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Pulmonary Function in Cement Industry Workers in the West of Iran

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Abstract: One of the most hazards in cement industry is the impacts of cement dust on respiratory system of the workers. The present study aimed at investigating pulmonary function of the workers in one of the cement factories in the west of Iran. The current study followed a descriptive-cross sectional procedure in which 80 workers from one of the cement factories in the west part of Iran took part. Participants' demographic information and spirometry data were collected and entered in SPSS-16 Software for further analysis. The findings indicated that the mean and the standard deviation of age and work experience of the participants were 7.2, 37.8, 5.2 and 12.6, respectively. About 2.25% of abnormal spirometry index was mixed, 2.25% restrictive, 3.75% obstructive and 91.25% had normal spirometry results. The findings showed that 8.75% of the participants were suffering pulmonary problems. Accordingly, appropriate measures such as controlling the workplace dust, using suitable respiratory tools, training the workers to use these tools appropriately and employing air conditioning systems for controlling the workplace dust is recommended.

Key words: Cement industry, Iran, pulmonary function, workers, West

INTRODUCTION

Cement as the key element in the concrete constructions is a dark green and soft powder whose particles are about 0.05-5 micron in size (ACGIH., 2007). It is produced by heating limestone containing calcium silicate hydrate, aluminum, magnesium, iron oxides, calcium sulfate and clay up to 1450 silcius (Abedi and Rostami, 2012). A small amount of manganese oxide, sodium, potassium and sulfur is also found in the cement structure. Cement is the most important material used in construction industry and other constructions and its application has a close association with the housing construction industry (Abedi *et al*., 2014). Cement factories in Iran are developing on a daily basis and a large number of workers are employed in this industry. Cement industry is considered as one of the polluting industries and nowadays dust spread is one of the major concerns in this sector. Development in cement industry is accompanied with the increase in the number of workers who, as their job requirements have direct contact with cement dust. Dust is the main hazardous factor in the cement production process which occurs in different stages (Abu Dhaise *et al*., 1997). Dust includes solid particles that come in different sizes from 1-100 μ and then change to airborne particles depending on their origin, physical characteristics and environmental conditions. Airborne particles are divided into three different types, including inhalable, thoracic and respirable ones. Frequent exposure to these particles may cause reaction or damage to the respiratory system (Aminian *et al*., 2012; Zawilla *et al*., 2014). Cement dust contains 60-67% calcium oxide, 17-25% silicon oxide, 3-5% aluminum oxide and some amounts of iron oxide, chrome, potassium, sodium and magnesium oxide. Encountering aluminum, iron, calcium and silicon in the workplace and the resulting reduction in pulmonary function in the workers who are in contact with cement dust has been observed (Barkhordari *et al*., 2011). Lipidic proxidation, oxidative and immunologic mechanisms are among poisonous and sickening mechanisms caused by exposure to cement dust (Ebrahimi *et al*., 2016a, b). Contact with cement dust results in stimulating and burning feeling of the lung air tube layer that, in turn, leads to reduction in the PEF and FEV variables in the workers employed in the cement factories (Gholami and Kakooei, 2012). Allergic deramite, rynite, pharyngitis and respiratory dysfunctions are some consequences of contact with cement dust. Cement is categorized as disturbing dust and according to Iranian ministry of

