International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 13, No. 12, December 2024 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_13.12.2024.45

Original Research

Correlation between exposure of industrial pollutants and related respiratory disorders in steel plant workers, both clinically and radiologically

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Received Date: 23 October, 2024 Accepted Date: 19 November, 2024

ABSTRACT

Background: Hazardous exposures in the workplace and elsewhere in the environment continue to contribute to the burden of lung diseases. The present study was conducted to establish correlation between exposure of industrial pollutants and related respiratory disorders in steel plant workers, both clinically and radiologically.

Materials & Methods: The study was carried out at Department of Respiratory medicine at Jawahar Lal Nehru Hospital and Research Centre, Bhilai, Chhattisgarh. Shop floor surveys were conducted in the steel plant in areas where there was pollutants exposure (coke oven, blast furnace, steel melting shop, rail mill, plate mill, etc.) and workers were randomly selected. Clinical examination, both general and systemic was done followed by radiological investigation (X-ray chest and HRCT) and spirometry. Spirometry was performed and parameters such as FVC, FEV1, and FEV1/FVC ratio were recorded.

Results: Spirometric finding of mild obstructive pattern and moderate obstructive pattern between was statistically significant whereas findings of mixed pattern and moderate restrictive pattern were comparable between both the study and control groups respectively. Final interpretation of chronic bronchitis and clinically and functionally bronchitis was statistically significant whereas occupational ILD and bronchiectasis were comparable between study and control group.

Conclusion: There is a causal relationship between exposure material and disease which has been proven statistically.Looking to the globalisation and rapid industrialisation, work/industrial pollutants related disorders are bound to create impact on the health related economy.

Keywords: pollutants, respiratory disorders, steel plant workers

Introduction

Hazardous exposures in the workplace and elsewhere in the environment continue to contribute to the burden of lung diseases.[1] With increasing concerns regarding the health effects of environmental and occupational exposures, clinicians must be prepared to recognize, diagnose and manage occupational and environmental lung diseases.[2] As patient access to sources of information regarding such exposures expands, health care providers must also be prepared to provide preventive advice and to address patient's concerns regarding such exposures.[3] Most respiratory diseases including asthma, chronic obstructive pulmonary disease (COPD), interstitial lung disease and lung cancer may be caused or exacerbated by factors in the workplace, but rarely are such disorders distinguishable pathologically or clinically from idiopathic or non- occupational causes.[4] Thus, a high level of suspicion and knowledge of the basic approaches used in the diagnosis and management of occupational and environmental disorders is essential for all practitioners.[5,6]

Occupational factors make an important contribution to the global burden of disease, but the reliable data on occupational disease are much more difficult to obtain.[7] Data from population based studies and cross-sectional studies of working populationshave indicated a long term effect on lung function from exposure to welding fumes and gases although the evidence is not entirely consistent.[8,9]The present study was conducted to establish correlation between exposure of industrial pollutants and related respiratory disorders in steel

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plant workers, both clinically and radiologically.

Materials & Methods

The study was carried out at Department of Respiratory medicine at Jawahar Lal Nehru Hospital and Research Centre, Bhilai, Chhattisgarh. All gave their written consent to participate in the study. Inclusion criteria was workers with minimum 10 years of exposure, workers between the age group of 35-60 years, workers who are exposed to the industrial dust and working in the plant for >10 years, workers who gave consent to be included in the study and full time adult male workers.

Data such as name, age, gender etc. was recorded. Shop floor surveys were conducted in the steel plant in areas where there was pollutants exposure (coke oven, blast furnace, steel melting shop, rail mill, plate mill, etc.) and workers were randomly selected. Patients presenting complaints and the history of presenting complaints were noted. Past history of any medical illness, occupational dust exposure, drugs or radiation exposures and infections were noted by verbal communication.Clinical examination, both general and systemic was done followed by radiological investigation (X-ray chest and HRCT) and spirometry.Spirometry was performed and parameters such as FVC, FEV1, and FEV1/FVC ratio were recorded. Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

Results

Table: IAge and clinical symptoms of study group with respect to place of work

Parameters	Blast Furnace (N=14)	Coke Oven (N=12)	Plate Mill (N=12)	Roll Mill (N=12)	Steel Melting Shop (N=20)
Age (years)	53.5 ± 4.8	50.2 ± 4.7	46.8 ± 6.6	45.7 ± 5.4	50.7 ± 5.3
Clinical symptoms					
Cough	4 (28.6%)	2 (16.7%)	3 (25%)	1 (8.3%)	5 (25%)
Cough with sputum	2 (14.3%)	2 (16.7%)	0 (0%)	0 (0%)	1 (5%)
Chest tightness	2 (14.3%)	0 (0%)	0 (0%)	0 (0%)	1 (5%)
Dyspnoea	2 (14.3%)	3 (25%)	0 (0%)	0 (0%)	3 (15%)
Weakness	0 (0%)	3 (25%)	1 (8.3%)	0 (0%)	1 (5%)

