

## EFFECT OF SHORT-TERM EXPOSURE TO COTTON DUST ON LUNG FUNCTIONS IN YOUNG FEMALE SPINNING MILL WORKERS

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### ABSTRACT

**Context:** Workers in textile industry are constantly exposed to cotton dust and are liable to develop impairment of lung functions. Effect of long term exposure is well documented but limited data is available with regard to early pulmonary response to cotton dust.

**Aim:** To study the effect of exposure to cotton dust for 1-5 years duration on lung function tests in young female workers.

**Settings and Design:** A prospective study of 100 female cotton textile workers was undertaken. **Materials and Methods:** Pulmonary function tests were carried out on 100 young (20-35 years) female, non-smoking cotton textile workers and compared with data obtained from 100 age and sex matched controls.

**Statistical analysis:** Data analysis was done using student's 't' test using SPSS software.

**Results:** FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/VC, PEFR, MEF<sub>75%</sub> were significantly less (p<0.01) in cotton textile workers as compared to controls. The results suggested that lung function changes do occur even with shorter duration of exposure (1-5 years). Precautions have to be taken to prevent the development of chronic lung disease in these workers.

**Key words:** pulmonary function tests, early pulmonary response, textile workers, short duration of exposure, cotton dust.

### INTRODUCTION

For nearly 300 years, work in textile industry has been recognized as an occupational hazard. Byssinosis is the most common, widely studied, disease affecting the cotton textile workers; though other symptom complexes like mill fever, weaver's cough, mattress-maker's cough, also occur in textile workers.<sup>1</sup> In the earlier stages of Byssinosis, there is chest tightness and shortness of breath on the first days back to work after an absence from the mill ('Monday Dyspnea'). These

symptoms progress to the point where they persist throughout the work week. To date, no characteristic radiological or pathological findings have been associated with acute or chronic symptoms of Byssinosis.<sup>2</sup> However various longitudinal and cross-sectional studies have shown changes in lung functions, in cotton textile workers as compared to controls.

Many of these studies, however, have been done on textile workers exposed for a long duration to cotton dust and limited data is available about exposure for a short duration, especially in the female workers.<sup>3</sup> Hence the present study was undertaken to document the short term effects of inhaling the cotton dust on pulmonary function tests in young female subjects.

### AIMS AND OBJECTIVES

The aim was to study the effects of inhalation of cotton dust on PFTs in female workers working in a spinning mill who have been exposed for short duration from 1 to 5 yrs.

### MATERIALS AND METHODS

The study was done at a Spinning Mill in Hubli with permission from the Management of the mill. The mill processes raw, ginned cotton to yarn.

100 workers of the mill formed the subjects of the study. They were selected on the basis of following inclusion and exclusion criteria:

### INCLUSION CRITERIA

- ❖ Female workers aged 20-35 yrs, with 1-5 yrs duration of exposure to cotton dust. Female workers were selected to remove the confounding effect of smoking on lung function tests, because most females were non-smokers. Including workers of younger age group removed the confounding effect of old age, as many studies have shown that lung functions decrease as the age increases beyond 35 years.

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**Exclusion criteria**

- ❖ Previous exposure to cotton or other occupational dust.
- ❖ Those with history of smoking or atopy.
- ❖ Those with history of COPD, Bronchial Asthma, Cardiovascular Disease, Hypertension, Diabetes Mellitus.

The PFT data from cases was compared to data from 100 age and sex matched controls. They were similar to study subjects in all respects except that they were not exposed professionally to cotton dust at any time in their life.

The procedure of spirometry, a noninvasive investigation to be performed in the study for obtaining lung functions was explained to subjects and their consent was taken. The study and its conduct were cleared by the ethical committee.

**Method of collection of data**

- ❖ A structured questionnaire was given to the subjects, to elicit the details of occupational history and history of past or present respiratory illnesses.
- ❖ Lung Function Tests were performed using spirometry SPL-95 manufactured by France International Medical (FIM), Lyon. Slow Vital Capacity (SVC), Forced Vital Capacity (FVC) parameters and flow rates were recorded.
- ❖ Statistical Analysis of the pulmonary function test data of the study subjects and controls was done by student's 't' test using SPSS16 software. The level of significance was fixed at 5%.

**RESULTS**

The cotton spinning mill workers and controls were similar in height, weight and BSA. Static lung volumes did not differ between cotton textile workers and controls. (Table 1) Dynamic lung volumes and capacities (FEV<sub>1</sub> and FVC) were significantly lower in cotton textile workers. FEV<sub>1</sub> was reduced more significantly than FVC. The ratios FEV<sub>1</sub>/VC and FEV<sub>1</sub>/FVC were also significantly lower in them. (Table 2 & Fig. 1)

Flow rates at higher lung volumes (PEFR and MEF<sub>75%</sub>) were lower in cotton textile workers (Fig. 2) whereas flow rates

at lower lung volumes (MEF<sub>50%</sub> and MEF<sub>25%</sub>) did not differ significantly between study subjects and controls.

