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# Effect of duration of exposure to cotton dust and respiratory function tests in textile mill workers

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**ABSTRACT** **Background :** Long term occupational exposure to cotton dust is associated with respiratory symptoms and loss of pulmonary function. This study was conducted to explore respiratory symptoms, pulmonary function tests in textile mill workers and its correlation with pulmonary function tests (PFT).**Methodology:** 395 males of Jamshri Textile mill, Solapur. 253 male workers served as cases and 142 two males served as controls. Controls were totally healthy, age matched and selected from the clerical department of the mill and were not exposed to cotton dust. Subjects were in the age groups ranged from 20-59yrs. After screening all were subjected to Respiratory function test (RFT). The results were analysed using students unpaired T-test **Results:** Workers exposed for 1-10 yrs. exhibited significant decrease in FVC, FEVI, PEFR, FEF0.2-1.2 and MVV. The above parameters were significantly decreased in the workers exposed for 11-20 yr along significant decrease in FEF 25-75%. PFER, FEF 25-75%, FEF 0.2-1.2, FEF 25% and FEF 50% reduced significantly in workers exposed for 21-30 yr. There was a linear relationship between duration of exposure and decline in RFT. **Conclusion :** The present study on respiratory function in textile mill workers showed that exposure to cotton dust is definitely an occupational hazard.A regular periodic assessment of workers in the industry should be done for the detection of respiratory dysfunction.

KEYWORDS :

**Introduction :**

The textile industry has a unique place throughout the world. The industry provides cloth, one of the basic necessities of life and employment to millions of people. The greatest health hazard is due to inhalation of cotton dust.

Cotton is a natural fiber obtained from plant "Gossypium". It contains 90% cellulose and 6% moisture. The cotton from field is collected and fed into a machine called 'Gin' which separates fibers from seeds by pneumatic suction. Then cotton is compressed into bales and sent to textile industry. Saprophytic organisms ( gram negative bacteria and fungus ) which grow during storage release endotoxin initiating inflammatory changes of airways.[1]

Exposure to cotton dust occurs throughout the manufacturing process but is most pronounced in blowing, mixing and carding sections. Attempts to control dust levels by use of exhaust hoods , general increases in ventilation and wetting procedures have been highly successful. Eventhough , respiratory protective equipment appears to be required during certain operations to prevent workers from being exposed to levels of dust that exceed the current cotton dust standard [2] Larger dust particles ranging from 5-7 um lodge in larger airways causing irritation of mucus membranes .Smaller dust particles of size 0.1 – 5 um also known as respirable dust remain permanently in alveolar passages [3] Severe pulmonary dysfunction due to prolonged exposure to cotton dust may lead to COPD (chronic obstructive pulmonary diseases) which is a disabling and usually irreversible condition leading to early death [1]

Noninvasive methods such as pulmonary function tests (PFTs) can be used for the assessment of respiratory disorders due to cotton dust exposure . 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 respiratory effects of exposure to cotton dust; the study was undertaken to assess the relation between duration of exposure to cotton dust and respiratory function tests in textile mill workers.

**Material & Methods :**

The present study was conducted in 395 males of Jamshri Textile mill, Solapur. 253 male workers served as cases and one hundred and forty two males served as controls. Controls were totally healthy, age matched and selected from the clerical department of the mill and were not exposed to cotton dust. Subjects were in the age groups ranged from 20-59yrs.

The subjects having previous major illnesses, respiratory diseases, smoking habits were excluded from the study. Screening of each subject was done with following proforma. Occupational History was taken as duration of Service in a particular department , number of hours/day , h/o change of job or transfer to other department.

After screening all were subjected to Respiratory function test (RFT).All the recordings were done at an average temperature of 28 degree C, between 11 am. to 2 pm. The instrument used was 'Medspiror', a computerized pneumotachometer. [4] The instrument fulfilled the criteria/conditions for performance and reproducibility laid by American Thoracic Society (ATS).

The procedure was explained in detail so that subject gets complete understanding and trials were given after the demonstration of forced expiratory manoeuvre and maximum voluntary ventilation. All were tested in sitting position. Three trials were given and maximum reading was taken for observation. Standard data and standard regression equations in the software of the microprocessor, predicted values of respiratory function parameters were calculated by the instrument and were corrected to BTPS by the instrument itself. Each subject was asked to perform following two manoeuvres. Forced expiratory manoeuvre. Subject was asked to take maximum inspiration and then blow into the mouthpiece without interruption as hard, fast and completely as possible. Maximum Voluntary Ventilation Manoeuvre subject was asked to respire (inspiration and expiration) as rapidly and deeply as possible, for 10 seconds in the mouthpiece of instrument. With these two manoeuvre actual values of all RFT parameters were recorded in instrument. Out of following ten nine were recorded with first manoeuvre and the last by second manoeuvre. These parameters are , FVC, FEV 1, PEFR, FEF, FEVI/ FVC, MVV.

