Journal of Rawalpindi Medical College (JRMC); 2008;12(2):95-98

Effect of Job Environment on Pulmonary Functions of Railway Employees

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Abstract

Background: **To seek relationship between job related exposure of Pakistan Railways workers and the development of respiratory diseases.**

Methods: **One hundred (100) exposed railway workers and a reference group of 100 office workers were recruited in the study. Respiratory symptoms, smoking habits, physical examination findings, chest x-ray and spirometry results were recorded on standard proforma.**

Results: **The FEV_1/FVC ratio was significantly lower in the Railway workers than in the reference group ($p<0.001$). Exposed Railway employees had significantly high ($p<0.001$) incidence of pulmonary diseases as compared to the reference group. Disproportionately higher incidence of chronic obstructive airway disease was observed in the exposed Railway employees who smoked as compared to the non-smokers in the same group ($p<0.001$).**

Conclusion: **In exposed Railway workers there is an increased risk of respiratory symptoms, decline in lung functions and chronic obstructive pulmonary disease (COPD) as compared to referents. There is disproportionately higher incidence of COPD among the smokers in the Railway workers as compared to the non-smokers in the same group.**

Key words: **Railway work, bronchial asthma, chronic obstructive pulmonary disease.**

Introduction

Inhalation of noxious substances at workplace can lead to many acute and chronic pulmonary diseases.[1] These may be classified as pneumoconiosis, hypersensitivity pneumonitis, obstructive airway disorders, toxic lung injury, lung cancer, pleural diseases, and miscellaneous disorders.[2] Majority of these do not manifest themselves until many years after the original exposure. Therefore, a physician should always consider the possibility of occupational exposure whenever a working or retired adult worker presents with unexplained respiratory illness.[3]

Identifying a workplace-related cause of disease is important because it can lead to cure and prevention for others.[4] Objective assessment of workers with spirometry in addition to clinical assessment is advisable as it not only helps in confirming but also in monitoring the progression of most occupational lung diseases.[5] Claims in compensation cases always carry more weight if such evidence can be offered.[6]

With industrialization, the railroad industry has evolved substantially and the work-related injuries in this industry have increased significantly.[7] Pakistan Railway has a huge number of employees at risk of being exposed to smoke, industrial dust and chemicals. This study was designed to determine the effect of job environment on these workers' pulmonary functions.

Patients and Methods

This convenient sampled case control study was conducted at Railway Hospital, Rawalpindi from 1st April 2003 to 31st March 2004. Two hundred railway employees with ≥10 years of service presenting with respiratory symptoms (cough, expectoration, wheeze, dyspnoea & chest pain) were recruited. The study group comprised of one hundred railway workers exposed to environmental hazards which included engine drivers, gangmen, loco-shed, carriage factory and central diesel locomotive workers. The control group comprised of one hundred office workers not exposed to the above said environmental hazards. Subjects were excluded from the study if they were already diagnosed with any respiratory condition before the commencement of job in Pakistan Railway or if they had comorbidities like bronchogenic carcinoma, pulmonary tuberculosis, ischaemic heart disease, congestive cardiac failure, chronic renal failure or connective tissue disorders.

A standard proforma was devised to record respiratory symptoms, smoking habits, physical examination findings and spirometry result. Spirometric measurements were performed in the sitting position with a bellow spirometer (Vitalograph S with PFT2) operated by the doctor. Recorded variables were vital capacity, forced vital capacity

(FVC), forced expiratory volume in one second (FEV_1) and FEV_1/FVC ratio.

FEV_1 / FVC ratio of less than 0.7 was required to diagnose obstructive airways defect, while FEV1 / FVC ratio of more than 0.7 was required to diagnose restrictive airway defect. Subjects with FEV_1 / FVC ratio of less than 0.7 combined with history of chronic cough, expectoration, breathlessness, and/or wheezing were diagnosed as having chronic obstructive pulmonary disease (COPD). Asthma was coded positive in subjects reporting physician diagnosed asthma.

Data was analyzed by using statistical software SPSS ver. 10. Discrete variables were listed as counts or percentages and were compared using Chi-square or Fisher's exact test. Continuous variables were listed as means with SDs and were compared using Student's *t* test. Significance was set at $p<0.05$.

Table 1: Breakup of Professions and Disease Pattern among Railway Workers.

Profession	Disease				Total
	Normal Pulmonary Functions	COPD	Asthma	Restrictive Lung Disease	
Asstt. Driver	2	0	0	0	2
Asstt. Mech. Engr	1	0	0	1	2
Driver	9	7	0	0	16
Electrician	1	3	2	0	6
Fireman	3	1	1	1	6
Fitter	19	8	2	1	30
Fuel Issuer	3	1	1	0	5
Gangman	0	1	1	0	2
Mechanic	10	7	4	2	23
Painter	0	1	0	0	1
Welder	5	1	1	0	7
Total	**53**	**30**	**12**	**5**	**10**

Table 2: Break-up of Professions and Disease Pattern among Office Workers.

