

RESPIRATORY PROBLEMS IN COTTON MILL WORKERSRavi Dosi¹, Arpit Jain², Priyanshu Jain³, Gaurav Jain⁴, Prakash Joshi⁵, Saurabh Karnawat⁶, Arun Chandelkar⁷, Garima Singh Rawat⁸¹Associate Professor and HOD, Department of Pulmonary Medicine, SAIMS, Indore, Madhya Pradesh, India.²3rd Year Resident, Department of Pulmonary Medicine, SAIMS, Indore, Madhya Pradesh, India.³2nd Year Resident, Department of Pulmonary Medicine, SAIMS, Indore, Madhya Pradesh, India.⁴1st Year Resident, Department of Pulmonary Medicine, SAIMS, Indore, Madhya Pradesh, India.⁵Senior Resident, Department of Pulmonary Medicine, SAIMS, Indore, Madhya Pradesh, India.⁶3rd Year Resident, Department of Radiation Medicine, SAIMS, Indore, Madhya Pradesh, India.⁷3rd Year Resident, Department of Pulmonary Medicine, SAIMS, Indore, Madhya Pradesh, India.⁸1st Year Resident, Department of Obstetrics and Gynaecology, SBKS Medical College, Vadodara, India.**ABSTRACT****BACKGROUND**

Cotton textile workers are at increased risk of respiratory symptoms such as chest tightness, chronic bronchitis and loss of pulmonary function due to inhalational exposure to cotton dust. Indore has been a hub of textile manufacturing from past 30 - 40 years and a large subset of population is employed in textile manufacturing.

An observational study was conducted on 200 subjects in the suburbs of Indore city to compare prevalence of respiratory problems among cotton mill workers and unexposed individuals.

MATERIALS AND METHODS

Universal sampling method was used to decide sample size. Statistical analysis was done using SPSS 20.0 version. Continuous variables are presented as mean SD. Categorical variables are expressed as frequencies and percentages. Chi-square test is used for the determination of association between two qualitative variables and independent sample t-test will be used for evaluation of difference between means. A p-value of less than 0.05 will be taken to indicate significant difference.

RESULTS

Cotton mill workers were predominantly found to have COPD Stage 2 and 3 which was seen in 70% of the subjects and Bronchial Asthma seen in 30% of the subjects.

CONCLUSION

Study showed that respiratory symptoms and pulmonary function abnormalities are seen more frequently in cotton workers compared to controls. It can be concluded from the study that more aggressive measures must be taken in the workplace with regular sampling of the workplace and regular medical check-up of all cotton mill workers should be done to prevent the harmful respiratory effect of cotton dust exposure on lung function.

KEY WORDS

American Thoracic Society (ATS) Questionnaire, Chronic Obstructive Pulmonary Disease (COPD), Pulmonary Function Test (PFT), FEV₁, FVC.

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BACKGROUND

The Indian textile industry continues to be the second-largest employment generating sector in India.^(1,2) Survey on cotton mill suggests that there are about 1962 cotton textile mills in India, of which 80% are in the private sector and the rest in the public and cooperative sector. Apart from these, there are several thousand small factories with three to ten looms.^(3,4)

Cotton textile workers are at risk of respiratory symptoms such as chest tightness, chronic bronchitis and loss of pulmonary function due to inhalational exposure to cotton dust.

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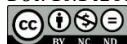
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The acute respiratory response to cotton dust has been described in many studies. The acute airway response is described as a cross-shift drop in forced expiratory volume in 1 s (FEV₁) with or without respiratory complaints. It is considered that acute response is reversible after short-term exposure, but chronic effects may result from prolonged exposure.⁽⁵⁾ About 25 - 45% of patients with Chronic Obstructive Pulmonary Disease (COPD) worldwide have never smoked. This is the contribution of workplace exposures to obstructive lung disease. While a number of non-tobacco related environmental exposures may cause COPD, textile industry makes major bulk of it. Around 60 million people are employed in the textile or clothing industry worldwide, while textile industry in India provides direct employment to around 35 million people, being the second largest employment generating sector in India.^(1,3) A cotton mill is a factory, housing powered spinning or weaving machinery for the production of yarn or cloth from cotton.

The modern Indian mechanised textile industry was born in 1854, when a steam-powered mill was opened in Bombay by Cowasjee N. Davar; however, a large share of Indian

Cotton Industry remained handloom dependent. Workers in cotton industry, more so in handloom sector, are exposed to variety of air-borne agents, originating from natural fibrous materials and dust in their work environment.^[6] Thus, they are at risk of respiratory symptoms and loss of pulmonary function due to inhalational exposure to cotton dust.^[5] Non-invasive methods such as Pulmonary Function Tests (PFTs) can be used for the assessment of respiratory disorders due to cotton dust exposure; however, the long-term effects of exposure to cotton dust using an accurate objective measurement is not well-understood. This prospective study of 100 cotton mill workers from Malwa Mills of Indore, Madhya Pradesh, was designed to evaluate the long-term respiratory diseases due to non-synthetic textile work, i.e. cotton in the context of disease classifications such as reversible or irreversible obstructive lung disease. This study compares lung function between cotton mill workers and control group to identify and compare prevalence of obstructive lung disease in both the groups of Malwa Mill Area at Indore.

