ORIGINAL ARTICLE

The Health of Workers in Cement Factory: Evaluation of Lung Function

Radhwan Hussein Ibrahim, Ayman Fathi Ramadhan

Department of Clinical Nursing Sciences, College of Nursing, Universitiy of Mosul, Mosul, 4001, Ninevah, Iraq.

ABSTRACT

Introduction: Very few follow-up studies have investigated the respiratory function of cement employees. This research's key objectives were to calculate overall dust exposure, evaluate chronic respiratory problems, and determine lung function status in cement factory workers. **Methods:** This cross-sectional study was done in the Cement Factory - City of Mosul. 100 cement production employees participated in this study who is exposed directly to the dust. Another 100 employees were chosen from the departments where the workers are not exposed to dust. The "Medical Research Council Questionnaire (MRCQ)" that recommended for use in epidemiological and occupational respiratory surveys was used. Lung function tests were performed using a Cosmed Pony FX spirometer. At the end of the day's shift, acute respiratory symptoms were scored on a five-point Likert scale (1-5) using a modified questionnaire for respiratory symptoms. Different lung function was tested. **Results:** The mean age of the workers was 36.4 years (range 28-61), all of them were male. Cement overall dust ranged from (1.1 to 11.6 mg/m^3) at the workplace. The (TLC) for 10 mg/m^3 was exceeded in just one of the tests. For the exposed group, "the volume of air that can forcibly be blown out in the first 1 second, after full inspiration" FEV1 is (72.20 ± 11.35), the volume of air that can forcibly be blown out after full inspiration, measured in liters (FVC%) is (70.40 ± 12.27). **Conclusion:** Preventive measures are needed to reduce exposure to dust. Chronic respiratory symptoms and decreased lung function have been associated with high exposure to cement dust.

Keywords: Cement, Dust exposure, Chronic respiratory problems, Spirometry, Mosul

Corresponding Author:
Radhwan Hussein Ibrahim, PhD
Email: prof.dr.radhwan@uomosul.edu.iq
Tel: +964-770-1620-882

INTRODUCTION

In recent years, the workplace has progressively been a critical, worldwide public health issue. According to the International Labor Organization, two million men and women die annually as a result of occupational accidents and work-related diseases. There are about 270 million occupational accidents and 160 million cases of occupational diseases in the world annually, and work-related accidents and diseases cost 4% of the world's gross domestic product.Occupational Exposure might contribute to developing various health problems among workers (work-related health problems), and well-documented (1). Traditionally The workplace condition presents a risk of injuries or illness to the Staff. However, several thousands of employees globally are exposed to dangerous materials (2). Employment injuries may contribute to joblessness and decreased job profits. Job-related accidents might impact the patients in the following ways: reduced wages, the financial cost of recovery, difficulties returning to work, and lost jobs due to the accident (3). Occupational asthma, or work-related asthma, is a classic problem and one of the most prevalent occupational respiratory illnesses, with frequency ranging from (2 - 5) cases per 100,000 employees. This accounts for about 15 to 20 percent of adult-asthma burden, mainly due to allergy to high-molecular-weight (e.g., wheat flour in baking), low-molecular-weight (e.g., diisocyanates in spray painting) and respiratory sensitizers (4, 5). Investigating work-site injuries is a continuing concern, and A striking rise in workplace morbidity and mortality occurred during the last century. The International Labor Organization reports that nearly 270,000,000 accidents are happening last year at the expense of $76,000,000,000 (6). Furthermore,International Labour Oganization (ILO) report shows noise is the main hazards (7). Several studies have linked heavy and long-term use of certain chemicals with increased blood pressure, tightness of blood vessels, and reduced heart variability (8). All the processes involved in manufacturing cement include different phases, like, grinding, raw milling, mixing, and clinker making, and clinker packaging. Recent research has discovered that cement dust can produce respirable particles that vary from 0.05 to 5 micrometers in size (9-11). Meo et al. found that mean pulmonary volumes were reduced, including FEV1, FVC, and PEF, in workers who were exposed to cement dust for more than 10 years as compared to the control group.(12) Exposure to industrial cement dust has been linked to inflammatory and pathological changes in the nasal and pharyngeal epithelium in both animal and human studies (13).