For each subject a printed sheet of actual, predicted, and percent predicted values of all respiratory function parameter was taken. Instrument was reused with a new, disposable mouthpiece to next subject.

The results were then subjected to statistical analysis to find out, their statistical significance according to age groups and duration of exposure. The parameters taken in our study can be explained with the help of forced expiratory spirogram and flow volume curve .The results were analysed using students unpaired T-test.

**Results :**

**Table No. 1 Demographic profile**

| Variables | Textile Mill Worker n=253 | Control n=142 |
|---|---|---|
| | Mean ± SD | Mean ± SD |
| Age (in yrs) | 37.08 ± 3.17 (18-55) | 40.09 ± 3.59 (18-55) |
| Height (in cms) | 170.05 ± 2.37 (142-170) | 174.09 ± 3.06 (150-180) |
| Weight (kg) | 59.12 ± 3.29(38-70) | 68.09 ± 2.33 (45-80) |
| Yrs of exposure to cotton dust | 15.51 ± 2.90(1-36) | -- -- -- |

From this table, it becomes evident that variables like age, height and weight were almost similar in both the study groups of textile mill workers and control. The range is indicated in parantheses.

**Table No.2 Comparison of RFT values of textile mill workers according to duration of exposure to cotton dust and control**

| Duration of Exposure | 1-10 yrs | | 11-20 yrs | |
|---|---|---|---|---|
| RFT Parameter | Textile Mill Workers n=73 | Control n=24 | Textile Mill Workers n=137. | Control n=54 |
| | Mean ± SD | Mean ± SD | Mean ± SD | Mean +/= SD |
| FVC (lit ) | **1.86±0.58 | 2.71 ± 0.44 | **1.84 ± 0.47 | 2.32 ± 0.35 |
| FEVI (lit) | **1.83 ±0.49 | 2.68 ± 0.43 | **1.78 ±0.41 | 2.28 ± 0.34 |
| FEVI/FVC (%) | 97 ± 7.32 | 99 ± 2.36 | 98 ± 7.82 | 98 ± 4.11 |
| PEFR (L/S) | **5.7 ± 2.07 | 7.9 ± 1.29 | 995.1 ± 1.85 | 7 ± 1.99 |
| FEF 25-75%(L/S) | 4.18 ± 1.65 | 4.64 ± 1.03 | *3.51 ± 1.21 | 4.12 ± 1.23 |
| FEF 0.2-1.2(L/S) | **4.4 ± 2.18 | 6.5± 1.16 | 3.6 ± 1.55 | 5.4 ± 1.82 |
| FEF 25%(L/S) | **5.2± 2.19 | 7 ± 1.27 | **4.5 ± 1.78 | 6.2 ± 2.17 |
| FEF 50% (L/S) | 4.55 ± 1.76 | 5.01 ± 1.05 | 3.85 ± 1.34 | 4.39 ± 1.35 |
| FEF 75(L/S) | 3.2 ±1.19 | 3.29 ± 0.93 | 2.81 ± 1 | 2.89 ± 0.95 |
| MVV(L/Min) | **104 ± 18. | 121± 27 | **96 ± 19.2 | 111 ± 22.4 |

P<0.01-** P<0.02-0.05-*

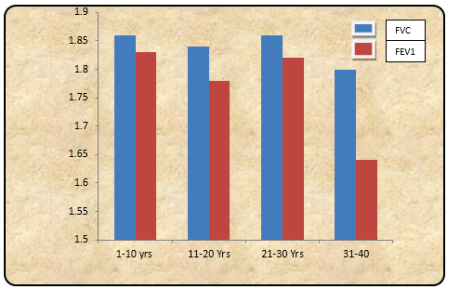
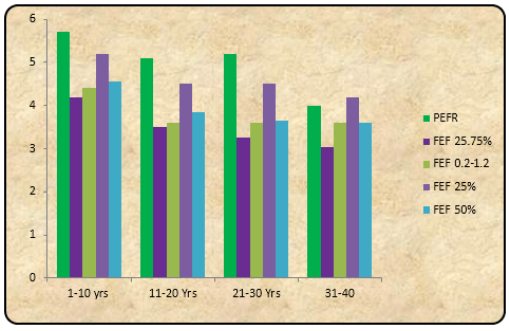