MATERIALS AND METHODS

It is a descriptive comparative study. All workers and residents of Malwa Mill area, Indore were interviewed and examined by the pulmonologist. A pilot study was conducted in 10 patients with pre-tested and semi-structured questionnaire. The questionnaire was modified accordingly. It included questions on personal information, respiratory symptoms and work history. Personal information included name, age and history of smoking and tobacco chewing. Respiratory symptoms such as dyspnoea, cough and chest tightness were documented. All subjects examined were advised for complete workup at Medical College.

Place of Study

Sri Aurobindo Medical College and PG Institute.

Study Design

A cross-sectional descriptive comparative study.

Study Period- July 2016 to July 2017.

Study Duration- 12 months.

The study population consisted of 100 cotton textile workers who were exposed to airborne cotton dust and employed more than 9 years in cotton textile mills in Indore, Madhya Pradesh. 100 unexposed subjects who were relatives of workers or the people living in same area, i.e. Malwa Mill area in Indore, were taken as the control group. Subjects were excluded from the study if they had history of respiratory diseases such as asthma, bronchitis, emphysema, bronchiectasis, lung cancer or any other chronic condition and smokers. The study was conducted at Sri Aurobindo Medical College under Respiratory Medicine Department.

The Sample Size required was taken for Convenience

A modified version of the American Thoracic Society (ATS), respiratory symptoms questionnaire was completed for each worker.^[7] All workers were interviewed and examined by the pulmonologist.

PFTs and chest radiography were conducted for all subjects. PFTs were carried out by a trained technician using a calibrated spirometry (Jaeger). The highest values for FEV₁ and Forced Vital Capacity (FVC) after three acceptable manoeuvres according to ATS criteria were used in subsequent analysis.^[8]

According to ATS criteria, in the cases with obstructive pattern, changes in FEV₁ and FVC were measured before and 20 mins after the separate inhalation of four puffs of 250 µg salbutamol from a metered-dose inhaler. Patients rested for 20 mins after the first measurement.

Statistical Analysis

Statistical analysis was done with the statistical package for the Social Science System Version SPSS 20.0. Data was analysed and quantitative and qualitative variables were measured. Continuous variables were presented as mean SD. Categorical variables will be expressed as frequencies and percentages. Chi-square test was used for the determination of association between two qualitative variables, while independent sample t-test was used for evaluation of difference between means, both in exposed and unexposed groups. For all statistical tests, a p value less than 0.05 will be taken to indicate a significant difference.

RESULTS

All 100 exposed (cotton workers) and 100 unexposed individuals underwent an interview, physical examination, assessment of PFTs and radiographic results by a pulmonologist.

A total of 51% and 31% of the cotton textile workers had one or more respiratory symptoms and respiratory signs, respectively. Table 1 summarizes the prevalence of respiratory complaints and PFTs of both groups. The prevalence of cough, sputum and chest tightness were statistically significant (<0.001) between two groups.

PFTs were performed for all subjects. Statistically significant (< 0.001) decrease in FEV₁, FVC and FEV₁/FVC were noted in cotton workers when compared with the control group [Table 1]. Twenty-eight percentage of subjects in the exposed group and 5% of subjects in the unexposed group had an obstructive pattern. Overall, 25% (7/28) of exposed group with airway obstructive pattern on PFT showed reversibility after post-bronchodilator test.

	Cotton Workers (Case)	Controls	P
Respiratory Symptoms			
Cough	47	10	<0.001
Dyspnoea	15	9	0.19
Chest Tightness	26	7	0.002
Chest Pain	14	6	0.24
Sputum	41	5	<0.001
Respiratory Signs			
Wheeze	20	4	<0.001
Crackles	14		
Pulmonary Function Tests			
FEV ₁	3.02+/-0.66	3.45+/-0.53	<0.001
FVC	3.62+/-0.59	4.22+/-0.50	<0.001
FEV ₁ /FVC	0.72+/-0.07	0.78+/-0.04	<0.001

Table 1

DISCUSSION

Cotton dust is defined as dust generated into the atmosphere as a result of processing the cotton fibers combined with any naturally occurring materials such as stems, leaves, bracts and inorganic matter which may have accumulated on the cotton fibers during growing and harvesting period.⁽⁹⁾ Most studies in cotton and hemp workers report an increased incidence of chronic and progressive dyspnoea, cough and sputum production characteristic of symptoms seen in COPD.^(10,11,12,13,9)