In order to address inhalation hazards of dry pork cement, Occupational safety and Health Administration (14) has established a permissible exposure limit. Employers should limit airborne exposure to Portland cement for a total dust of 15 mg/m^3 per cubic metre, with respiratory dust of 5 mg/m3. As the level Cr(VI) is so low for Portland cement, it is expected that employers will also comply with Cr(VI), 5 and 2.5 micrograms per cubic meter respectively (µg/m^3), by meeting the 15 mg/m^3 permissible exposure limit (PEL) for Portland cement (15).

It appears from the information referenced above that cement dust could negatively affect lung function, but this is in dispute and more research is required to substantiate this. To the best of our knowledge, there is little study done on the relationship between workplace hazards and health conditions has been undertaken, no study has examined the respiratory system of cement workers in the City of Mosul. This reflects a need to comprehend the multiple health impacts of airborne dust present in cement factories on workers' respiratory health. The present study aims to determine these challenges by examining lung function parameters and describing the association between workers' socio-demographic characteristics and their lung function status.

MATERIALS AND METHODS

The study was authorized in Nineveh Health Directorate, Mosul City, Iraq, by the Ethical Research Committee. A cross-sectional study was used in the Al Mosul Cement factory in the Nineveh Province in Iraq. This factory was chosen because no previous studies on adverse respiratory effects were conducted. Two groups of male workers were interviewed, namely A and B. The group (A) or (exposed) one hundred employees were picked at random from the staff pool on the production line. The group (B) or (Non-Exposed) consisted of 100 workers was chosen from the departments where the workers are not exposed to dust, such as the sales department, administration, and financial affairs. The British Medical Research Council questionnaire (MRCQ) was translated into Arabic by one of the sworn translators and then re-translated into English again by another sworn translator. The introductory part of the questionnaire included age, years of education, years of work in the cement factory, use of respiratory protective equipment, previous respiratory diseases, and smoking habits. The second part of the MRCQ(16) comprises 17 questions on respiratory symptoms (cough, phlegm, breathlessness, wheeze and chest illnesses, now and during the past 2 years), detailed questions on smoking history and a checklist on past illnesses, these questions were scored on a five-point Likert scale as never (1), mild (2), moderate (3), severe (4) or very severe (5) using a modified questionnaire for respiratory symptoms. validity of study tools was examined by a panel of experts, while the reliability was tested by a pilot study on 10 workers through a test-retest approach with a gap period of one week . the participants in the pilot study were excluded from the original study sample. Based on the evidence, a worker was found with a (cough, mucus, recurrent bronchitis, dyspnea, shortness of breath, and bronchial asthma.) Employees who responded yes to the query (does your chest ever produce a wheezing or whistling sound?) were diagnosed as suffering from asthma and necessary medication administered. All the interviews were conducted face to face by the researchers themself. The study was clarified to participants, and they decided to participate. Additional measurements were done by the authors, such as height, weight, age, and smoking status were recorded for the study participants. After gathering relevant information about their background and demographics, the lung function tests were run. Spirometry is one of the methods used to test for the presence of respiratory obstructions in the lungs. Lung function tests were performed using a Cosmed Pony FX spirometer (Rome, Italy) by measuring the amount of air we inhale and exhale, as well as how quickly we exhale, by the American Thoracic Society (ATS) protocols(17). The pulmonary status was assessed by comparing it to the ATS criteria, and the findings were then interpreted accordingly. The procedures for the ventilatory function test were explained individually to the workers. Before the morning shift, the spirometry was performed while the workers were seated. The parameters used as determinants of lung function were FVC, FEV1, and FVC/FEV1 ratio were recorded as per standard procedure (18). Eleven spirometer recordings were excluded SPSS 25.0 was used for data management and analysis.