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Health and ACGIH, the standard amount of contact with it is 3 mgm^{-3} for inhalable dust, 10 mg for total dust (Giahi *et al*., 2014; Zeleke *et al*., 2010). Previous studies have shown that the amount of inhalable dust in the cement factories is more than the standard level (Giahi *et al*., 2014). Various studies have been conducted to evaluate the major and chronic impacts of contact with cement dust, one of which is a study carried out in Utopia in which a significant difference was found between the control and the experimental groups, considering the decrease in PEF (Golbabaii *et al*., 2012). In another study in Tanzania, a significant relationship was found between the amount of exposure to dust, on one hand and chronic coughs, difficulty in breathing and chronic bronchitis (Kakooe *et al*., 2012). Abuhaise *et al*. study showed that workers who had contact with dust suffered more from asthma (Kalacic, 1973). Some studies have also been conducted in Iran, some of which are reported here. Neghab and Choobineh (2007) study on cement factory workers indicated that there is a significant relationship between cement dust and respiratory problems and decrease in pulmonary capacity (Khazraee *et al*., 2015). The study by Pournajaf *et al*. was indicative of a significant reduction in FEV1, FVC, FEV1/FEV parameters in the experimental group as compared to the control group (Kumar *et al*., 1997). Considering the paramount importance of this issue and lack of such a study in the West of Iran, the present study targeted the investigation of the pulmonary function of the workers in one of the cement factories in the West of Iran.

MATERIALS AND METHODS

The current study was a descriptive cross-sectional evaluation of the pulmonary function of the workers in one of the cement factories in the West of Iran. About 80 workers and mechanic, administration, electricity, electronic and production staff were selected, randomly, for the purpose of the study. All participants were required to fill in the consent form before embarking on the study and performing spirometry test (Mohammadi and Tajdinan, 2010). Demographic information of the participants, such as age, height and work experience were collected and recorded using a checklist (Mwaiselage *et al*., 2004). Then, using spirometry tests, spirometry levels, at the end of the working shift and in similar temperature and humidity, were calculated. The most important criterion for recruiting the participants was GP's diagnosis of a lack of previous non- work related pulmonary problems such as asthma, sinusitis and infection.

Table 1: Diagnosis procedure of the respiratory patterns based on ATS standards

	Percentage of predicted spiromeric index based on ATS standards		
Types of response	FVC (%)	FEV1 (%)	FEV1/ FVC (%)
Normal	≤80	≥80	≤75
Obstructive	≥80	<80	≤75
Restrictive	<80	<80	≤75
Mixed	<80	<80	<75

The analysis was done using the SPSS-16 Software

Three indices including FVC, FEV1 and the proportion of FVC to FEV1were calculated to investigate the pulmonary function using SPIROBAK-G spirometer. The participants were required to avoid taking a bath and smoking, at least 2 h before spirometery test and stop using drugs that could have an impact on the function of the lung, about 24 h before the test. The participants were, then, asked to sit on a chair 5 min before the test and stop doing hard activities. A clip was placed on the participant's nose to prevent the air from exiting through the nose while conducting the test. Through investigating the obtained volumes, a prediction of <80 and a prediction of <FEV/ FVC 75% was considered as an index for reduced FVC/FEV1. Table 1 illustrates the diagnoses procedure for respiratory patterns based on ATS standards (Khazraee *et al*., 2015; Mohammadi and Tajdinan, 2010; ACGIH, 2007).

RESULTS AND DISCUSSION

The findings indicated that the mean and the standard deviation of age and work experience of the participants were 7.2, 37.8 and 5.2, 12, 6 respectively (Table 2). The mean and the standard deviation of the pulmonary function tests in each workplace unit have been shown in Table 3. About 80 workers went under investigation in the present study.About 7 of these participants had abnormal spirometry results out of which 3 (3.75%) suffered restrictive, 2 (2.5%) none-restrictive and another 2 (2.5%) showed mixed pattern (Fig. 1 and 2).

As the Table 4 shows there exists a positive correlation between FVC and FEV1, on one hand and between FEV1 and FVC/FEV1, on the other hand. However, no correlations was found between other variables.