Mechanism of lung function abnormality, specific pathogenesis is not known. Suryakar et al found that oxidative stress may contribute to respiratory disorders in cotton mill workers. As duration of exposure is increased, the effect was enhanced. Long-term exposure to cotton dust results in macrophage/ neutrophil migration into the airspaces, which generate reactive oxygen species production by opsonisation.⁽¹⁴⁾ According to Lai and Christiani, organic dust exposure in the textile industry leads to obstructive lung disease that has features of both asthma and COPD. An inversion of the pulmonary macrophage: dendritic cell ratio may be a mechanistic explanation for persistent inflammation and obstructive lung disease seen in endotoxin-related textile exposures. One study showed that the prevalence of respiratory symptoms being higher in smokers than non-smokers.⁽¹⁵⁾ Smoking has an additive effect on cotton dust exposure.

Dust present during the handling and processing of cotton is considered cotton dust. This dust is a complex mixture of components which may include ground-up plant matter, cotton fiber, bacteria, fungi, soil or pesticides. It may also include other contaminants that have accumulated during the growing, harvesting and subsequent processing or during storage periods.

Occupational exposure to cotton dust can also induce acute airway responses such as byssinosis. Byssinosis is characterised by feeling of shortness of breath and chest tightness on the 1st day of the working week. There may be increased cough and sputum production. In the early stages of byssinosis, these symptoms subside by the end of the workday and reoccur on Monday morning after being away from the dust for a period.

As the length of exposure increases over the working years of the employee, symptoms of the chest tightness and shortness of breath occur more frequently and on all workdays. It is believed that the degree or severity of response for individuals with symptoms of is related to the dust level in the workplace. The beginning steps in yarn preparation generally produce more dust. Therefore, the closer to the beginning of the process, the higher will be the dust level and the more likely the pulmonary reaction or response for some workers.^[16]

In this study, cotton industry workers reported a higher prevalence of respiratory symptoms namely cough, dyspnoea, chest tightness, chest pain, sputum, more than unexposed individuals. Results of our survey were in line with previously published studies that reported higher prevalence of respiratory symptoms in cotton workers. Prevalence of respiratory symptoms in cotton workers is similar to that reported by other studies namely Wang et al,¹⁷ Altin et al,¹⁸ Bünger et al¹⁹ and Christiani et al.²⁰ The characteristic respiratory symptoms such as chest tightness

and cough have been standardised by Schilling et al.²¹ In our study, the most common respiratory symptoms were cough and sputum production. These symptoms probably represent variants of the airway irritation because of dust inhalation.

Respiratory Symptoms	Cotton Workers (Case)	Controls	P
Cough	47	10	<0.001
Dyspnoea	15	9	0.19
Chest Tightness	26	7	0.002
Chest Pain	14	6	0.24
Sputum	41	5	<0.001

Our study also showed higher prevalence of respiratory signs namely wheezes and crackles in Cotton Mill workers as compared to unexposed individuals.

Respiratory Signs	Cotton Workers (Case)	Controls	P
Wheeze	20	4	<0.001
Crackles	14		

We also found that cotton industry workers had lower predicted FEV₁% and FEV₁/FVC values as compared to the group of unexposed individuals. Previous studies like Lai, et al²² and Wang et al²³ also had similar findings. Trupin et al²⁴ observed accelerated decline in FEV₁ in cotton workers as compared to the control group, even in non-smokers and after retirement.

Pulmonary Function Tests	Cotton Workers (Case)	Control	P
FEV ₁	3.02+/-0.66	3.45+/-0.53	<0.001
FVC	3.62+/-0.59	4.22+/-0.50	<0.001
FEV ₁ /FVC	0.72+/-0.07	78+/-0.04	<0.001

The physiological picture suggested predominantly obstructive pattern, which was seen in 28% of cases in our study, which was in line with previously conducted studies Aminian et al²⁵ and Kobayashi et al,²⁶ though restrictive or mixed pattern may also be found in some cotton mill workers.

According to our study, it can be concluded that cotton mill workers are at higher risk for developing respiratory symptoms, signs and loss of pulmonary function when exposed to cotton dust for a longer period, which is consistent with other studies namely Shi et al²⁷ and Chattopadhyay et al.²⁸

CONCLUSION

Our study shows that respiratory symptoms and pulmonary function abnormalities are seen more frequently in cotton workers compared to controls. The study shows that as the duration of exposure increased, symptoms increased. Lung function abnormality was present even in absence of exposure. This suggests that more aggressive measures must be taken in the workplace. Sampling of the workplace must be done at regular intervals. Regular medical check-ups of all cotton mill workers should be done to prevent the harmful respiratory effect of cotton dust exposure on lung function.

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