Section: Pulmonary Medicine

Original Research Article

A COMPARATIVE STUDY ON THE PREVALENCE AND SEVERITY OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE IN INDUSTRIAL WORKERS VERSUS AGRICULTURAL WORKERS

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a major public problem particulalry among occupational groups exposed to inhaled irritants. Industrial and agricultural workers represent two such high-risk due to chronic exposure to inorganic and organic airborne pollutants respectively. Despite this direct comparative studies assessing COPD burden across these populations are limited particulalry in developing countries including India. **Materials and Methods:** This cross-sectional observational study included 100 individuals—50 industrial and 50 agricultural workers—aged 30 to 60 years each with a minimum of 10 years of occupational exposure. Participants underwent structured interviews, clinical evaluation and spirometry. COPD was diagnosed based on a post-bronchodilator FEV1/FVC ratio <0.70 and severity was graded according to GOLD 2019 criteria. Statistical analyses was done using chi-square tests and logistic regression to adjust for factors such as age, smoking status, and exposure duration. **Result:** Mean age was significantly lower in the industrial group (42.47 ± 7.72 vs. 46.64 ± 5.99 years, p=0.0032). Males were more common in industrial work as compared to agricultural work and this difference was statistically significant (P=0.03). COPD prevalence was higher among industrial workers (32%) as compared to agricultural workers (18%) (p=0.1652). The industrial workers exhibited slightly higher severity of COPD across GOLD stages. Smoking status and duration of occupational exposure were comparable between both the groups. Dyspnoea and chronic cough were the most frequently reported symptoms in both groups. **Conclusion:** Industrial workers exhibited a higher prevalence and severity of COPD compared to agricultural workers despite similar durations of exposure and smoking history. These findings are important as they underscore the pathogenic potential of industrial pollutants in causing COPD.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a growing public health concern due to its high morbidity, mortality as well as economic burden it imposes on individuals.[1] It is reported to be one of the leading causes of morbidity and mortality worldwide. COPD imposes a significant disease burden in both developed and developing nations particularly among populations with prolonged exposure to airborne pollutants and irritants. Individuals employed in occupational settings characterized by frequent inhalation of dust, fumes, and chemical vapors are at heightened risk. Among these, industrial and agricultural workers constitute major at-risk cohorts due to chronic exposure to a variety of occupational hazards.[2]

There is an elevated risk of COPD among workers in industrial environment. The nature of industrial work involves exposure to harmful particulates such as chemical fumes and irritant gases. Workers in industries such as mining, metal works and automotive workshops show an increased risk for developing COPD.[3] These findings are important in understanding the etiological significance of prolonged occupational exposure to dusts, fumes and volatile organic compounds. Moreover, occupational exposure to asbestos and diesel exhaust in these settings has been independently associated with obstructive pulmonary function impairment. Also, even among non-smokers, a higher incidence of

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COPD has been observed in occupations such as material moving equipment operators and non-construction labourers, suggesting that occupational factors may play a primary role in the disease's pathogenesis.[4]

Similarly, COPD poses a significant health risk for individuals involved in agricultural workers. This is due to exposure to organic dusts, endotoxins, ammonia and pesticides.[5] Various studies have also reported COPD to be associated with livestock-related activities, particularly swine and cattle farming.[6] Risk was further increased in individuals exposed to smoke as a result of smoking and household air pollution from biomass cooking. The intensity of agricultural exposure in traditional farming environments lacks adequate protective measures and this increases the susceptibility of agricultural workers to developing chronic respiratory conditions. This is more so in developing countries including India.[7]

Comparative assessments of COPD burden among industrial and agricultural workers are limited though both populations share common occupational risk factors. However, the nature, duration and intensity of exposures differ substantially between the two.[8] Industrial workers are more frequently exposed to inorganic chemicals and particulate matter whereas agricultural workers typically encounter organic dusts and biogenic irritants.[9] Use of protective strategies such as respirators and masks is more common in industrial workers as compared to rural agricultural workers. Understanding the impact of these factors in individual having occupational exposures is important for devising effective preventative strategies.[10]

Existing research has largely focused on single-population studies within specific occupational domains. There are very few studies which have done direct comparative evaluations of industrial and agricultural workers for presence of COPD. The current study addresses this knowledge gap by conducting a comparative analysis of the prevalence and severity of COPD among industrial and agricultural workers. This study was undertaken with an aim to quantify the burden of COPD in both these groups.

