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RESEARCH ARTICLE

PULMONARY FUNCTIONS AMONG CONSTRUCTION PAINTERS

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Abstract: Context: Occupational exposure is a known risk factor for pulmonary diseases. Construction painting workers are at high risk of developing respiratory diseases. ***Aims:*** This study was planned to evaluate the pulmonary function tests (PFT) among construction painters. ***Settings and Design:*** A case control study ***Methods and Material:*** This study was conducted in the Department of Physiology, S. N. Medical College, Bagalkot, from January 2012 to December 2012. A total of 50 apparently healthy males aged more than 18 years who were exposed directly to chemical substances present in the paint were enrolled in study group and equal number of appropriately age matched, apparently healthy male adults from general population were enrolled in control group. ***Statistical analysis used***: Mean and Standard Deviation (SD) were calculated for quantitative variables and categorical measurements were presented as numbers and percentages. Student paired 't' test (two tailed, independent) was used to find the significance of study parameters on continuous scale between two groups. Chi-square test was used to compare the categorical variables. ***Results:*** The mean age in study group was 28.52 ± 9.85. The mean duration of painting in study group was 8.49 ± 7.98 years. Chest pain was the commonest clinical presentation seen in 10% of painters. On spirometry, the predicted percentage of FEV1, FEV1/FVC ratio, PEFR were significantly reduced. Conclusions: Based on spirometry findings the construction painting workers are at high risk of developing obstructive respiratory diseases.

Keywords: Occupational health; Respiratory disease; Spirometry; ***Key Messages:*** Construction painting workers are at high risk of developing obstructive respiratory diseases .

INTRODUCTION

Globalization and rapid industrial growth in India during the last few decades has resulted in emergence of occupational health related issues.1 Certain occupations are known to produce respiratory diseases which increase the risk of chronic respiratory illness. Construction workers are exposed to a wide range of substances that are potentially hazardous to the respiratory system, including cement dust, wood dust from sawing, dust from the ground, dust from using pneumatic tools on concrete or other stone work, fumes from welding, roofing or paving, and diesel exhaust from machines.2 In addition, climatic influences and personal lifestyle factors, such as smoking increase the risk of respiratory disease like COPD.3 It has been suggested that painters may be at increased risk of respiratory disease due to exposure to solvents and other materials found in paints. Various potentially toxic materials are used in different types of paints, including epoxy resins, isocyanates, metal pigments, silica fillers, and organic solvents.4

To date, little is known about the patterns of COPD morbidity in the various professional groups of the construction industry. The prognostic significance of the various pulmonary morbidity measures for permanent disability and mortality has not been clearly evaluated. Knowledge of this prognostic significance, however, would facilitate identification of persons at high risk for permanent disability or death, who might benefit most from secondary prevention programmes that could be tailored to individual lifestyle factors as well as to work-related characteristics.

Relatively little is known about the effects of exposure to paints on the respiratory system. A few surveys of workers exposed to paints have suggested that painters may be at increased risk of chronic obstructive pulmonary disease and other respiratory illnesses.4 Several studies have evaluated the pulmonary functions in other occupations like welders, wood carpenters, building workers, cotton textile industry workers, millers and bakers, metal, shoe and chemical industry workers, workers employed in mining, tunneling and quarrying, who are at risk of developing respiratory diseases.5 However there are only few studies4,6-8 on construction painters, who are also at high risk of developing respiratory diseases. In this study an attempt was made to evaluate the pulmonary function tests and highlight the respiratory disease patterns among construction painters.

MATERIAL AND METHODS

Subjects and Methods: This study was comprised of 50 painters registered at Building Construction Union in the study area. Apparently healthy males aged more than 18 years who were exposed directly to chemical substances present in the paint were enrolled in study group and equal number of appropriately age matched, apparently healthy male adults from general population were enrolled in control group. Individuals with chest and spine deformities, chronic disease like, diabetes

mellitus, hypertension, cardiac disease and with history of respiratory disease before joining the occupation were excluded from the study. Prior to the enrolment, patients were explained about the nature and benefits of the study and a written informed consent was obtained.