**Table No. 3 Comparison of RFT values of textile mill workers according to duration of exposure to cotton dust**

| Duration of Exposure | 21-30 yrs | | 31-40 yrs | |
|---|---|---|---|---|
| RFT Parameter | Textile Mill Workers n=35 | Control n=38 | Textile Mill Workers n=8 | Control n=26 |
| | Mean ± SD | Mean ± SD | Mean ± SD | Mean +/= SD |
| FVC (lit) | **1.86±0.54 | 2.09±0.37 | 1.80±0.51 | 1.9±0.52 |
| FEVI (lit) | **1.82±0.47 | 2±0.34 | 1.64±0.64 | 1.82±0.53 |
| FEVI/FVC( %) | 96 ±1.3 | 98±3.9 | 88±21.6 | 96±10.8 |
| PEFR (L/S) | **5.2 ± 2.2 | 6.90±2.2 | **4±1.93 | 6.7±2.26 |
| FEF 25-75%(L/S | *3.25±1.23 | 4.12±1.43 | 3.03±1.82 | 3.63±1.47 |
| FEF 0.2-1.2(L/S) | *3.64 ±1.68 | 4.7±2.17 | 3.6±2.11 | 4.7±2.53 |
| FEF 25% (L/S) | **4.5±2.17 | 6.1±2.23 | 4.2±2.68 | 6.1±2.65 |
| FEF 50% (L/S) | *3.64±1.31 | 4.67±1.91 | 3.59±1.84 | 4.14±1.44 |
| FEF 75% (L/S) | 2.59±0.91 | 2.85±0.99 | 2.4±1.07 | 2.35±0.93 |
| MVV (L/Min) | 91±21.6 | 100±23.4 | 83±21.9 | 99±21.2 |

P<0.01**, P<0.02-0.05*




Decline in PEFR and FEF 25% was highly significant in those workers exposed for 21-30yrs. While FEF 25-75%, FEF 0.2-1.2, and FEF 50% decreased significantly.

In workers exposed for 31-40 yr. PEFR was only parameter reduced significantly.

**Discussion :**

Our study included 253 male textile mill workers and 142 age matched healthy controls. This total study population had characteristics as shown in table no. 1

A highly significant decline in FVC and FEV1 was seen in those exposed for 1-20 yrs in workers of all sections of mill.

Bryan Gandevia et al 1965 [1] also observed that decline in FVC and FEV1 was significant in those workers who served for 1-10 yrs.In our study also workers exposed for 1-10 yrs showed highly significant decline in FEV1.In one more study by VLN Rao et al 1979[6] asymptomatic textile mill workers showed a significant fall in FVC and FEV1. A significant across shift decline in FVC and FEV1 had been reported by Gerald Hayes et al1994[7] ,Eugenija Zuskin et al 1975[8] James A Merchant et al 1975[9], J R Parikh et al 1990 [10], D avid Fishwick et al 1996. [11]In a study of effects of organic dusts (tea coffee, fur etc ) on respiratory function tests , Eugenija Zuskin et al 1993[12] found significant decline in FVC and FEV1 in workers of respective industries.

In our results decrease in PEFR was more pronounced with advancing age and duration of exposure to cotton dust.

Maximum decline of 40 % in PEFR was observed in those exposed for 31-40 yrs . A significant decline in PEFR in cotton mill workers was reported by James a merchant 1975(9) , J C GILSON ET AL 1961[13] ..FEF 25-75 % was significantly decreased in workers exposed for 11-30yr When our results were compared with few other studies we observed following things. Workers exposed for 1-10 yrs. exhibited significant decrease in FVC, FEVI, PEFR, FEF25%, FEF0.2-1.2 and MVV. The above parameters were highly significantly decreased in the workers exposed for 11-20 yr along with significant decrease in FEF 25-75%. Gerald Hayes et al 1994 [7]also observed acrss shift declines in FEF 25 -75 %. Eugenija Zuskin et al 1975 [8] reported a highly significant fall of 23% in FEF 50% than in FVC and FEV1.. So they claimed that FEF 50 % is a more sensitive indicator of acute ventilator changes. FEF 25% and FEF 50% reduced significantly in workers exposed for 21-30 yr. FEF 25-75% and FEF 50% are effort independent and indicate airflow in peripheral airways where disease of chronic airflow obstruction begin [14]We found decrease in

these parameters in workers exposed for 11-30yrs. So decrease in FVC and FEV1 along with decreased flow rates suggest involvement of large airways initially and as duration of exposure increases medium and small airways seem to be affected .MVV reduced by a significant value in all workers exposed for 1-20 yrs. There was a linear relationship between duration of exposure and decline in RFT. Jamshri Textile mill has already taken preventive measures like exhaust ventilation, artificial humidification and use of enclosed machinery at working place. The following suggestions can further minimize the hazards of cotton dust inhalation in the mill. Management should be advised to hold a pre-employment examination of a worker to detect overall health status and especially the status of respiratory functions. A regular periodic assessment of workers in the industry should be done for the detection of respiratory dysfunction.Workers should be advised to use masks while working in any section of the cotton mill. Transfer to a less dusty department should be advised if the worker shows pulmonary dysfunction. because early identification and proper measures taken to prevent such exposure has shown improvement in lung functions.

Our study was cross -sectional. But a longitudinal study along with microbiological, immunological and biochemical studies will be helpful to understanding the patho-physiology of the effects of such exposure to cotton dust.

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