MATERIALS AND METHODS

This comparative observational study was conducted over a 12-month period from January to 2024 to December 2024. 100 individuals (50 industrial workers and 50 agricultural workers above 30 years of age) were included in this study on the basis of a predetermined inclusion and exclusion criteria The sample size was calculated using an estimated COPD prevalence of 25% in industrial workers and 10% in agricultural workers, with a confidence level of 95% and power of 80%, yielding a minimum required sample size of 45 per group. To account for potential dropouts or incomplete data, 50 participants were recruited for each group.

Agricultural and industrial workers were selected through purposive sampling from workplaces located in an urban area. Data collection involved face-to-face interviews using a structured questionnaire followed by clinical examination and spirometric testing. The questionnaire included sections on demographic profile, smoking history, duration and nature of occupational exposure and respiratory symptoms. Spirometry was done in call cases. A standardized protocol in accordance with the American Thoracic Society and European Respiratory Society guidelines was used for spirometry. Pre- and post-bronchodilator FEV1 and FVC values were recorded. Diagnosis of COPD was made when post-bronchodilator FEV1/FVC ratio was less than 0.70. The severity of airflow limitation was categorized based on the GOLD 2019 criteria.

Data from spirometric tests, responses to prestructured questionnaire and clinical evaluation were compiled and a detailed analysis was done. Descriptive statistics were used to summarize demographic and clinical characteristics. Prevalence rates were calculated and compared for industrial and agricultural workers using chi-square tests. A p-value of less than 0.05 was considered statistically significant.

Inclusion Criteria

- Age above 30 years and up to 60 years.
- Minimum of 10 years of continuous or near continuous employment in industrial or agricultural work
- Willingness to participate and provide informed consent

Exclusion Criteria

- History of bronchial asthma or other chronic respiratory diseases
- Acute respiratory infection in the preceding four weeks
- Incomplete or technically unacceptable spirometric tests
- Inability to perform spirometry due to medical or cognitive limitations.
- Patients with significant psychiatric illnesses.

RESULTS

The analysis of the gender distribution of the studied cases showed that among industrial workers, males constituted the majority (76.00%) while females accounted for 12 cases (24.00%). Among agricultural workers 27 (54.00%) were males and 23 (46.00%) were females. There was a male predominance in industrial workers as compared to agricultural workers and this difference was statistically significant (P=0.03) [Table 1].

The analysis of the age group among the studied cases showed that in the industrial workers group 41–50 years (44.00%) was the most common age group followed by 30–40 years (38.00%) and 51–60 years

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(18.00%).In the agricultural workers group 51–60 years (40.00%) was the most common age group followed by 41–50 years (34.00%) and 30–40 years (26.00%). The mean age of industrial workers was 42.47 ± 7.72 years, while that of agricultural workers was 46.64 +/- 5.99 years. The difference in age distribution was found to be statistically significant (P = 0.003) [Table 2].

Table 1: Gender Distribution among Study Participants

Gender distribution	Industrial Workers		Agricultural Workers		P Value
	Number of Cases	Percentage	Number of Cases	Percentage	
Males	38	76.00%	27	54.00%	=0.03*
Females	12	24.00%	23	46.00%	
Total	50	100.00%	50	100.00%	

Table 2: Age Distribution among Study Participants.

Age Group (years)	Industrial		Agricultural		P Value
	Number of Cases	Percentage	Number of Cases	Percentage	
30 – 40	23	46.00%	6	12.00%	P = 0.0032*
41–50	18	36.00%	32	64.00%	
51–60	9	18.00%	12	24.00%	
Total	50	100.00%	50	100.00%	
Mean Age (Years)	42.47 +/- 7.72		46.64 +/- 5.99		

The analysis of smoking status among the studied cases showed that among industrial workers, 21 individuals (42.0%) had never smoked, 14 (28.0%) were former smokers and 15 (30.0%) were current smokers. Similarly, in the agricultural workers group, 24 individuals (48.0%) had never smoked, 12 (24.0%) were former smokers and 14 (28.0%) were current smokers [Table 3].

