

Original Article

Respiratory symptoms and pulmonary function tests in security and safety products plant workers

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Abstract: Objective: Lock and key factory workers are under the risk of metal pneumoconiosis and occupational asthma. In this cross-sectional study, it's aimed to evaluate the relationship between metal dust exposure and respiratory symptoms, pulmonary function tests of workers in different section of lock and key factory. Methods: 54 male workers (mean age, 32.8 ± 5.4) in a security and safety products plant were evaluated for respiratory symptoms, pulmonary function tests and smoking habits. Results have been interpreted by comparison of the painting (28/54) and grinding group workers (26/54). Results: There was no significant difference between painting (32.1 ± 4.8) and grinding (33.6 ± 6.1) groups regarding mean age ($P > 0.05$). Smokers were in significantly higher in grinding group (18/26). Cough and sputum were reported 14.3% (4/28) in painting and 3.8% (1/26) in grinding workers ($P > 0.05$). Chest tightness was seen in 7.1% and 7.7% of painting and grinding workers, respectively ($P > 0.05$). But no chest tightness was reported in both groups when they were away work. Breathlessness was seen in 10.7% and 7.7% of painting and grinding workers, respectively ($P > 0.05$). Breathlessness was similar in both groups (7.1% vs. 3.8%) when they were away work. When comparing painting and grinding workers respiratory functions no significant difference observed. Chest radiography in painting and grinding workers showed hyperlucency (3.6% vs. 11.4%), respectively. Conclusion: Painting groups in lock and key factory workers had more but statistically insignificant respiratory complaints. Interestingly, chest tightness was only observed when both groups were at work. It was thought that ventilation and using personal protective equipment in factory could provide significant benefits.

Keywords: Lock and key factory workers, respiratory symptoms, respiratory functions

Introduction

Metallurgical industry workers in the developing countries are often exposed to high concentrations of dusts and fumes that affect pulmonary function [1].

Many metals such as chromium, steel, brass, nickel, phosphorus, copper, iron and aluminum are used in the manufacture of lock and key. There are several steps like sintering, galvanization, grinding and painting while manufacturing lock and key in a security and safety products plant. Sintering step is a method for creating objects from powders, including metal and ceramic powders. Galvanization step is the process of applying a protective zinc coating to steel or iron, in order to prevent rusting. Grinding is the most comprehensive and diversified of all machining methods and is employed

on many materials predominantly iron and steel but also other metals, wood, plastics, stone, glass, pottery and so on. Painting is the dyeing of key and lock systems using powder paint and powder varnish [2]. In a study a high prevalence of the co-occurrence of welding related respiratory and systemic symptoms has been reported. The prevalence of work related respiratory symptoms when welding on mild steel (almost 20%) was similar to that when welding on galvanized steel (18%) [3].

A high prevalence of respiratory symptoms was also found among hard metal workers together with occupational asthma, abnormal chest radiography and pneumoconiosis [4, 5].

Lock and key factory workers are under the risk of metal pneumoconiosis and occupational asthma [6-9].

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Table 1. Demographic, clinical, spirometric parameters of workers

PARAMETERS	Painting N = 28	Grinding N = 26	P
<i>Demographic data</i>			
Age, y, (mean ± SD)	32.1 ± 4.8	33.6 ± 6.1	
Male, n (%)	28 (100)	26 (100)	P > 0.05
Smokers, n (%)	17 (60.7)	18 (69.2)	
Duration of working, y (mean ± SD)	10.8 (5.1)	10.2 (4.7)	
<i>Respiratory symptoms, n (%)</i>			
Cough	14.3 (4)	3.8 (1)	P > 0.05
Phlegm	14.3 (4)	3.8 (1)	
Chest tightness	10.7 (3)	7.7 (2)	
Dyspnea	7.1 (2)	7.7(2)	
<i>Pulmonary functions, (mean ± SD)</i>			
FVC (%)	94.6 (10.2)	96.4 (11.1)	P > 0.05
FEV ₁ (%)	93.5 (14.7)	94.7 (11.7)	
FEV ₁ /FVC (%)	80.3 (8.4)	80.1 (7.6)	
MMFR (%)	93.8 (34.0)	92.1 (24.7)	

SD, standard deviation; y, year; FVC, force vital capacity; FEV₁, force expiratory volume in the first second; MMFR, maximal midexpiratory flow rate.

In this cross-sectional study, it's aimed to evaluate the relationship between metal dust exposure and respiratory symptoms, pulmonary function tests of workers in different section of lock and key factory

Methods

Study population

54 male workers in a security and safety products plant were evaluated for respiratory symptoms, pulmonary function tests and smoking habits during health screening of lock and key workers. A written informed consent was obtained from all participants. The local Ethical Committee approved the study. Data on demographics, episodes of wheezing or chest tightness, symptoms of dyspnea, cough, phlegm, any other allergic and/or respiratory symptoms, duration of symptoms and smoking habits were determined by a questionnaire modified from the American Thoracic Society Questionnaire [10]. Physical examination was performed in all subjects. The questionnaire was administered in a person-to-person interview.

Lung function measurements

The tests were performed by using a standard spirometer (Vitalograph Alpha, Vitalograph Ltd., Ireland) according to American Thoracic Society

criteria, while the patients were at rest and seated in the upright position [11]. A minimum of 3 satisfactory forced expiratory manoeuvres was required for each subject. Forced vital capacity (FVC), forced expiratory volume in the first second (FEV₁), FEV₁/FVC (%) and maximal mid-expiratory flow rate (MMFR) were measured. Results were expressed as absolute values and as percentages of predictive values.

