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Early diagnosis of small airway disease in asymptomatic polishing sector workers of a leather factory

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ABSTRACT

Background: The leather industry stands as one of India's burgeoning sectors, boasting significant manpower. Workers in the finishing sector, particularly those involved in polishing, face heightened risks due to exposure to formaldehyde, aniline, and resins, which can lead to respiratory complications. **Aims and Objectives:** The aims and objectives of the study are to determine the small airway obstruction in asymptomatic finishing sector workers of a leather factory. **Materials and Methods:** The current study was a cross-sectional study conducted in a leather factory located in Chennai, Tamil Nadu. A random sample of 60 workers was drawn from different sectors of a leather factory. Basic demographic details, smoking history, nature of work, exposure to irritants along with duration, and respiratory symptoms were collected. All workers were subjected to spirometry as per ATS guidelines and the results were analyzed. Association between length (years) of exposure, respiratory symptoms, and spirometry impairment among the workers were analysed. **Results:** Out of 60 samples, 38 were exposed to irritants and 22 were not exposed to irritants. Out of 38, 25 had small airway disease, seven had large airway obstruction, one had a restrictive pattern, and five had normal spirometry. 42.1% of them were asymptomatic. **Conclusion:** Small airway obstruction is notably prevalent, especially among asymptomatic workers in the polishing sector. Prolonged exposure is associated with the development of large airway obstructive disease. This study underscores the importance of continuous monitoring for airway diseases in occupationally exposed workers, advocating for timely preventive and protective measures to curb disease progression.

Key words: Polishing sector; Aniline; Formaldehyde; Resins; Spirometry; Small airway obstruction

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INTRODUCTION

The leather industry stands as one of India's burgeoning sectors, boasting significant manpower. Its production processes encompass a range of stages, from hide preparation to tanning and finishing, including casein and nitrocellulose treatments. However, workers in the finishing sector, particularly those involved in polishing, face heightened risks due to exposure to formaldehyde, aniline, and resins, which can lead to respiratory complications.[1] To address this, spirometry serves as a vital tool, enabling the detection and quantification of impaired lung function while aiding in pinpointing affected anatomical sites. This study seeks to assess the prevalence of small airway obstruction among leather factory workers employed in thepolishing sectors.

Aims and objectives

To determine the small airway obstruction in asymptomatic finishing sector workers of a leather factory using spirimetry.

MATERIALS AND METHODS

This cross-sectional study was conducted in a leather factory situated in Chennai, Tamil Nadu, in June 2023.

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A random sample of 60 workers was selected from various sectors of the factory. Demographic information (Figure 1), smoking history, nature of work, past and present exposure, along with duration, and respiratory symptoms, were collected. All workers underwent spirometry following ATS guidelines, and the results were analyzed. The average duration of exposure to irritants among the exposed group of workers was found to be 5.07 years.

Pulmonary function tests play a crucial role in diagnosing, assessing, and monitoring respiratory symptoms and diseases. These tests involve measurements such as forced expiratory volume in 1 s (FEV1), which is the volume expired forcefully in 1 s after full inspiration, and forced vital capacity (FVC), which is the maximum volume expired during forced expiration. These parameters primarily detect larger airway diseases. In addition, maximum mid-expiratory flow or forced expiratory flow (FEF) 25–75 is considered an indicator of small airway function and helps identify small airway obstruction. A normal range for FEV1 and FVC is typically above 80%. Values below 80% for both FEV1 and FVC but with FEV1/FVC ratio above 0.7 indicate restriction, whereas FEV1 below 80% with normal FVC suggests obstruction.

The association between length of exposure (in years), respiratory symptoms, and spirometry impairment among workers in the polishing sector was analyzed using Chi-square analysis and presented as a Row by Column table. A two-sided P≤0.05 was considered statistically significant. Smoking status was included as a potential confounder in this study, selected based on prior literature review. The duration of exposure in years was treated as a continuous variable, and types of work were classified into two categories: Those exposed to chemical irritants and those not exposed.

RESULTS

The average FEV1 in the irritant-exposed group is 79.7, compared to 104.8 in the non-exposed group, yielding a significant P=0.932. This indicates a positive correlation between irritant exposure and respiratory compromise. The average FEF of 25–75 in the exposed group is 65.4, representing a significant reduction and indicating small airway obstruction (Table 1).

Summarizing the analysis of irritant-exposed workers, 25 workers exhibited small airway obstruction, whereas seven had large airway disease, demonstrating a positive association between exposure and outcome (Table 2).

As shown in Table 3, the majority of exposed workers were asymptomatic or experienced only occasional coughing, with a significant P-value. Shortness of breath was the next most predominant symptom among exposed workers.