Table 3: Smoking Status of the studied cases.

Smoking Status	Industrial (n, %)	Agricultural (n, %)
Never	21 (42.0%)	24 (48.0%)
Former	14 (28.0%)	12 (24.0%)
Current	15 (30.0%)	14 (28.0%)

The analysis of the duration of occupational exposure among the studied cases showed that in the industrial workers group 20–29 years (48.00%) was the most common duration of exposure followed by 10–19 years (38.00%) and ≥30 years (14.00%).In the agricultural workers group 20–29 years (44.00%) was the most common duration of exposure followed by 10–19 years (30.00%) and ≥30 years (18.00%).The mean duration of exposure in industrial workers was 22.17 ± 6.93 years, while that in agricultural workers was 21.43 ± 9.37 years. The difference was not statistically significant (P = 0.6544) [Table 4].

Table 4: Comparison of Occupational Exposure Duration

Years	Industrial (n, %)	Agricultural (n, %)	P value
10–19	19 (38.0%)	15 (30.0%)	P = 0.6544
20–29	24 (48.0%)	22 (44.0%)	
≥30	7 (14.0%)	9 (18.0%)	
Mean Duration of Exposure	22.17 +.- 6.93	21.43 +/- 9.37	

The analysis of disease presence among the studied cases showed that 16 industrial workers (32%) had COPD, while 34 (68%) did not. In comparison, among agricultural workers, 9 individuals (18%) had COPD present and 41 (82%) were without it. Although a higher proportion of industrial workers showed COPD compared to agricultural workers, the difference was not statistically significant (p=0.1652) [Table 5].

Table 5: Prevalence of Chronic Obstructive Pulmonary disease in Studied cases.

Group	Present	Percentage	Absent	Percentage	P Value
Industrial Workers	16	32 %	34	68 %	P= 0.1652
Agricultural Workers	9	18 %	41	82 %	

42 (84%) industrial workers and 34 (68%) agricultural workers were having some or the other signs and symptoms related to respiratory system. The analysis of presenting complaints among the studied cases showed that in the industrial workers group, the most common complaint (most predominant sign or symptoms) was dyspnoea (28.00%), followed by chronic cough (24.00%), sputum production (18.00%) and wheezing (14.00%).In the agricultural workers group, the most common complaint was also dyspnoea (20.00%), followed by chronic cough (20.00%), sputum production (16.00%) and wheezing (12.00%).Among the total study population of 100 patients, the most

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frequent presenting symptom was dyspnoea (24.00%), followed by chronic cough (22.00%), sputum (17.00%), and wheezing (13.00%) [Figure 1].

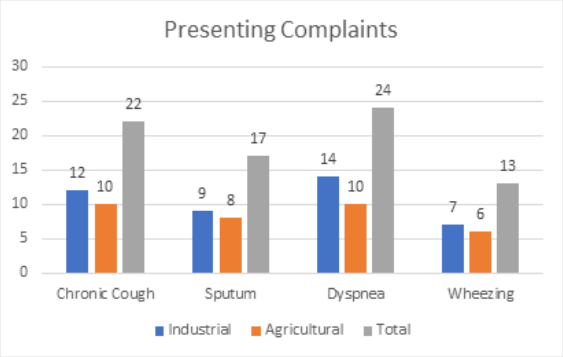

Figure 1: Comparison of Symptom Profile in COPD Cases

The analysis of the severity of COPD based on GOLD criteria among the diagnosed cases showed that in the industrial workers group, moderate COPD (14 %) was the most common severity grade, followed by mild (12 %), severe (4 %), and very severe (2%).In the agricultural workers group, mild and moderate COPD was seen in 4 (8.00%) patients each whereas severe COPD was seen in 1 (2 %) patient [Figure 2].