The selected painters and individuals were interviewed and a detailed history and demographic data including age was obtained. Based on the modified questionnaire,9 on respiratory symptoms from the British Medical Research council the symptoms reported by the painters were noted. Further, all the painters and individuals were evaluated for spirometry. Helios 501 Handheld Portable Computerized Spirometer (Manufactured by M/S Recorders and Medicare systems Ltd., India) was used to record the pulmonary functions in the Department of Physiology. Each individual was made to rest for 15 minutes. In standing position, with nose clips and with lips firmly held around the reusable mouthpiece, the individuals were asked to inspire maximally and then expire forcefully and rapidly into the mouthpiece. Three attempts were made and the best of the three spirograms were evaluated. During the spirometry, FVC, FEV1, PEFR, FEF25-75% and FEV1/FVC were noted.

The data obtained was coded and entered into Microsoft Excel spread sheet and master chart was prepared. Mean and Standard Deviation (SD) were calculated for quantitative variables and results on categorical measurements were presented in numbers and percentages. Student paired 't' test (two tailed, independent) were used to find the significance of study parameters on continuous scale between two groups. The Chi-square test was used to compare categorical variables. A probability value (p value) of less than or equal to 0.05 was considered statistically significant.

RESULTS

The mean age in study and control group was statistically similar (28.52 ± 9.85 vs 27.16 ± 8.11 years; p=0.453). The mean duration of painting in study group was 8.49 ± 7.98 years. The history of smoking was present in 26% of the individuals in control group compared to 18% in controls but this difference was statistically not significant (p=0.334). The history of tobacco consumption was present in 62% of the individuals in control group compared to 6% of individuals in control group. This difference was statistically significant (p<0.001). Chest pain was the common presentation seen in 10% of individuals in study group. The mean height (165.53 ± 7.12 vs 158.86 ± 10.15 cms; p<0.001) was high, whereas weight (52.00 ± 9.61 vs 57.30 ± 10.52 Kgs; p=0.010) and BMI (18.97 ± 3.22 vs 22.96 ± 5.75 Kg/m^2; p<0.001) were significantly low in study group. No statistically significant difference was noted with respect to SBP levels between study and control group but DBP was significantly less in study group (72.52 ± 11.38 vs 77.44 ± 6.49 mm Hg p<0.001). The predicted percentage of FVC was 79.30 ± 41.85 percent in study group compared to 88.46 ± 19.74 percent in control group. However, this difference was statistically not significant (p=0.166). the predicted percentage of FEV1 was 64.30 ± 95.42 percent in study group compared to 95.42 ± 21.47 percent in control group and this difference was statistically significant (p<0.001). FEV1/FVC predicted percentage was 85.10 ± 43.08 percent in study group which was significantly low compared to control group (108.18 ± 8.50 percent; p<0.001). The predicted FEV25-75 percentage was comparable among the individuals between study and control group that is 76.64 ± 33.40 percent in study group and in control group it was 81.42 ± 23.35 percent (p=0.409).

Table 1. Comparison of FVC

Variables	Study (n=50)		Control (n=50)		p value
	Mean	SD	Mean	SD	
Pred.	3.31	0.57	3.22	0.58	0.422
M. Pred	2.48	0.70	2.76	0.40	0.017
% Pred	79.30	41.85	88.46	19.74	0.166

Table 2. Comparison of FEV1

Variables	Study (n=50)		Control (n=50)		p value
	Mean	SD	Mean	SD	
Pred.	2.83	0.50	2.79	0.48	0.649
M. Pred	1.76	1.04	2.59	0.40	<0.001
% Pred	64.30	45.95	95.42	21.47	<0.001

Table 3. Comparison of FEV1/FVC

Variables	Study (n=50)		Control (n=50)		p value
	Mean	SD	Mean	SD	
Pred.	86.42	5.75	86.84	2.41	0.632
M. Pred	73.32	37.29	92.30	14.05	<0.001
% Pred	85.10	43.08	108.18	8.50	<0.001

Table 4. Comparison of FEV25-75%

Variables	Study (n=50)		Control (n=50)		p value
	Mean	SD	Mean	SD	
Pred.	4.27	0.62	4.25	0.51	0.859
M. Pred	3.32	1.49	3.40	0.81	0.724
% Pred	76.64	33.40	81.42	23.35	0.409