The present study aimed at investigating the spirometry indices in the workers exposed to the cement dust. The finding indicated that 8.75% of the participants were suffering pulmonary problems with obstructive, mixed and restrictive patterns. The results were consistent with the findings of other related studies (Aminian *et al*., 2012). Another finding was that, the most prevalent index in the suffering participants was obstructive type which

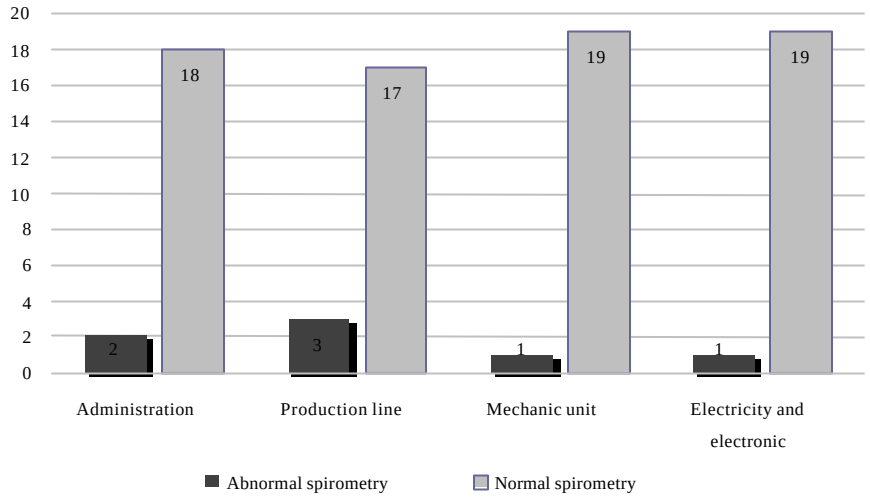

Fig. 1: The frequency of pulmonary complications in terms of calories

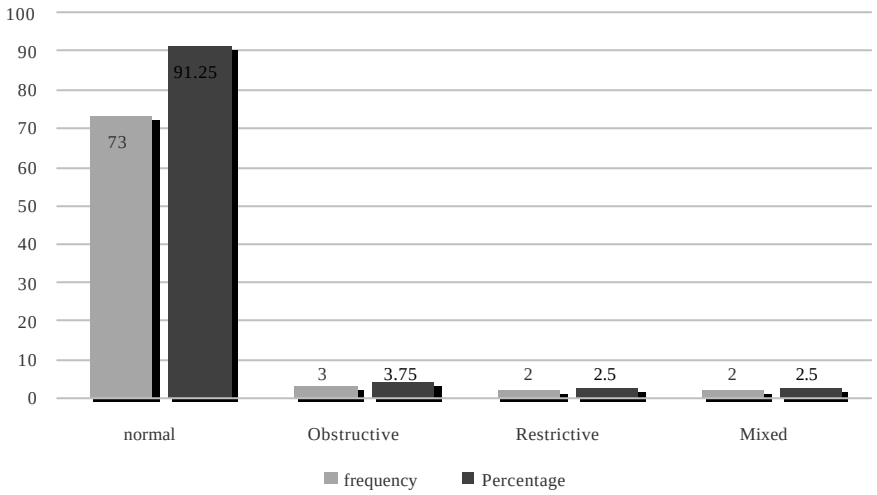

Fig. 2: The spirometry test result in cement factory workers (N80)

Table 2: Demographic information and pulmonary symptom status in the cement factory workers (n = 80)

Variables	Mean	SD	Maximum	Minimum
Age	37.8	7.2	59	28
Work experience	12.6	5.9	25	3
FVC	106.2	13.9	139	63
FEV1	97.9	12.4	128	60
FEV1/FVC (%)	94.3	7.7	123	72

Table 3: Pulmonary symptom status in workers according to their workplace unit (n= 80)

Work unit	No. of samples	Type of response	Mean	SD
Mechanic unit	20	FVC	107.2	15.1
		FEV1	96.6	11.08
		FEV1/FVC (%)	90.7	7.1
Administration	20	FVC	103.7	12.08
		FEV1	96.2	9.2
		FEV1/FVC (%)	96.5	8.6
Electricity and electronic	20	FVC	109.5	11.7
		FEV1	102.1	9.8
		FEV1/FVC (%)	96.5	6.4
Production line	20	FVC	104.7	16.6
		FEV1	96.9	17.7
		FEV1/FVC (%)	93.5	7.7

is correlated with other factors such as air pollution and smoking. In Khazraei *et al.* study of construction industry, obstructive index was more than other indices, thus, the large amount of this index is probably the result of air pollution and smoking in the studied group. Other findings of the present study are in line with the findings of the results of the studies by other researchers (Aminian *et al*., 2012; Neukirch *et al*., 1994; Ogle *et al*., 1989; Ogunbileje and Akinosun, 2011). According to the

