Original Article

Respiratory problems among cotton textile workers

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ABSTRACT

Background: Long term occupational exposure to cotton dust is associated with respiratory symptoms and loss of pulmonary function. **Aim:** This study was conducted to explore respiratory symptoms, pulmonary function tests and chest radiography of workers, and to evaluate the findings of high resolution computed tomographyand its correlation with pulmonary function tests (PFT). **Material and Methods:** The study was conducted on 100 cotton workers as exposed group and 100 unexposed subjects. Smokers were excluded from the study. All workers were interviewed and examined by the pulmonologist. PFT and chest radiography were conducted for all subjects. HRCT was performed for those with abnormal PFT or chest radiography. **Results:** A total of 51% and 31% of the cotton textile workers had one or more respiratory symptoms and respiratory signs respectively. 28% of subjects in the exposed group and 5% of subjects in unexposed group had obstructive pattern. Bronchia wall thickening and air trapping were the most frequent chest radiography and HRCT abnormalities respectively. There was a significant correlation between HRCT and the results of PFT. **Conclusion:** We conclude that long term exposure to cotton dust is associated with obstructive disease that increase with duration of exposure (history of working years), also use of HRCT as a sensitive tool in the assessment of pathologic changes and it's correlation with PFT, confirms the expected pathophysiology of airway obstruction in cotton workers.

KEY WORDS: Cotton workers, respiratory, textile

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INTRODUCTION

One of the largest industries in the world is the textile industries.[1] Textile industries have been expanded in developing countries. Iran is one of the cotton producing and consuming countries. 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.[2]

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 (FEV_1), 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.[3-5]

Noninvasive methods such as pulmonary function tests (PFTs) can be used for the assessment of respiratory disorders due to cotton dust exposure, but there is no consensus on the use of other methods such as high-resolution computed tomography (HRCT) in the assessment of respiratory problems, however, the long-term effects of exposure to cotton dust using an accurate objective measurement is not well-understood.

Access this article online

Quick Response Code:

Website: www.lungindia.com

DOI: 10.4103/0970-2113.177444

How to cite this article: Mansouri F, Pili JP, Abbasi A, Soltani M, Izadi N. Respiratory problems among cotton textile workers. Lung India 2016;33:163-6.

According to our knowledge, studies to date have not evaluated the changes in other objective measurements such as chest radiography and computed tomography in relation to chronic function loss in cotton textile workers. To provide the additional understanding of the chronic respiratory effects of exposure to cotton dust; we have conducted this study to determine the frequency of respiratory symptoms, changes in PFTs, and chronic respiratory impairment among cotton textile workers.

MATERIALS AND METHODS

This cross-sectional study for the assessment of respiratory disease among cotton textile workers was established in 2013. The study population consisted of 100 cotton textile workers who were exposed to airborne cotton dust and employed more than 3 years in cotton textile mills in Kermanshah, Iran and 100 unexposed subjects who were relatives of workers, matched for age and sex involved in this study as the control group. Subjects were excluded from the study if they were current or ex-smokers or had a history of respiratory diseases such as asthma, bronchitis, emphysema, bronchiectasis, lung cancer, or any other chronic condition in the preemployment assessment. The study was approved by the Ethics Committee of the Kermanshah University of Medical Sciences. The participants gave written informed consent before the study.

A modified version of the American Thoracic Society (ATS), respiratory symptoms questionnaire was completed for each worker.[6] All workers were interviewed and examined by the pulmonologist.

PFTs and chest radiography were conducted for all subjects on Thursday morning at the end of working week. PFT were carried out by a trained technician using a calibrated spirometer (Jaeger). The highest values for FEV_1 and forced vital capacity (FVC) after three acceptable maneuvers according to ATS criteria were used in subsequent analysis.[7]

According to ATS criteria in the cases with obstructive pattern, changes in FEV_1 and FVC were measured before and 20 min after the separate inhalation of four puffs of 250 μg salbutamol from a metered dose inhaler, administered through a 750 ml spacer device. Patients rested 20 min after the first measurement.