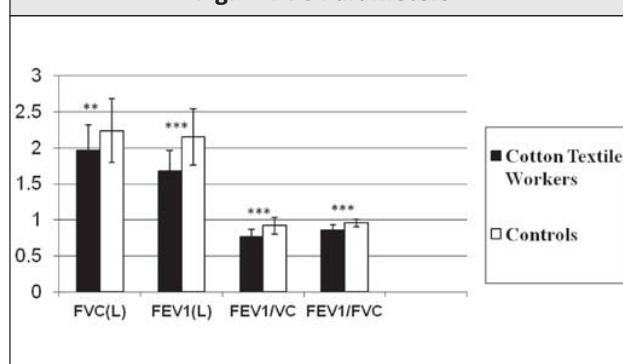
**Table 1- SVC Parameters**

Parameters	CTW (n=100) Mean ± SD	Controls (n=100) Mean ± SD	'p' value
VC (L)	2.28 ± 0.40	2.30 ± 0.44	>0.05
ERV (L)	0.64 ± 0.34	0.60 ± 0.31	>0.05
IRV (L)	1.20 ± 0.36	1.19 ± 0.31	>0.05
IC (L)	1.59 ± 0.40	1.68 ± 0.39	>0.05
TV (L)	0.41 ± 0.098	0.44 ± 0.07	>0.05

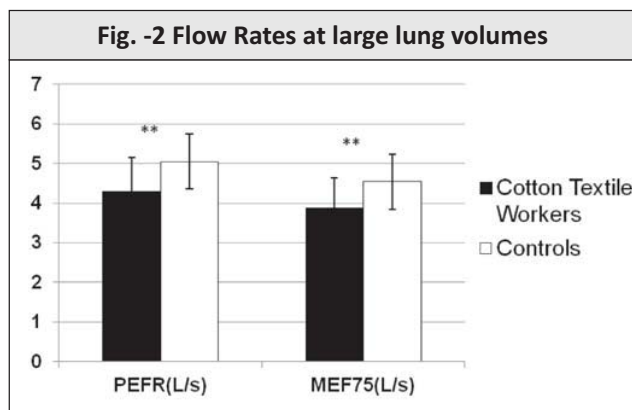
p < 0.05 taken as significant

**Table 2: FVC Parameters**

Parameters	CTW (n=100) Mean ± SD	Controls (n=100) Mean ± SD	'p' value
FVC (L)	1.97 ± 0.348	2.24 ± 0.44	<0.01
FEV <sub>1</sub> (L)	1.68 ± 0.286	2.15 ± 0.39	<0.001
FEV <sub>1</sub> /VC	0.77 ± 0.098	0.92 ± 0.12	<0.001

**Fig. 1- FVC Parameters**

\*\* - p<0.01, \*\*\* - p<0.001



\*\* -  $p < 0.01$

## DISCUSSION

Textile workers are exposed to airborne particulate from natural and synthetic fibrous materials in their work environment. Inhalation of this particulate dust has been shown to affect lung function tests.<sup>4-9</sup> All these studies however have been done on workers exposed to cotton dust for more than 5yrs and the mean age of workers was 40- 45 yrs. Shortest duration for development of Byssinosis which results in irreversible lung function changes, according to a study is 7yrs.<sup>10</sup> So we chose to do this study to observe the short term effects of cotton dust exposure on the pulmonary functions in young female textile workers exposed to cotton dust for 1-5 years. Results of our study highlight the early deleterious effect of cotton dust on pulmonary functions.

FEV<sub>1</sub> and FVC were significantly less in cotton textile workers as compared to controls; FEV<sub>1</sub> was reduced more significantly than FVC. FEV<sub>1</sub>/VC was also less in them. All these point towards obstructive nature of respiratory pathology. Among the flow rates PEF75 and MEF75% (flow rates at large lung volumes)<sup>11</sup> were less in cotton textile workers. Low PEF75 and MEF75% values indicate that probably the larger bronchi are affected first in the pathology caused by cotton dust. This affection of larger airways has been shown in one of the pathological studies of byssinosis. This study by Edwards C. et al has shown that in the larger bronchi of the byssinotics there was a significantly higher percentage of muscle and gland with a corresponding lower percentage of connective

tissue and cartilage. However, in segmental bronchi no significant changes were observed.<sup>12</sup>

However, these changes in lung functions did not decrease significantly with duration of exposure in our study. Similar results have been observed in some studies, the researchers have attributed this to a possible reversible pulmonary response to cotton dust in early years of exposure.<sup>13</sup>

Initial studies in the pathogenesis of Byssinosis pointed towards cotton dust induced histamine release or an immunologic mechanism in the form of antigen (cotton dust extract) – antibody reaction as the mechanism of cotton dust lung diseases. A study by Schachter et al shows that both cotton bract extract and cotton dust extract exert similar physiologic effects in inducing airway hyper-reactivity.<sup>14</sup> Cotton dust is often contaminated with Gram-negative bacteria, which contain endotoxins (lipopolysaccharide) in their outer cell wall.<sup>15</sup>

A growing body of literature has confirmed endotoxin as the main mediator in the pathogenesis of byssinosis and obstructive airway disease.<sup>16,17</sup>

## CONCLUSION

Cotton dust exposure even for a short duration can bring about decrease in dynamic pulmonary functions. These changes don't progress faster for few years during which they may be reversible also. To prevent the occurrence of chronic changes, precautions in the form of reduced dust levels, pre-employment and yearly health check-ups of employees, use of respirators by them have to be taken.

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