Profession	Disease				Total
	Normal Pulmonary Functions	COPD	Asthma	Restrictive Lung Disease	
Accountant	5	2	0	0	7
Admin Officer	3	0	0	0	3
Asstt Adm Officer	6	0	0	0	6
Cabin Man	8	0	1	0	9
Constable	5	0	0	0	5
Gate Man	7	0	0	0	7
Office Runner	25	0	0	0	25
Porter	22	4	3	1	30
Shunting Master	3	1	0	1	5
Station master	2	0	0	0	2
Water Man	1	0	0	0	1
Total	**87**	**7**	**4**	**2**	**100**

Results

Both groups had similar age distribution with mean ages of 49.93 ±7.01 years and 53.24 ±5.37 years for Railway & Office workers respectively. Breakup of various professions and final diagnosis among both study groups are shown in Tables 1 and 2.There was no significant difference in smoking habits of both groups (Railway workers 39%, Office workers 45%, p=0.99). The spirometry was abnormal in 45% of Railway workers and in only 13% of Office workers and this difference was highly significant (p<0.001). The abnormal spirometry revealed obstructive defect in 40% of Railway workers and in 11% of Office workers while restrictive defect was found in 5% of Railway workers and 2% of Office workers.

In general, there was significantly high (p<0.001) incidence of pulmonary diseases in Railway workers (47%) as compared to Office workers (13%). Railway workers also had significantly high incidence of COPD, asthma and restrictive lung diseases as compared to Office workers [Table 3].

Table 3: Spectrum of Pulmonary Diseases

Disease	Group	
	Railway workers	Office workers
COPD	30%	7%
Br. Asthma	12%	4%
Restrictive Lung Disease	5%	2%
Normal	53%	87%
Total	**100%**	**100%**

Among the smokers, the incidence of Pulmonary diseases was significantly high (p<0.001) in Railway workers (77%) as compared to Office workers (18%). Similar pattern was observed among the non-smokers where 30% of Railway workers and 9% of Office workers were diagnosed with Pulmonary diseases (p=0.009).

COPD was found to be the commonest Pulmonary disease in both the groups (n=37), followed by bronchial asthma (n=16). Significantly higher (p<0.001) proportion of COPD patients were found among the smokers in the Railway workers (56%) as compared to the Office workers (9%). Among the non-smokers, relatively more COPD patients were found in the Railway workers (13%) as compared to the Office workers (5%) but this difference was not statistically significant (p=0.211).

Further analysis of COPD in Railway workers showed disproportionately high incidence of this condition in subjects who smoked (56%) as compared to non-smokers (13%) in the same group. This difference was statistically significant (p=<0.001).

There was no statistically significant difference in the incidence of bronchial asthma among smokers in both the study groups, but a trend of more asthma incidence (p=0.064) was observed among non-smokers in the Railway workers.

Discussion

A causal link between occupational dust exposure and the development of mucus hypersecretion is generally accepted,[8] but the relationship between development of airways obstruction and exposure to dust at work has been controversial.[9] The methodologies of many of these studies that addressed this relationship have been criticized on the basis of small cohort numbers, inappropriate case controls, confounding of smoking habits, and lack of lung function and exposure data. However, recent epidemiologic studies addressed these criticisms and provide a clearer picture of the effects of chronic exposures to certain dusts and fumes including coal dust, cadmium, welding fume, and cotton dust on lungs.

Longitudinal studies in work forces exposed to dusts or gases show an association with dust exposure, resulting in a more rapid decline in FEV1.[8] Randam et al showed the causative effects of asphalt in obstructive symptoms of asphalt workers.[10] In a study of workers in the Paris area, men who were exposed to dust had on average a 5 – 15 ml/year excessive decline in FEV1 due to the exposure.[11] A study of 1933 randomly sampled men from Bergen in Norway showed a significant dose-effect relationship between the number of occupational agents they were exposed to and the decline in FEV1.[12] Longitudinal studies of British coal miners indicate a relationship between exposure to dust and the development of a small excess longitudinal decline in FEV1 and increased mortality.[13] Similarly Bakke et al, observed the lung function decline in tunnel construction workers having exposure to dust and gases.[14]

Our study also confirmed the above findings and showed an association of abnormal spirometry with predominantly obstructive defect in Railway

workers who were exposed to dust, gases or fumes. There was no difference in the smoking habits of both study groups but the incidence of obstructive airways diseases remained significantly higher among the exposed Railway workers [Table 3].

Many studies of welders demonstrated an increased prevalence of chronic cough and sputum. A cross-sectional study of shipyard workers exposed to welding fume showed a small but significant impairment in FEV1 of 250 ml compared with non-exposed workers.[15] A 7-year follow-up study of these workers demonstrated an annual decline in FEV1 of 16.2 ml in non-smoking, non-exposed workers, with declines attributable to smoking of 17.7 ml/year and to welding fume of 16.4 ml/year.[16] Hence, an interaction was noted between smoking and welding-fume exposure, with a disproportionate effect of fume on smokers compared with non-smokers.

Our study also demonstrated significantly high incidence of COPD among the exposed Railway workers who smoked as compared to the non-smokers in the same group. The above observation does suggest the possibility of a synergistic interaction between smoking and exposure to dust, gases or fumes leading to disproportionately high incidence of COPD in this population.

To avoid a healthy worker selection bias, we chose a reference group that was comparable to the study group with respect to socioeconomic status and selection for employment. Therefore, we believe that the observed differences of respiratory airflow limitation between the two groups reflect differences in occupational exposure. A source of bias may be preferential recall of respiratory symptoms by workers exposed to job effects, but this would only result in overestimating the symptoms and wouldn't have any effect on the pulmonary function tests. The study design may have led to an underestimation of the effects of exposure because sensitive employees might have left the occupation. The other important aspect of this study is the fact that not a lot of data on this subject exists locally and no such study had been carried out previously in Pakistan.

This study is limited by the fact that it was a hospital based study with subjects recruited from Rawalpindi district only hence, the results may not be generalized to other districts. Also the sample size was small and the duration of study was short. Therefore, future studies with big sample size and longer duration are needed to further confirm and validate the results.

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