC Pulmonary function and respiratorysymptoms of Portland cement workers in SouthernTaiwan .*Kao Hsing I HsuehKoHsuehTsa Chih*1993;9:189-92.
10. Moen B, BrtveitM.Acute respiratory health effects among cement factory workers in Tanzania: an evaluation of a simple health surveillance tools *Int Arch Occup Environ Health*2005;79:49-56.
11. Mwaiselage J, Bratveit M, Moen BE, and MashallaY.Respiratory symptoms chronic obstructive pulmonary disease among cement factor workers. Scand J Work Environ Health 2005;31:316-23.
12. Meo SA, Azeem MA, Ghori MG, Subhan MM. Lung function and surface electromyography of intercostals muscles in cement mill workers. Int J Occup Med Environ Health 2002;15:279-87.
13. Ali BA, Ballal SG, Albar AA, Ahmed HO. Post-shift changes in pulmonary function in a cement factory eastern Saudi Arabia. Occup Med (London) 1998;48:519-22.
14. Yang CY, Huang CC, Chiu HF, Chiu]F, Lan S], Ko YC Effects of occupational dust exposure on the respiratory health of Portland cement workers.*j. Toxicol. Environ. Health* 1996; 49:581-86.
15. Marko S, Ivo K, Ankica H. Follow-up of ventilatory lung function in a group of cement workers. British Journal of Industrial Medicine 1976;33:18-24.
16. AbuDhaise B, Rabi A ,Al-Zwairy M .Pulmonary manifestation in cement workers in Jordan .Int J Occup Environ Health 1997;10:417-28.