Postbronchodilator test and HRCT scan were performed for those with abnormal PFTs or chest radiography. The HRCT scans were all performed using a 16-slice HRCT scanner (Toshiba Aquilion scanner; Toshiba Medical Systems, Tokyo, Japan) and assessed by one experienced radiologist.

Data were analyzed by SPSS version 16.0 program for Windows (SPSS Inc., Chicago, IL, USA). Quantitative and qualitative variables were measured. Chi-square test was used for the determination of association between two qualitative variables while independent sample *t*-test was used for evaluation difference between quantitative variables both in exposed and nonexposed groups. $P < 0.050$ has been considered as a significant association.

RESULTS

All 100 exposed (cotton workers) and 100 unexposed groups 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 was performed for all subjects. Statistically significant (<0.001) decrease in FEV_1, FVC, and FEV_1/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 postbronchodilator test.

The most prevalent findings in chest radiography were bronchial wall thickening (31%), and air filled lungs (20%), which was statistically significant between groups [Table 2].

Computed tomography was performed in 44 subjects of exposed group and five subjects of the control group who had abnormal chest radiography or PFTs. The most common finding was air trapping (63%, 12/44) [Table 2].

A significant correlation was observed between air trapping and PFT in cotton workers. The results of PFT showed the

Table 1: Demographic and clinical data of the study population

	Cotton workers (case)	Office workers (control)	*P*
Age	36.75±7.35	36.94±7.27	0.85
Years worked	9.24±3.68	-	-
Respiratory symptoms (%)			
Cough	47	10	<0.001
Dyspnea	15	9	0.19
Sputum	41	5	<0.001
Chest pain	12	7	0.23
Chest tightness	26	9	0.002
Respiratory signs (%)			
Wheeze	20	4	<0.001
Rhonchus	13	-	-
Crackle	-	-	-
Pulmonary function test			
FEV_1	3.12±0.66	3.45±0.53	<0.001
FVC	3.89±0.59	4.22±0.50	<0.001
FEV_1/FVC	0.77±0.07	0.81±0.04	<0.001

FVC: Forced vital capacity, FEV_1: Forced expiratory volume in 1 s

decrease in FEV_1 and FVC in subjects with air trapping compared with workers without air trapping [Table 3].

Table 4 shows a significant correlation between the presence of respiratory symptoms, respiratory signs, abnormal findings in PFTs, chest radiography, HRCT and length of exposure (years worked in cotton textile), and age.

DISCUSSION

The high prevalence of respiratory symptoms in cotton workers is similar to that reported by other studies.[8-12] The characteristic respiratory symptoms such as chest tightness and cough have been standardized by Schilling,[13] 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.

Table 2: The results of chest radiography and HRCT of both groups

	Cotton workers (case %)	Office workers (control %)	*P*
Chest radiography			
Bronchial wall thickening	31	3	<0.001
Nodular pattern	-	-	-
Reticular pattern	6	-	-
Reticulonodular pattern	2	-	-
Infiltration alveolar pattern	-	-	-
Air fullness	20	4	<0.001
CT			
Ground glass	-	-	-
Honey comb	-	-	-
Air trapping	28	4	<0.001

HRCT: High resolution computed tomography, CT: Computed tomography

Table 3: Results showing the correlation between HRCT and PFT

Spirometric parameters	With air trapping (HRCT)	Without air trapping (HRCT)	*P*
FEV_1			
Cotton workers (case)	2.43±0.57	3.23±0.56	<0.001
Office workers (control)	2.30±0.25	3.50±0.48	<0.001
FVC			
Cotton workers (case)	3.49±0.54	4.03±0.54	<0.001
Office workers (control)	3.30±0.39	4.20±0.47	<0.001