Table 1: Average of spirometry parameters of the samples

Parameters (Percentage predicted)	Exposed to chemicals (Average)	Not exposed to chemicals (Average)
FEV1	79.7	104.8
FVC	83.04	101.1
FEF 25–75	65.4	81.7

FEV1: Forced expiratory volume in 1, FVC: Forced vital capacity, FEF: Forced expiratory flow, P=0.932

Table 2: Spirometry results of the samples

Spirometry results	Exposed to chemicals (38) (%)	Not exposed to chemicals (22) (%)
Small airway obstruction	25 (66)	2 (9)
Large airway obstruction	7 (18)	1 (5)
Restriction	1 (3)	0
Normal	5 (13)	19 (86)

Table 3: Symptomatology of samples

Symptoms	Exposed to chemicals (38) (%)	Not exposed to chemicals (22) (%)
Asymptomatic	16 (42.1)	19 (86.4)
SOB	15 (39.4)	1 (4.4)
Occasional cough	5 (13.16)	0
Nasal block	2 (2.63)	2 (9)
Sneeze	1 (2.63)	0

SOB: Shortness of breath, P=0.0001

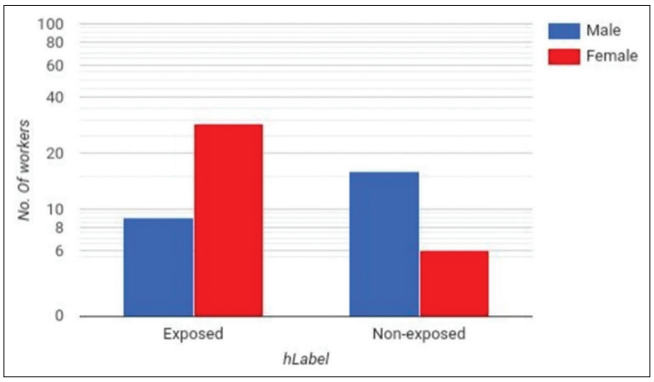

Figure 1: Demographic details

DISCUSSION

The lungs, being constantly engaged with the external environment through each breath, are particularly susceptible to environmental factors. Consequently, the incidence of occupational lung diseases escalates with the progression of industrialization. In India, a swiftly

industrializing nation, this trend is pronounced. Despite this, only a small fraction of workers worldwide, and even fewer in India, have access to occupational health services. Prolonged exposure to toxins in the workplace leads to a spectrum of lung ailments, including occupational asthma, chronic bronchitis, allergic bronchitis, and rhinitis.[2] Assessing patients with occupational exposure requires a comprehensive approach, including detailed history-taking, examination of work practices and duration of exposure, physical examination, and pulmonary function testing.

The leather industry, a burgeoning sector in India, involves various processes, including hide preparation, tanning, and finishing. Among these, workers in the tanning sector face an elevated risk of occupational lung disease. Similarly, those in the finishing sector, especially involved in polishing, are exposed to harmful substances such as formaldehyde, aniline, and resins, heightening their vulnerability to respiratory ailments.[6,7] Notably, respiratory impairment is significantly higher among workers in the polishing sector, often presenting as small airway obstruction.

This increased morbidity is attributed to chronic exposure to hazardous substances such as resins, aniline, and formaldehyde, which can precipitate occupational asthma. Symptoms such as watery and burning eyes,[8,9] along with cough and chest tightness, are common manifestations. Moreover, inhalation of these substances can lead to sensitization-induced asthma,[4,5] characterized by a latency period between exposure and symptom onset. Formaldehyde, a sensitizing agent commonly used in the finishing process, exemplifies this phenomenon. Conversely, irritant-induced occupational asthma manifests rapidly after exposure, indicating an inflammatory response to substances such as formaldehyde.[3,10]

Our study identified small airway obstruction in workers with prolonged exposure, whereas those with shorter durations often complained of nasal blockage and sneezing due to local irritation. Interestingly, female workers, predominantly in the finishing sector, showed a higher prevalence of small airway disease compared to their male counterparts, who typically engage in loading and manual labor. However, smoking emerged as a confounding factor, exacerbating small airway obstruction.

Given these findings, timely intervention is imperative to prevent and manage small airway obstruction effectively. Collaboration between pulmonologists, occupational health practitioners, and researchers is essential to mitigate the burden of occupational lung diseases through early diagnosis and targeted preventive measures.

Limitations of the study

1. Further investigation with ossilometry, CT chest not done
2. Limited sample size
3. Other sector workers are not included in the study

CONCLUSION

Small airway obstruction is notably prevelant among asymptomatic workers of polishing sector. Prolonged exposure is associated with large airway obstruction. This study underscores the importance of continuous monitoring for airway diseases in occupationally exposed workers, advocating for timely preventive and protective measures to curb disease progression.

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SPS- Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; definition of intellectual content, literature survey, prepared the first draft of the manuscript, implementation of the study protocol, data collection, data analysis, manuscript preparation, and submission of the article; **BS**- Design of study, statistical analysis, and interpretation and review manuscript; **CC**- Review manuscript; **MN**- Literature survey and preparation of figures; **MR**- Coordination and manuscript revision.

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