RESULTS

The mean values of lung function parameters for the total number of cement exposure and non-exposure are presented in Table I. In cement employees, a statistically significant reduction was demonstrated in the mean values of FVC and FEV1. The mean value for FEV1/FVC ratio was significantly higher exposure group. Anthropometric parameters for the total number of cement workers and the control group are shown in Table II. There were no significant differences between the means of anthropometric parameters, i.e., age, height, or weight in both groups.

Two separate groups of males of varying ages, heights, weights, BMI, work duration, educational level, and smoking habits were involved. The geometric mean dust exposure was found in the exposure sections and non-exposure sections (96.8 mg/m^3), (94.3 mg/m^3) respectively.

Table I: Lung function of exposed and non-exposed groups

Parameters	Exposed (mean ± SD)	Non-exposed (mean ± SD)	t	P-value
FVC%	70.40 ± 12.27	84.40 ± 13.33	3.8	0.001
FEV1%	72.20 ± 11.35	82.29 ± 12.53	4.6	0.001
FEV1/FVC%	93.60 ± 11.79	100.63 ± 9.33 0.007	6.1	0.001

This table shows that there statistically significant differences between exposed group and non-exposed group in relation to FVC%, FEV1%, and FEV1%/FVC%.at p value <0.05.

The exposed and unexposed mean ages were (35 ± 8.1) and (32.2 ± 5.7), respectively. Among workers, (18.2 %) were illiterate, (40.9%) had primary educational level, (27.3%) had middle while (13.6) had secondary Educational level, and (33.3%) had institute/ College-educational level. The pulmonary function tests are administered to all subjects (n=94) who have been exposed to the hazard, and to all other subjects (n=54) who have not. Mean (FVC) and FEV1 (FEV1 predicted) for the exposed group were 70.40 and 72.20, respectively, whilst 84.40 and 82.29 for the unexposed group. Analysis showed that the workers who were exposed to the hazard had lower ventilatory indices than those who were not. Table III shows that the obstructive impairment (FEV1\FVC%) was more in the directly exposed workers. However, no correlations were found between other variables.

DISCUSSION

As mentioned in the literature review, exposure to cement dust and how this impacts health has become a leading respiratory health risk. Exposure to cement dust can cause respiratory dysfunction, including poor respiratory system function and chronic respiratory disease. Previous studies report that chronic obstructive pulmonary disease has a greater risk of developing a chronic obstructive pulmonary disease caused by occupational exposures (19-25). The most interesting finding was that relative to the cement production employees, they have recorded an elevated prevalence of impaired lung function. Dust exposure has the potential to impair respiratory function. It is not yet proven that breathing in cement dust causes respiratory issues. We have found in the current study that different for exposed workers; cough (77%), asthma (21%) shortness of breath (40%) whereas for non exposed workers; cough (19%), asthma (9%), and shortness of breath (19%). This finding

Table II: Spirometric Values according to workes Socio-demographic variables

Socio-demographic variables		FEV1/FVC (%) Mean	FEV1/FVC (%) SD	FEV1 (%) Mean	FEV1 (%) SD	FVC (%) Mean	FVC (%) SD
Age	**≤35 yr**	95.1	2.6	94	0.2	103	4.5
	>35 yr	94.5	2.1	93	0.6	98.2	7.6
		t=6.7,p<0.001		t=4.9,p<0.001		t=7.2,p<0.001	
Smoking	**Smokers**	94.1	3.7	96.3	6.6	99.6	1.6
	Nonsmokers	95.6	4.9	98.5	7.4	99.5	1.8
		t=1.011,p<0.03		t=1.014,p<0.04		t=0.154,p<0.03	
Setting	**Exposed to cement dust**	94.3	3.8	93.2	5.4	99.5	1.6
	Non exposed to cement dust	96.8	0.6	94.6	5.2	98.4	1.2
		t=0.948,p<0.05		t=1.97,p<0.03		t=0.67,p<0.04	
Duration of employment	**≤ 10 yr**	95.7	2.2	96.1	4.5	99.3	9.2
	> 10 yr	94.5	1.6	93.4	3.2	99.3	6.3

All the spirometric values were lower in the exposed workers but the differences were not statistically significant.