Symptom of cough was found in 5(25%) workers in steel melting shop, 4 (28.6%) workers in blast furnace, 3 (25%) workers in plate mill, 2 (16.7%) workers in coke oven and in 1 (8.3%) worker in roll mill.Chest tightness was found in 2 (14.3%) workers in blast furnace and in 1 (5%) worker in steel melting shop. dyspnoea was found in 3 (15%) workers in steel melting shop and in 3 (25%) workers in coke oven respectively, and in 2 (14.3%) workers in blast furnace. cough with sputum was found in 2 (14.3%) workers in blast furnace, 2 (16.7%) workers in coke oven and in 1 (5%) worker in steel melting shop. weakness was found in 3 (25%) workers in coke oven, 1 (8.3%) worker in plate mill and in 1 (5%) worker in steel melting shop.

Table II Chest X-ray findings in study group with respect to place of work

Chest X-ray findings	Blast Furnace (N=14)	Coke Oven (N=12)	Plate Mill (N=12)	Roll Mill (N=12)	Steel Melting Shop (N=20)
B/L nodular opacities	1 (7.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
B/L increased BVM	7 (50%)	6 (50%)	2 (16.7%)	1 (8.3%)	7 (35%)
B/L reticulonodular opacities	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (5%)
B/L tram track opacities with cystic spaces with increased BVM	1 (7.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Normal study	5 (35.7%)	6 (50%)	10 (83.3%)	11 (91.7%)	12 (60%)

12 (60%) workers in steel melting shop had normal study on chest x-ray followed by 11 (91.7%) in roll mill, 10 (83.3%) in plate mill, 6 (50%) in coke oven and 5 (35.7%) in blast furnace.B/L increased BVM was found on chest x-ray in 7 (50%) workers in blast furnace, 7 (35%) workers in steel melting shop, 6 (50%) in coke oven, 2 (16.7%) in plate mill, and 1 (8.3%) in roll mill.B/L nodular opacities was found in 1 (7.1%) worker in blast furnace.B/L reticulo nodular opacities was found in 1 (5%) worker in steel melting shop.B/L tram track opacities with cystic spaces with increased BVM was found in 1 (7.1%) worker in blast furnace.

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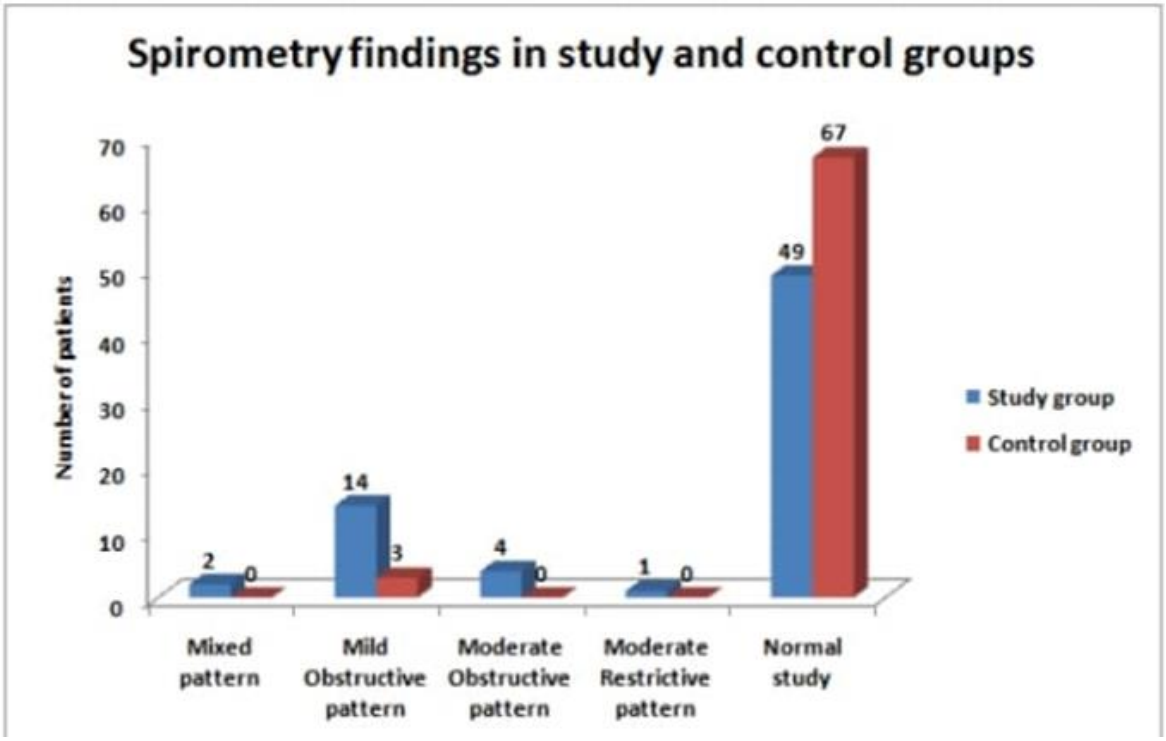
Table III Spirometry findings in study group with respect to place of work