Table 4: Correlation between the variables

Variables	Tests	Age	Work experience	FVC	FEV1	FVC/ FEV1
Age	Pearson correlation	1				
	Sig. (2-tailed)					
Work	Pearson correlation	0.9**	1			
	Sig. (2-tailed)	0.001				
FVC	Pearson correlation	0.006	0.055	1		
	Sig. (2-tailed)	0.961	0.626			
FEV1	Pearson correlation	0.023	0.60	0.831**	1	
	Sig. (2-tailed)	0.841	0.597	0.001		
FEV1/FVC	Pearson correlation	0.83	0.35	-0.016	0.410**	1
	Sig. (2-tailed)	0.466	0.756	0.889	0.001	

** Correlation is significant at the 0.01 level (2-tailed)

findings, the relationship between spirometry indices and age and work experience of the participants was not statistically significant. A significant relationship was not found between the influential variables on spirometry parameters such as age, gender, height, weight, work experience and smoking experience in the work forces under study in Kakooei *et al*. study. This leads us to conclude that reduction in the pulmonary function variables has been the result of exposure to cement dust (Poornajaf *et al*., 2010). Based on the evaluation of pulmonary function of the workers in different units, the average percentage of indices FVC, FEV1 and FEV/ FEV1 in repair mechanic, administration , electricity and electronic and production units was at the normal range of the ATS that is 80-120. The findings of the study by Ghiahi *et al*. (2014) which was examining the pulmonary capacity of the workers in steel industry, indicated that FEV/FEV1, FEV and FEV1 percentage in the workers working in the kiln, gas and material was the lowest and lower than the normal standards of ATS and this average was even lower in sections with combined fume pollutants, kiln dust and foundry sections. On the contrary, the average percentage of the pulmonary function indices in repair mechanic and administration, warehouse, electricity and electronic units were at a normal rate of ATS (Poursadeghiyan *et al*., 2016). The present study showed a positive correlation between FVC and FEV1 and FVC/ FEV1 and FVC. Kumar's study showed that workers exposing with cement dust, had normal FEV1. Furthermore, in this study, FEV1 rate decreased and FVC also decreased in the same rate but generally both rates were near to normal values (Richard *et al*., 2016).

However, no significant relationship was found between the pulmonary function variables in the workers in Jajrood cement factory, as Seifaghaei's study reported (Rundle *et al*., 1993). There seems to be inconsistencies in the findings of the studies which have been investigating the impact of cement dust on the workers' pulmonary function. Although the reason for such disagreement is not quite known, it appears that factors such as the density of the dust in the workplace, the exposure duration, correct use of appropriate safety tools and smoking among the workers who have contact with dust may explain some of these discrepancies (Abu Dhaise *et al*., 1997). Aminian's findings showed that increase in respiratory symptoms and decrease in some pulmonary function indices is the result of exposure to cement dust, since there was not a meaningful difference between smoking as a damaging variable, previous respiratory problems and race in the two groups. Moreover, as the experimental group who suffered more problems, was even younger in age and had less work experience in cement factories the growth in the respiratory problems and decrease in pulmonary function indices was probably due to contact with cement dust (Abu Dhaise *et al*., 1997). some of the risk assessment methods must be used in industrial for assessing the exposure of health risk factor (Seifaghaei, 2000; Short and Petsonk, 1998). we recommended effects of administrative interventions on improvement of safety and health in workplace must be done to reduced exposure of staff (Yarmohammadi *et al*., 2016a, b).