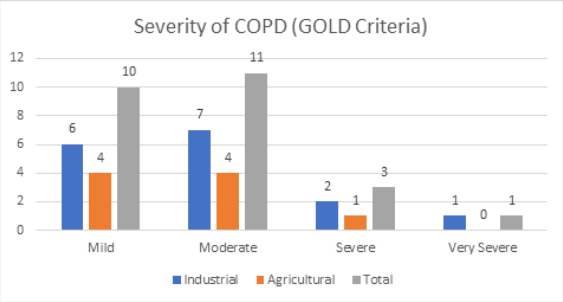

Figure 2: Comparison of Severity of COPD (GOLD criteria)

DISCUSSION

Our study revealed a statistically significant difference in gender distribution between industrial and agricultural workers. We found male predominance in the industrial cohort (76%) as compared to agricultural workers (54 %). This variation may be due to broader occupational trends where men are more commonly employed in manufacturing industries whereas women work more in farming and related agricultural activities. Gender differences in occupational exposure can influence COPD risk. In a review study by Ho T et al it was noted that female workers particularly in developing countries are more likely to remain underdiagnosed partly due to atypical symptom presentation and also because of social barriers to healthcare access.[11] Similarly Mohan et al found that rural Indian women exposed to biomass fuels and farm dust had high symptom burdens but they remain fairly undiagnosed due to limited access to spirometry and clinical evaluation. The study also concluded that Co-morbid conditions such as tuberculosis and diabetes mellitus make the diagnosis of COPD difficult and also contribute to mortality.[12]

In our study agricultural workers were slightly older than industrial workers (mean age 46.64 vs. 42.47 years, p=0.0032). Age is a well-established risk factor for COPD largely due to cumulative exposure and age-related decline in lung function. Despite the older age of agricultural workers in our study the industrial cohort exhibited a higher COPD prevalence. This difference suggests that industrial exposures may be responsible for more potent pathogenic effects within a shorter duration of exposure. These results are supported by the findings of Torén et al who demonstrated that certain industrial jobs such as construction work increases COPD risk even after adjusting for age and smoking.[13] In comparison another study by Schenker et al evaluating farmworkers noted that age-related increases in respiratory symptoms were often compounded by seasonal exposure patterns.[14] These patterns are similar to our data and underscore the variable impact of different occupational environments across age groups.

Smoking status showed relatively comparable distributions between the two groups, with current smokers comprising 30% of industrial and 28% of agricultural workers. This makes it clear that occupational exposure is an independent risk factor for COPD, as the difference in disease prevalence (32% in industrial vs. 18% in agricultural workers) occurred despite similar smoking patterns. Eisner MD et al confirmed that occupational exposure to vapours, gases, dust, and fumes (VGDF) was associated with COPD risk independent of smoking. These findings confirm the additive nature of occupational irritants.[15] This study concluded that substantive burden of COPD is attributable to risk factors other than smoking Mehta et al also emphasized this in their multicenter study showing that even never-smokers had significant COPD prevalence when exposed to workplace pollutants. 16 These findings are similar to the findings of our inference that occupational exposures play a central role in COPD development which is beyond the conventional impact of tobacco use.

The duration of occupational exposure did not differ significantly between groups (mean 22.17 years for industrial vs. 21.43 years for agricultural workers, p=0.6544), suggesting that duration alone may not fully explain the observed variation in COPD prevalence. Instead, the nature and intensity of the exposure likely play an important role. De Matteis et al demonstrated that individuals with long-term exposure to inorganic dusts and fumes, particularly in heavy industry had higher COPD odds compared to those with similar durations in less noxious environments.[16,17] Similar findings were also reported by Omland et al et al.[18]

Finally, our study found a higher (though not statistically significant) prevalence of COPD among

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industrial workers (32%) compared to agricultural workers (18%). The distribution of COPD severity also followed this trend, with industrial workers showing slightly higher numbers across mild, moderate, and severe categories. Symptomatically, both groups reported similar complaints, with dyspnoea and chronic cough being most prevalent. These outcomes suggest that industrial exposures may lead not only to more frequent but also potentially more severe disease manifestations. Ma L et al reported similar findings in their study. They found that exposures to metals and smoking were associated with the increased risk and severity of COPD and there was a significant correlation between the two exposures for the risk of COPD.[19] Similar Findings were also reported by Murgia N et al.[20]

CONCLUSION

There was a higher prevalence as well as severity of COPD among industrial workers as compared to agricultural workers in spite of similar smoking pattern and duration of occupational exposure. These findings are important and suggest that the type and intensity of workplace pollutants may contribute more significantly to COPD risk than exposure duration alone. The observed trend toward greater disease prevalence in industrial settings highlights the need for regular spirometric screening and early preventive measures.

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