Spirometry	Blast Furnace (N=14)	Coke Oven (N=12)	Plate Mill (N=12)	Roll Mill (N=12)	Steel Melting Shop (N=20)
Mixed pattern	2 (14.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Mild Obstructive pattern	3 (21.4%)	4 (33.3%)	2 (16.7%)	1 (8.3%)	4 (20%)
Moderate Obstructive pattern	2 (14.3%)	1 (8.3%)	0 (0%)	0 (0%)	1 (5%)
Moderate Restrictive pattern	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (5%)
Normal study	7 (50%)	7 (58.3%)	10 (83.3%)	11 (91.7%)	14 (70%)

Normal study on spirometry was found in 14 (70%) workers in steel melting shop, 11 (91.7%) workers in roll mill, 10 (83.3%) workers in plate mill, 7 (58.3%) workers in coke oven and in 7 (50%) workers in blast furnace. mild obstructive pattern was found in 3 (21.4%) workers in blast furnace, 4 (33.3%) workers in coke oven, 4 (20%) workers in steel melting shop, 2 (16.7%) workers in plate mill and in 1 (8.3%) worker in roll mill respectively. Moderate obstructive pattern was found in 2 (14.3%) workers in blast furnace, 1 (8.3%) in coke oven and 1 (5%) worker in steel melting shop. moderate restrictive pattern was found in 1 (5%) worker in steel melting shop. mixed pattern was found in 2 (14.3%) workers in blast furnace.

Graph: I Spirometry findings of study and control population



Spirometric finding of mild obstructive pattern and moderate obstructive pattern between was statistically significant whereas findings of mixed pattern and moderate restrictive pattern were comparable between both the study and control groups respectively.

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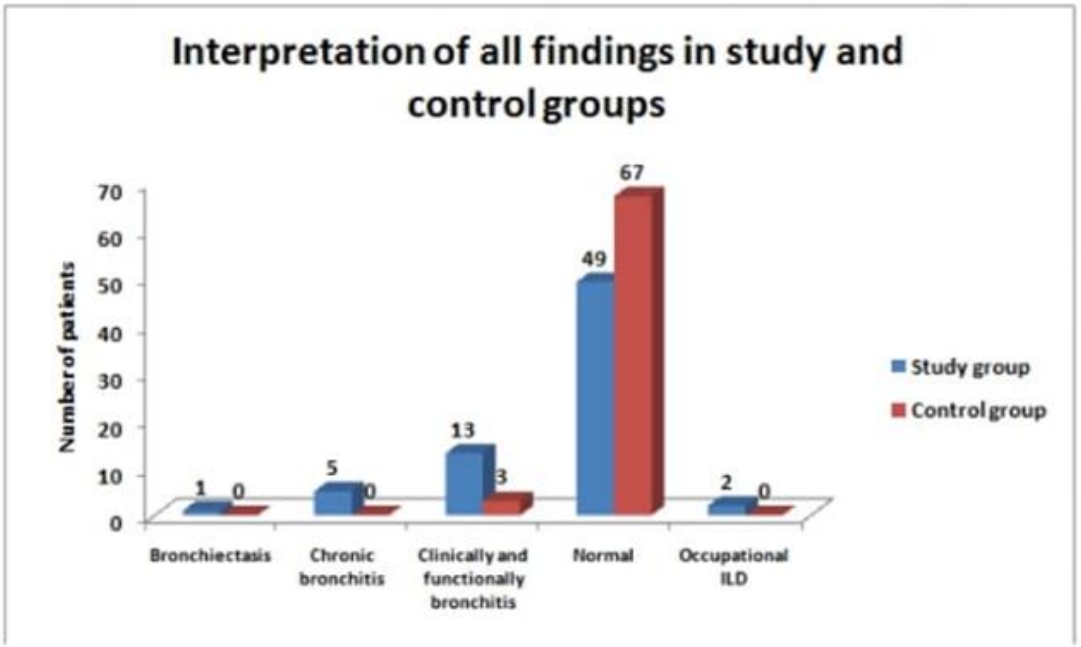
Graph: II Interpretation of all findings in study and control population