Table III: Correlation between the variables

Variables	test	Age	work	FVC	FEV1	FEV1/FVC
Age	Pearson correlation Sig. (2-tailed)	1 0.001				
Work	Pearson correlation Sig. (2-tailed)	0.92** 0.97	1			
FVC	Pearson correlation Sig. (2-tailed)	0.003 0.81	0.044 0.63	1		
FEV1	Pearson correlation Sig. (2-tailed)	0.028 0.42	0.7 0.59	0.84** 0.001	1	
FEV1/FVC	Pearson correlation Sig. (2-tailed)	0.81 0.31	0.38 0.77	0.018 0.89	0.500** 0.001	1

is consistent with Ahmad and Balkhyour (19), who found that the Prevalence of chest tightness was 22.7% and 10% in both exposed and non-exposed individuals. Wheezing and whistling were reported as having been detected in (13.6%) and not detected in (6.7%), while nasal/throat irritation was observed in 22.7% and 10% of controls. 18.2% of cases and 6.7% of controls had chronic sneezing. These observations match those found in previous research. The statistical analysis of the data conducted on Employees of a Cement Industry in Shiraz, Iran, revealed that symptoms such as phlegm, coughing, shortness of breath, and breathlessness are significantly more prevalent among workers exposed to the toxin. Similarly, affected workers' chest radiographs showed various abnormalities, including emphysematous changes, old calcified granulomas, and chronic inflammation (26). The finding of the present study showed that the rate of wheezing, chest tightness and phlegm was substantially higher among cement workers relative to controls, This confirms previous results that have examined the effect of exposure to dust on lung function among Portland cement factory workers in Rawang, Malaysia (27). Furthermore, the present findings seem to be consistent with other research conducted in Tanzania, to investigate the cumulative Exposure to dust from a Portland cement factory, this study found that Workers had significantly lower "forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), (FEV1/FVC), (FVC %, FEV1 %), and (PEF %) than controls. The cumulative total dust exposure effects on FVC forced expiratory volume in 1 second, and the peak expiratory flow rate was significant. There is a higher risk of developing airflow obstruction from cumulative total dust exposure exceeding 300 mg/m per year versus less than 100 mg/m (28). Opacities were found in the chest radiographs of 2640 Portland cement workers, up to approximately 1 percent for pleural abnormalities and up to 2 % for small opacities. When analyzed according to age and smoking, the Prevalence is significant after adjusting for age and smoking (29). Data have been collected from Portland cement plant employees to evaluate respiratory symptoms and pulmonary function for them. The Prevalence of symptoms for cement workers and controls was close, except that 5.4% of cement workers had dyspnea compared with 2.7% for the controls. The mean indices of lung function for both groups are similar. The rate of chronic phlegm with tenure was elevated among cement plant employees, while the rate of wheezing was associated with tenure and the dust level. There was no significant exposure relation with other symptoms and pulmonary function indices (30).

CONCLUSION

Based on the data analysis and outcomes measurement findings, the present study concluded that there are significant differences between exposed and non-exposed groups concerning FVC%, FEV1%, and FVC% / FEV%. Because the working atmosphere is full of dust, lack of ventilation, and prolonged exposure periods, so, Proper dust management interventions like personal protection equipment (respirators), preparation and health education, and the repair of machinery in the workplace are expected to minimize severe respiratory health effects. Rigorous supervision and the availability of high-quality personal respiratory protection equipment are strongly recommended for factory staff. Additional investigations are needed to explore the potential sensitizing effects of cement.

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