Statistical analysis

Data analyses and descriptive statistics were performed with the statistical package for the social sciences (SPSS, 17.0). Chi-squared test was used to compare categorical variables. Pearson's analysis was used as the correlation test. P values less than 0.05 were considered to be statistically significant. Results have been interpreted by comparison of the painting (28/54) and grinding group workers (26/54).

Results

The mean age of workers was 32.8 ± 5.4 years. There was no significant difference between painting and grinding groups regarding to gender, mean age, smoking and duration or working.

Cough and sputum were reported 14.3% (4/28) in painting and 3.8% (1/26) in grinding workers (P > 0.05). Chest tightness was seen in 7.1% and 7.7% of painting and grinding workers, respectively (P > 0.05). Breathlessness was seen in 10.7% and 7.7% of painting and grinding workers, respectively (P > 0.05). Demographic, clinical, spirometric parameters of workers are shown in **Table 1**.

Phlegm and cough were reported in both groups when they were away work. But no chest tightness was reported in both groups when they were away work. Breathlessness was similar in both groups (7.1% vs. 3.8%) when they were away work.

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Respiratory symptoms were statistically insignificant but higher in painting groups than in grinding groups. But chest tightness was observed in both groups only in workplace rather than away from work.

Nasal discharge and conjunctivitis were observed in only one patient (3.8%) in grinding group, respectively. No urticaria was seen in any worker. There was no statistically significant difference between grinding and painting groups regarding the expected values of FVC, FEV₁, FEV₁/FVC and MMFR. No significant PEF variability was observed in all patients followed by PEF meter. The mean predicted FVC, FEV₁, FEV₁/FVC, and MMFR values of workers were shown in **Table 1**.

Chest radiography in painting and grinding workers showed hyperlucency (3.6% vs. 11.4%), respectively.

Discussion

In the present study, workers in the manufacture of lock and key developed more frequent cough, phlegm and chest tightness complaints in painting group compared to grinding group whereas dyspnea rate was same in both group.

A cross-sectional study was conducted among 182 among aluminium cast-house workers similar to security and safety products plant workers. Workers reported significantly more respiratory symptoms, repeated trouble with breathing, wheezing, asthma attack and doctor diagnosed asthma compared to general population [6]. A study from Podgorica, Montenegro included 215 potroom workers from the aluminium factory. Potroom workers mostly complained of breathlessness associated with the workplace (56.7%) [12].

The respiratory tract is mainly affected by inhalation of nickel. Independent of the type of nickel species, short-term high-dose inhalation exposure induces several lung diseases and damages to the nasal cavity and nasal mucosa. Lung irritation, lung inflammation (pneumonia) and emphysema have been observed. Also, different degrees of hyperplasia of pulmonary cells, fibrosis, pneumoconiosis and allergic asthma have been reported [7, 8]. Human data for effects of chronic nickel inhalation are only available from occupational exposure studies. For nickel refinery workers higher mortality

from non-cancerous lung diseases compared to the normal population has been reported after 5 years of exposure. Pneumoconiosis could be observed after 12-20 years of exposure [9].

Bala *et al* have identified and assessed all risk factors and also have performed measurements of dynamic pulmonary function in 459 subjects - 90% of iron-steel and ferrochrome industry workers. The prevalence of COPD oscillated from 19.6% up to 25.7% while severity varied from mild to very severe [1].

A study including 61 workers from iron-steel industry showed the relation between zinc exposure in the galvanization process and high zinc levels among exposed workers, which was associated with a high prevalence rate of metal fume fever (MFF) and low blood copper and calcium levels. In that study, workers with a longer duration of employment in the galvanization process did not show a statistically significant higher prevalence of MFF or easy fatigability, dyspnea, asthma-like symptoms, or muscle cramps and twitches than those with a shorter duration of employment. There was no statistically significant difference between the exposed and the control groups as regards the test results of the ventilatory function [8].

It has been reported that inhaling large amounts of zinc (as zinc dust or fumes from smelting or welding) can cause a specific short-term disease called MFF, which is generally reversible once exposure to zinc ceases [9]. The term "metal fume fever" describes an acute industrial illness characterized by a variety of symptoms, including fever, chills, dyspnea, muscle soreness, nausea, and fatigue, that occur in workers following the inhalation of finely dispersed particulate matter formed when certain metals are volatilized. The oxides of a number of metals, including zinc, can cause this acute, reversible syndrome. Zinc fume from galvanized coatings is a common cause [15].

Chattopadhyay *et al* found that, in smelter plant workers both the restrictive and obstructive impairments were found higher compared to captive power plant and the community people [16].

In another cross-sectional study, exposure to dusts in steel workers has also been strongly associated with reductions in FVC, FEV₁, and

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FEV₁/FVC%. Significant decreases in FEV₁ and FVC have been associated with increases in occupational exposures to gases and fumes [17]. Combined occupational exposures to dusts and gases and fumes have been reported to reduce peak expiratory flow rate (PEF) [18]. In our study, there was no statistically significant difference between grinding and painting groups regarding the respiratory functions.

In conclusion, painting groups in lock and key factory workers had more but statistically insignificant respiratory complaints. It was thought that ventilation and using personal protective equipment in factory could provide significant benefits.

Disclosure of conflict of interest

None.

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