Table 5. Comparison of Peak expiratory flow rate (PEFR)

Variables	Study (n=50)		Control (n=50)		p value
	Mean	SD	Mean	SD	
Pred.	8.80	0.93	8.47	0.69	0.049
M. Pred	4.72	2.18	5.29	1.73	0.147
% Pred	53.48	24.44	63.16	21.66	0.039

DISCUSSION

In the present study the mean age (28.52±9.85 vs 27.16±8.11 years; p=0.453) was statistically similar. Although the history of smoking was statistically similar (26% vs 18%; p=0.334), the history of tobacco chewing was significantly high among painters compared to control group (62% vs 6%; p<0.001).

The mean duration of painting in study group was 8.49 ± 7.98 years. Based on modified questionnaire,9 from Respiratory Symptoms from the British Medical Research council, chest pain was the commonest presentation seen in 10% of individuals in study group. The other symptoms observed were cough, wheeze and drying skin in 6% each and expectoration, syncope and itching of skin in 4% each. In contrast a study8 on 485 painters reported 45% of painters with irritation of upper respiratory tract and conjunctiva, 38% with irritation of the trachea or bronchus and 28% with chronic bronchitis using respiratory symptoms questionnaires. A questionnaire study10 conducted on 1000 construction painters and 1000 carpenters revealed that painters reported significantly more symptoms of asthma like, rhinitis and chronic bronchitis compared to carpenters. A study done6 to assess the potential respiratory effects exposure to paint product on construction painters reported significant excess symptoms like cough, wheeze and dyspnea, compared to metal workers. The disparity of the clinical symptoms observed in the present study and the other studies could be attributed to the smaller sample size of the present study and the difference in the method of symptoms assessment that the questionnaires were formed based on the different criterion.

In this study, on spirometry, the predicted percentage of FEV1 was significantly less in study group compared to control group that is, 64.30 ± 95.42 percent in study group compared to 95.42 ± 21.47 percent in control group (p<0.001). Also, FEV1/FVC predicted percentage was significantly low in study group that is 85.10 ± 43.08 percent compared to control group (108.18 ± 8.50 percent; p<0.001). Similarly, predicted PEFR percentage was also found to be significantly low among the individuals of study group compared to control group (53.48 ± 24.44 percent vs 63.16 ± 21.66 percent; p=0.039). But, the same was not true with FVC and FEV25-75 which were comparable in both the groups. In India, chronic respiratory disease was estimated to account for 7% of all deaths and 3% of loss at work place. Although smoking being the most important risk factor for these diseases, occupational exposures alone or in combination with smoking are responsible for a substantial proportion of the disease.10 Solvents are widely used in industry because of their ability to dissolve other organic materials such as oils, fats, resins, rubber, lacquers, waxes and plastic.6 Painters are exposed to solvent fumes and aerosols containing various concentration of pigments, binders, fillers and chemically reactive monomers, Specific components in paint, such as isocyanides and dimethyl

ethanol amines which are capable of inducing acute and chronic forms of airflow obstruction, the risk increases when spray application methods are used during painting.7 Though the painters are potentially at high risk of developing chronic respiratory diseases only few studies are done till today. In a study,8 pulmonary function tests were done on 448 painters, and 46% painters had obstructive ventilatory impairment, 6% had restrictive ventilatory impairment and 20% of the painters showed chest x-ray abnormalities. In another study4 respiratory illness was measured by questionnaire and spirometry and was found that, there was a significant association between duration of employment and the prevalence of chronic obstructive disease. There was decrement in FEV1 equal to 11 mL for each year worked. A study done6 to assess the potential respiratory effects exposure to paint product on construction painters reported significant association between years of exposure to paint products and airflow obstruction.

Overall, the present study showed that, based on spirometry findings the construction painting workers are at high risk of developing respiratory diseases. However, this study had certain limitations, that is, smaller sample size and the confounding variables such as personal history of smoking and tobacco consumption was not adjusted and, the anthropometry of the study population was not comparable which would have biased the study results. Also significant difference was observed between the vitals. Further studies on large sample after adjusting the confounding variables such as personal habits, anthropometry, vitals and specific age groups would further focus the health status of the painting construction workers.

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