HRCT: High resolution computed tomography, FVC: Forced vital capacity, FEV_1: Forced expiratory volume in 1 s, PFT: Pulmonary function test

Table 4: History of working years and age of cotton workers with and without respiratory symptoms, respiratory signs, abnormal PFT, CXR and HRCT

Abnormal findings	History of working years	*P*	Age (years)	*P*
With respiratory complaints	11.02±3.30	0.000	39.39±7.55	0.000
Without respiratory complaints	7.33±3.08		34±6.06	
With respiratory signs	12.34±2.86	0.000	42.17±7.37	0.000
Without respiratory signs	7.83±3.16		34.36±6.09	
Abnormal PFT	12±3.18	0.000	40.86±7.11	0.000
Normal PFT	8.12±3.28		35.15±6.59	
Abnormal CXR	12.19±2.75	0.000	41.22±7.24	0.002
Normal CXR	7.46±2.97		34.13±6.07	
Abnormal HRCT	11.50±3.22	0.000	40.21±8.01	0.003
Normal HRCT	8.32±3.47		35.4±6.65	

PFT: Pulmonary function test, CXR: Chest X-ray, HRCT: High resolution computed tomography

Our study showed that cotton workers had significantly more decrements in their FEV_1 and FVC when compared with subjects without exposure, which agrees with the findings of previous studies.[14,15] Accelerated decline in FEV_1 has been observed in cotton workers vs. controls, even in nonsmokers and after retirement.[16] Overall the physiologic picture suggests airways obstruction pattern that was 28% in our study, also a restrictive or mixed pattern may be seen in some workers.[17,18]

Bronchial wall thickening and air filled lungs which were the most findings in chest radiography which can lead to airflow limitation and respiratory complaints.

Recently, HRCT has been known as an extremely diagnostic method to evaluate pulmonary involvement in patients with respiratory complaints, although prone and end-expiratory HRCT scans allow better recognition of air trapping found in airways disease. According to our data, no study has been performed to determine the HRCT findings of cotton workers. The evaluation of HRCT findings in patients with abnormal chest radiography or PFT showed air trapping. This indicates that this method as a sensitive tool for the assessment of pathologic changes, confirms the expected pathophysiology of airway obstruction in cotton workers.

There was a significant relationship between air trapping which was the most common abnormalities found on HRCT and the decrease in FEV_1 and FVC. Lung volumes are also routinely assessed in PFT. Limitation of airflow is due mainly to bronchoconstriction, this results in a reduction in FEV_1 and FEV_1/FVC ratio, as well as an increase in airway resistance. Early closure of peripheral airway resulted in lung hyperinflation or air trapping and increased residual volume. Some studies found a good correlation between FEV_1 and air trapping,[19] also a significant correlation between the extent of air trapping and FEV_1/FVC was seen in another study.[20] This study also shows that there is a good correlation between FEV_1 and the extent of air trapping. It seems that HRCT images are helpful for showing air trapping in patients with obstructive lung diseases. The presence of this finding in HRCT of cotton workers could be explained by chronic effect of long-term exposure to cotton dust.

Cotton workers worked for 9 years, on average with the range of 3–18 years and more than 44% had worked >10 years. It is concluded on the basis of the significant correlation of findings in Table 4 that respiratory complaints and abnormal findings on objective measurements occur more in those workers who are exposed to cotton dust for a longer period, which is inconsistent with other studies.[21,22]

CONCLUSION

To the current authors' knowledge, this is the only study, to date, in cotton workers using objective methods rather than PFT. Smoking as a major confounding factor can affect the results of studies on respiratory disorders, many studies did not adequately control for smoking, to control smoking effect; we exclude current or ex-smokers from the study. The identical standardized instrument, HRCT as a sensitive objective measurement and the same technician used in this study. The case and control group were similar in respect to socioeconomics. The main limitation of our study was the lack of quantitative exposure assessment to cotton dust; second, the healthy workers' effect could have affected the current results.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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