CONCLUSION

The findings of the current study showed that 8.75% of the participants were suffering pulmonary problems. Consequently, to care for the workers' health issue, taking efficient preventive measures such as effective control of the workplace dust through employing suitable respiratory tools and training the workers to use the tools and providing appropriate air conditioning systems are highly recommended. Assessing the common diseases among the workers can not only have a positive impact on preventing the diseases from spreading but also can improve the health condition of the workers and their productiveness, as well.

REFERENCES

ACGIH., 2007. Threshold limit values for chemical substances and physical agents biological exposure indices. American Conference of Governmental Industrial Hygiene (ACGIH), Cincinnati, OH., USA., pp: 56-69.

Abedi, G. and F. Rostami, 2012. Assessment of quality of life in hepatitis B patients compared with healthy people. Life Sci. J., 9: 5339-5343.

Abedi, G., S.H. Darvari, A. Nadighara and F. Rostami, 2014. The relationship between quality of life and marriage satisfaction in infertile couples using path analysis. J. Mazandaran Uni. Med. Sci., 24: 184-193.

AbuDhaise, B.A., A.Z. Rabi, M.A. Al Zwairy, A.F. El Hader and S. El Qaderi, 1997. Pulmonary manifestations in cement workers in Jordan. Int. J. Occup. Med. Environ. Health, 10: 417-428.

Aminian, O., M. Aslani and K.S. Haghighi, 2012. Pulmonary effects of chronic cement dust exposure. Occup. Med. Quart. J., 4: 17-24.

Barkhordari, A., S. Poorabdian, J. Khoobi and M. Karchan, 2011. The study of changes in the serial peak flowmetery test in the workers of car painting workshops in Isfahan. Scient. J. Kurdistan Uni. Med. Sci., 15: Pe73-Pe80.

Ebrahimi, M.H., L. Omidi, M.K. Handan, M. Poursadeghiyan and H. Biglari, 2016a. Relation between subjective sleepiness and changes in breathe and beat rates among the clinical night workers. Int. J. Trop. Med., (In Press).

Ebrahimi, M.H., M. Abbasi, M. Khandan, M. Poursadeghiyan, M. Hami and H. Biglari, 2016b. Effects of administrative interventions on improvement of safety and health in workplace: A case study in an oil company in Iran (2011-2015). J. Eng. Applied Sci., 11: 346-351.

Gholami, A. and H. Kakooei, 2012. Cement dust concentrations in different occupational groups of a Portland cement industry in South Khorasane. J. Health, 2: 50-56.

Giahi, O., E. Darvishi, M. Sarabi and S. Shahsawari, 2014. The relationship between exposure to respiratory pollutants and pulmonary function tests capacities in steel industry workers. Scient. J. Kurdistan Univ. Med. Sci., 19: 135-145.

Golbabaii, F., A. Faghihi, P. Ebrahimnejad, M.R. Baneshi, H.M. Taklo and A.R. Shokri, 2012. Assessment of occupational exposure to the respirable fraction of cement dust and crystalline silica. J. Health Saf. Work, 2: 17-28.

Kakooe, H., A. Gholami, M. Ghasemkhani and M. Hossaini, 2012. Survey of exposure to cement dust and its effect on respiratory function in workers of a cement complex. Quart. Horizon Med. Sci., 18: 60-65.

Kalacic, I., 1973. Chronic nonspecific lung disease in cement workers. Arch. Environ. Health: Int. J., 26: 78-83.

Khazraee, T., Z. Zamanian, R. Zare and F. Mobasheri, 2015. Pulmonary function test in construction workers and a referent food industry group: A comparative study. J. Fasa Univ. Med. Sci., 5: 338-346.

Kumar, V., R.S. Cotran and S.L. Robbins, 1997. Basic Pathology. 6th Edn., W.B. Saunders Co., Philadelphia, PA., USA., pp: 393-425.