In this present study, final interpretation of chronic bronchitis and clinically and functionally bronchitis was statistically significant whereas occupational ILD and bronchiectasis were comparable between study and control group.

Discussion

The present study is an observational, comparative study carried out at a tertiary care hospital during the period of July 2016- July 2017 which included 70 workers in both study and control groups, who fulfilled inclusion/exclusion criteria for both the groups respectively.This study aims to establish correlation between exposure of industrial pollutants and related respiratory disorders in steel plant workers, both clinically and radiologically with the help of spirometry, chest x-ray and high-resolution computed tomography chest.

We found that Symptom of cough was found in 5(25%) workers in steel melting shop, 4 (28.6%) workers in blast furnace, 3 (25%) workers in plate mill, 2 (16.7%) workers in coke oven and in 1 (8.3%) worker in roll mill.Chest tightness was found in 2 (14.3%) workers in blast furnace and in 1 (5%) worker in steel melting shop. dyspnoea was found in 3 (15%) workers in steel melting shop and in 3 (25%) workers in coke oven respectively, and in 2 (14.3%) workers in blast furnace. cough with sputum was found in 2 (14.3%) workers in blast furnace, 2 (16.7%) workers in coke oven and in 1 (5%) worker in steel melting shop. weakness was found in 3 (25%) workers in coke oven, 1 (8.3%) worker in plate mill and in 1 (5%) worker in steel melting shop.M Jaffer et al[10] showed that there was a statistically significant decrease in the level of FVC, FEV1, FEV1/FVC%, FEF25–75% and PEFR in cases compared to the controls. Among cases 30% of them were suffering from early small airway obstruction & mixed blockage, 76% of them were suffering from restrictive type of COPD severity. The lowering of all the dynamic PFT's compared to controls suggested a combination of restrictive & obstructive patterns in their lungs. Reduction in their dynamic lung functions was possibly associated with exposure to dust.

We found that normal study on spirometry was found in 14 (70%) workers in steel melting shop, 11 (91.7%) workers in roll mill, 10 (83.3%) workers in plate mill, 7 (58.3%) workers in coke oven and in 7 (50%) workers in blast furnace. mild obstructive pattern was found in 3 (21.4%) workers in blast furnace, 4 (33.3%) workers in coke oven, 4 (20%) workers in steel melting shop, 2 (16.7%) workers in plate mill and in 1 (8.3%) worker in roll mill respectively. Moderate obstructive pattern was found in 2 (14.3%) workers in blast furnace, 1 (8.3%) in coke oven and 1 (5%) worker in steel melting shop. moderate restrictive pattern was found in 1 (5%) worker in steel melting shop. mixed pattern was found in 2 (14.3%) workers in blast furnace.

Spirometric finding of mild obstructive pattern and moderate obstructive pattern between was statistically significant whereas findings of mixed pattern and moderate restrictive pattern were comparable between both the study and control groups respectively.In this present study, final interpretation of chronic bronchitis and clinically and functionally bronchitis was statistically significant whereas occupational ILD and bronchiectasis were comparable between study and control group.A Jain et al[11]observed that out of 200 workers most of the workers 102 (51.00%) had peak expiratory rate above 400 and 98 (49.00%) workers had peak expiratory flow rate below 400. It had been observed that among all the workers who were referred 78(39%) had mild obstruction while 19(9.5%) and 9 (4.5%) were having moderate and severe obstruction respectively. It can be concluded

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from their study that most of the findings were more among the workers of continuously exposed i.e. steel melting section, rolling mill section, and Quality control department group than intermittently exposed groups. Significant decrease in FEV1 and FVC have been associated with increase in occupational exposures to gases and fumes.

Conclusion

There is a causal relationship between exposure material and disease which has been proven statistically.Looking to the globalisation and rapid industrialisation, work/industrial pollutants related disorders are bound to create impact on the health related economy. Hence, it is imperative to say that if corrective measures are not followed, this may create a burden on the health budget of the country.

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