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INCIDENCE OF PHYSICAL COMPLICATIONS IN TILE INDUSTRY WORKERS DUE TO THE OCCUPATIONAL DUST EXPOSURE

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ABSTRACT:

Introduction: Tile industry workers are at great risk of multitude chemical agents that can have short-term or long-term adverse effects on the physical and/or mental health. This paper studied Incidence of physical complications in tile industry workers with occupational dust exposure.

Materials and methods: Workplace air sampling was done through 0 - 500 method of National Institute for Occupational Safety and Health (NIOSH) in different parts of a tile factory. Physical complications incidence was calculated in two groups (49 people in exposed group and 49 people in non - exposed group) by a researcher-designed questionnaire.

Results: The average concentration of dust was 232.8 ± 23.3 mg / m^3 in the crusher, 76.4 ± 47.2 mg / m^3 in the ball mill spray, 37.5 ± 34.9 mg / m^3 in the press, 27.6 ± 7.2 mg / m^3 in the glaze, and 7.6 1.2 ± mg/m^3 in the administrative sectors. In the exposed group, various physical complications were observed such as coughing up sputum 28.6 %, wheezing 28.6 %, dyspnea 30.6 %, hoarseness 38.8 %, dryness of throat 55.1 %, blurred vision 20.4 %, eye irritation 49 % which were observed statistically significant difference with those of the non - exposed group.

Conclusions: Since the dust concentration mean in the exposed group was above the Threshold Limit Value (TLV), the physical complications in these workers can be associated with the high concentration of dust from the raw material in their workplace.

INTRODUCTION

Air pollution is formed by many of pollutants and their potential health risks vary depending on the content of them, the amount and the hours of the occurrence, and the day or time of year [1, 2].

Todays, in industry, workers are exposed to several harmful agents that can have short - term or long - term adverse effects on the physical and / or mental health. Ineffective control systems, unsuitable design and misplacement of machinery in the workplace, insufficient budget allocations by employers to education and acculturation among workers to follow safety precautions and

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use personal protective equipment are increasing the incidence of work - related accidents and diseases [3].

In most cases, these complications occur gradually in a time span of a few years, and are unfortunately hard to treat. Such complication will lead to disabled workers in many cases. In addition to incurring costs to families and society, the industry will be deprived of specialized workforce and their experiences. Among the detrimental agents, the most common is dust that spreads along with the production process for various reasons. Exposure to such types of dust as silica has irreversible pulmonary complications for workers. Studies indicate that the dust in the workplace can cause diseases such as pneumoconiosis, occupational asthma, and lung cancer [4, 5].

Workers of ceramic, tile, wall tile, and sanitary porcelain products, are among workers who are exposed to the silica dust and are at potential risk of silicosis [6]. Researches regarding exposure to silica and its effects have been conducted by researchers. For instance, exposure to dust and the potential occurrence of pneumoconiosis in the ceramic industry in South Africa was carried out in which the analyses indicated that there was an amount of 23 % to 58 % silica in the dust samples, and that 80 % of the workers were diagnosed to be at a potential risk of lung diseases from dust [7]. Also a study conducted in a tile factory in Iran by measuring the concentration of dust in manufacturing halls and by recording symptoms due to exposure to dust in the case and control groups. Significant differences were observed between the respiratory and ocular complications between the groups [3].

Because studies in this area are limited, and different complications resulting from exposure to dust have been reported in them, this study was done to further study results of exposure to dust and the incidence of physical complications in tile industry workers.

MATERIALS AND METHODS

This study had two stages. The first stage, which was descriptive, dust concentration in different parts of a tile factory located in Iran, was determined. In this stage, workers' respiratory air was sampled by 0 - 500 method of National Institute for Occupational Safety and Health (NIOSH). Instruments used included 224 - PCTX8 SKC personal sampler, PVC filter of 37 mm and pore size 5 μm, filter holder, desiccators, and accurate laboratory scales with 0.001 mg. Measurement method was through gravimetric which included weighing the filters before and after the sampling. Sampling was done by a trained occupational health expert. It should also be noted that along with every 20 samples, a control sample was collected from the halls [8].

In the second analytic stage, a retrospective analysis was done in order to investigate the relationship between work - place pollution by dust and the resulting physical complications. Based on the descriptive results of the first stage, those working in the crusher, ball mill, spray dryer, glaze, and press halls, where the dust concentration was more than the Threshold Limit Value (TLV), were selected as the exposed group (case); official workers were allocated to the non - exposed group (control) because the dust concentration was lower than the Threshold Limit Value in the offices. The sample size was estimated to be 49 persons in each group according to occurrence of lung diseases in koohpaei' and et al.›s study and P1= 0.31 P0 = 0.06 comparison formula in the two groups [3].

A questionnaire was designed to collect data on physical complications resulting from exposure to dust. The questionnaire was designed on the basis of data from similar previous studies; its validity was approved of by scientific staff members of Birjand University of Medical Sciences, and its reliability was evaluated and confirmed upon its administration in a pilot study [3, 4, 9]. The first part of the questionnaire

requested for demographic information, and the second part determined the prevalence of physical complications caused by exposure to dust such as symptoms of dyspnea, wheezing, rhinorrhea or par nasal sinus problems, dryness of throat, itching of throat, blurred vision, and coughing up sputum. The questionnaires were completed through interviews with workers done by a trained occupational health expert.

The workers' height and weight were determined in standard conditions by German Seca scale and stadiometer with the precision of 50 g and 0.5 cm respectively. In addition to providing descriptive statistics, the data were analyzed in SPSS by t-test, Chi-square, and logistic regression at $\alpha = 0.05$.