Mohammadi, A. and S. Tajdinan, 2010. Survey of spirometric indeces and prevalence of respiratory symptoms in the workers of a pipe mills. Jundishapur J. Health Sci., 2: 37-45.

Mwaiselage, J., M. Bratveit, B. Moen and Y. Mashalla, 2004. Cement dust exposure and ventilatory function impairment: An exposure-response study. J. Occup. Environ. Med., 46: 658-667.

Neghab, M. and A. Choobineh, 2007. Work-related respiratory symptoms and ventilatory disorders among employees of a cement industry in Shiraz, Iran. J. Occup. Health, 49: 273-278.

Neukirch, F., J. Cooreman, M. Korobaeff and R. Pariente, 1994. Silica exposure and chronic airflow limitation in pottery workers. Arch. Environ. Health: Int. J., 49: 459-464.

Ogle, C.J., E.M. Rundle and E.T. Sugar, 1989. China clay workers in the South West of England: Analysis of chest radiograph readings, ventilatory capacity and respiratory symptoms in relation to type and duration of occupation. Br. J. Ind. Med., 46: 261-270.

Ogunbileje, J.O. and O.M. Akinosun, 2011. Biochemical and haematological profile in Nigerian cement factory workers. Res. J. Environ. Toxicol., 5: 133-140.

Poornajaf, A., H. Kakooei, M. Hosseini, F. Ferasati and H. Kakaei, 2010. The effect of cement dust on the lung function in a cement factory, Iran. Int. J. Occup. Hygiene, 2: 74-78.

Poursadeghiyan, M., L. Omidi, M. Hami, M. Raei and H. Biglari, 2016. Drowsiness and its relation with individual characteristics among night workers in a desert hospital in Iran. Res. J. Applied Sci., (In Press).

Richard, E.E., N.A.A. Chinyere, O.S. Jeremaiah, U.C.A. Opara, E.M. Henrieta and E.D. Ifunanya, 2016. Cement dust exposure and perturbations in some elements and lung and liver functions of cement factory workers. J. Toxicol. 10.1155/2016/6104719

Rundle, E.M., E.T. Sugar and C.J. Ogle, 1993. Analyses of the 1990 chest health survey of china clay workers. Br. J. Ind. Med., 50: 913-919.

Seifaghaei, F., 2000. Study of the pulmonary function of workers exposed to Portland cement dust. J. Sabzevar Univ. Med. Sci., 7: 54-60.

Short, S. and E. Petsonk, 1998. Respiratory System: The Variety of Pneumoconioses. In: Encyclopaedia of Occupational Health and Safety, Volume 1: The Body, Health Care, Management and Policy, Tools and Approaches, Stellman, J.M. (Ed.). 4th Edn., International Labour Organization, Geneva, Switzerland,ISBN-13: 9789221098140,pp: 10.66-10.69.

Yarmohammadi, H., E. Hamidvand, D. Abdollahzadeh, Y. Sohrabi, M. Poursadeghiyan, H. Biglari and M.H. Ebrahimi, 2016a. Measuring concentration of welding fumes in respiratory zones of welders: An ergo-toxicological approach. Res. J. Med. Sci., 10: 111-115.

Yarmohammadi, H., M. Poursadeghiyan, Y. Shorabi, M.H. Ebrahimi, G. Rezaei, H. Biglari and R. Rostami, 2016b. Risk assessment in a wheat winnowing factory based on ET and BA method. J. Eng. Applied Sci., 11: 334-338.

Zawilla, N., F. Taha and Y. Ibrahim, 2014. Liver functions in silica-exposed workers in Egypt: Possible role of matrix remodeling and immunological factors. Int. J. Occup. Environ. Health, 20: 146-156.

Zeleke, Z.K., B.E. Moen and M. Bratveit, 2010. Cement dust exposure and acute lung function: A cross shift study. BMC Pulmonary Med., Vol. 10. 10.1186/1471-2466-10-19