RESULTS AND DISCUSSION

In total, 98 people were studied in a case group and a control group (49 persons in each). According to the results, the average of age was 25.14 ± 4.35 years in the case group and 26.42 ± 4.84 years in the control group that was not statistically significant (P = 0.171).

BMI average was 21.32 ± 2.14 in the case group and 21.92 ± 2.93 in the control group that was not statistically significant (P = 0.265). The two groups were also similar in smoking.

Table 1 presents the average of dust concentration in the halls under study. These results are compared with the Threshold Limit Value (TLV) recommended by American Conference of Governmental Industrial Hygienists (ACGIH) [3].

Table 2 compares the prevalence of symptoms such as dyspnea, wheezing, hoarseness, rhinorrhea, dryness of throat, itching of throat, Eye irritation , blurred vision, and coughing up sputum in the case and control groups.

Table1. The average of dust concentration in the different parts of factory compared with the TLV

Halls under study	Average concentration of dust (mg / m^3)	Standard deviation (mg / m^3)	TLV (mg / m^3)
Crusher	232.8	23.3	10
Ball mill – spray	76.4	47.2	10
Press	37.5	34.9	10
Glaze	27.6	7.2	10
Administrative	7.6	1.2	10

Table 2. The prevalence of Physical complications

Sign	case group N = 49	control group N = 49	Statistical test result Chi-square	OR CI 95 % OR
	(Percent)	(Percent)		
Dyspnea	15 (30.06 %)	3(6.1 %)	X2 = 9.8 P = 0.002*	OR = 6.8 CI 95% (1.8 - 25.2)
Wheezing	14(28.6 %)	0 (0 %)	X2 = 16.33 P < 0.001*	OR = 1.4 CI 95% (1.2 - 1.7)
Hoarseness	19 (38.8 %)	3(6.1 %)	X2 = 15.005 P < 0.001*	OR = 9.7 CI 95 % (2.6 - 35.7)

Table 2. The prevalence of Physical complications

Sign	case group N = 49 (Percent)	control group N = 49 (Percent)	Statistical test result Chi-square	OR CI 95 % OR
Rhinorrhea	15 (30.6 %)	6(12.2 %)	X2 = 4.909 P = 0.027*	OR = 3.2 CI 95 % (1.1 - 0.9)
Dryness of throat	27 (55.1 %)	4(8.2 %)	X2 = 24.96 P < 0.001*	OR = 13.8 CI 95 % (4.3 - 44.4)
Itching of throat	11 (22.4 %)	4(8.2 %)	X2 = 3.857 P = 0.05*	OR = 3.2 CI 95 % (0.96 - 11.1)
Eye irritation	24(49 %)	5(10 %)	X2 = 17.68 P < 0.001*	OR=8.4 CI 95% (2.9 - 24.9)
Blurred vision	10(20.4 %)	3(6.1 %)	X2 = 4.346 P = 0.037*	OR = 3.9 CI 95 % (0.1 - 15.3)
Coughing up sputum	14 (28.6 %)	2(4.1 %)	X2 = 10.756 P = 0.001*	OR = 9.4 CI 95 % (0.2 - 0.44)

* It's significant at an Alpha level of less than 0.05.

The results showed that the average concentration of dust was above the TLV in the crusher, ball mill, spray dryer, glaze, and press halls. Investigations showed that the open system, inefficiency of crushed materials transfer system, high vibration of conveyor belt and the low capacity of discharge chamber created dust in the crusher hall. Inefficient conveyors and their high vibration, lack of proper local ventilation system, the discharge of the granules on the conveyor belt in spray and cyclone halls, and the dispersion of dust collected on the stairs and devices at the time of workers' walking created high amount of dust in the ball mill – spray hall.

In the press and glaze halls, the main reasons for the high concentration of dust come from the discharge of glaze and engobe materials into the ball mill as well as the adjacency of this hall to the ball mill – spray hall. Dust concentration has been reported as higher than the TLV in similar previous studies conducted in pottery, tiles, and ceramics factories, and the workers there have had different pulmonary problems [3 - 7].

As the results of Table 2 indicate, the risk of dyspnea, hoarseness, dryness of throat, itching of throat, blurred vision, and eye irritation is higher in the exposed people than in the non-exposed people. This is in line with the results from similar studies [3 - 7, 10].

Also, the results show that risk of problems such as rhinorrhea, sinus problems, wheezing and coughing up sputum are higher in the exposed people than in the non-exposed people; this is not consistent with results from similar studies [3, 4]. The two groups were similar in demographic characteristics. In addition, no person had a history of respiratory diseases, chest surgery and injuries in this area at the beginning of employment in the two groups. There was no significant difference between the two groups in terms of such variables as age, smoking, previous history of respiratory disease, family history, socio-economic and racial factors. The only difference, as the results show, lied in the different dust concentration in their workplaces. So, incidence of physical complications can be

associated with the high concentration of dust in the workplace. Similar findings have been reported by other authors [11-14].

CONCLUSIONS

The results of this study, in line with the results of previous studies, confirmed that there are grounds for dust concentration of above TLV in ceramic and tile factories and that there is a significant relationship between dust emissions of raw materials and the incidence of various physical complications. Therefore, it is necessary to apply engineering control methods, permanently evaluate dust concentration, and make use of individualistic and administrative control methods in these industries [15].

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COMPETING INTERESTS

The authors declared no conflicts of interest with respect to the authorship and / or publication of this article.

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ETHICAL CONSIDERATIONS

Ethical issues have been completely observed by the authors.

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