



## Effect of different department of textile mill exposure to cotton dust and respiratory function tests in textile mill workers.

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### ABSTRACT

**Background :** Due to extensive mechanization and use of chemicals, workers were exposed to different occupational hazards, such as diseases due to exposure to cotton dust the greatest health hazard was due to inhalation of cotton dust. So the aim of the study was as to evaluate the effect of different department of textile mill exposure to cotton dust and respiratory function tests in textile mill workers. **Methodology:** 395 males of Jamshri Textile mill, Solapur. 253 male workers served as cases and 142 two males served as controls of different departments of Textile mill. 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:** FEV<sub>1</sub>, FVC, PEFR, FEV<sub>0.2-1.2</sub>, FEF 25% were significantly reduced in workers of all departments but FEF 25-75% and FEF 50% declined by a significant value in workers of Blowing and Carding department only MVV showed a significant reduction in workers of all department except blowing. **Conclusion :** Workers of blowing and carding department seemed to be affected more than other departments which indicates the quantitative effects of dust. Transfer to a less dusty department should be advised if the worker shows pulmonary 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. Due to extensive mechanization and use of chemicals, workers were exposed to different occupational hazards, such as accidents, fire, diseases due to exposure to cotton dust, disabilities due to exposure to high temperature in spinning and weaving departments, hearing impairment produced by noise pollution by the rapidly rotating machines and different skin diseases caused by exposure to industrial chemicals. Of all, the greatest health hazard was due to inhalation of cotton dust.

Cotton is a natural fiber obtained from plant "Gossypium". It contains 90% cellulose and 6% moisture. Cotton was first cultivated in India as early as 2000-3000 B. C. and thus India became the homeland for cotton. Then it was grown in China, Korea and now all over the world. 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.

The cloth is then bleached, dyed, printed and processed for the sale. Constant inhalation of cotton dust produced due to processing of cotton in departments like blowing and carding causes various effects on respiratory system.

Cotton dust is an aerosol of heterogenous solid particles originated from mechanical comminution of a coarser material. Prolonged exposure to larger (5-7µm) and smaller dust particles (0.1-5µm) causes severe respiratory dysfunction which may lead to chronic obstructive pulmonary diseases (COPD). (1)

Byssinosis is a chronic disabling disease which does not show any characteristic physical and X-ray signs in initial stages. Taking into consideration the large number of workers involved in textile mills of Solapur and high incidence of Byssinosis progressing to COPD, we thought, assessment of respiratory functions may help to identify the pulmonary dysfunction at early stages to different department in which the workers are affected more so as to take appropriate measures to prevent disabling complications.

#### Materials and Method :

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. (2) 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<sub>1</sub>, PEFR, FEF, FEV<sub>1</sub>/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 different department. 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

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 according to departments of Textile mill workers.

RFT Parameter	Control n=142	Blowing n=16	Carding n=34	spinning n=38	Draw Frame n=43	Ring Frame n=122
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ±SD	Mean ±SD
FVC(L)	2.22 ± 0.51	**1.77±0.44	**1.83±0.45	**1.9 ± 0.4	**1.76±0.46	**1.88±0.58
FEV1 L	2.16± 0.52	**1.76±2.41	**1.75±0.43	**1.89±0.39	**1.73±0.39	**1.82±0.49
FEV1/FVC (%)	98±6.59	99±2.41	95±12.3	98±5.18	98±5.54	96±11
PEFR(L/S)	7.1± 2.06	**4.6±1.33	**4.9± 1.9	**5.6± 2.29	**5.5±2.01	**5.2±1.97
FEF 25-75% (L/S)	4.09± 1.36	**3.11±0.58	*3.75±1.3	3.87± 1.64	3.9±1.45	3.68±1.4
FEF 0.2-1.2(L/S)	5.2±2.14	**3.2±0.73	**3.4± 1.71	**4.2 ± 1.83	**3.8±1.93	**3.9±1.89
FEF 25% (L/S)	6.3± 2.22	**4.1±1.24	**4.4± 2.06	**5.2 ± 2.56	**4.8±2.08	**4.7±1.98
FEF 50% (L/S)	4.53± 1.54	*3.4±0.68	*3.52 ± 1.32	4.11± 1.69	4.27±1.48	4.12±1.58
FEF 75%(L/S)	2.81±1.01	2.49±0.53	2.53±0.9	2.8±1.12	3±1.11	3±1.11
MVV (L./Min)	107±34.1	103±17.2	*92±23.2	*98±17.9	*98±21.2	*97±19.4

This table indicates that FEV1, FVC, PEFR, FEF0.2-1.2, FEF 25% were significantly reduced in workers of all departments but FEF 25-75% and FEF 50% declined by a significant value in workers of Blowing and Carding department only. MVV showed a significant reduction in workers of all departments except blowing.

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

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

Following RFT parameters were recorded for each subject FVC, FEV1/FVC %, PEFR, FEF0.2-2., FEF 25-75 %, FEF25 %, FEF50%,FEF75%, & MVV.

Our control group (table no. 2) showed mean value of FVC as 2.22L, and of FEV1, as 2.16 L. These values appeared less as compared to values in the study of V.L.N. Rao et. al. (3) which were 3.16 lit for FVC and 2.80 for FEV1. Our values also appeared less when compared to control values in a study by Bryan Gandevia et al 1965 (4) as for FVC it was 3.76L and for FEV1, 3L.

Mean FEV1/FVC % in our control group was 98% (Table No. 2) The ratio seemed more as compared to values recorded by Eugenija

Zuskin et al (1975) as 76% (5 ) and by Roger Larson et al (1981) ( 6 ) as 80% PEFR value of our control group was 7.1 L/S and the value recorded by RN. Tiwari et al 1998(7 ) was 7.73 L/S. Our control group had mean value of FEF 25-75% as 4.09 L/S and of FEF 50% as 4.52 L/S .Eugenija Zuskin et al (1975)(5 ) reported a mean value 3.61 L/S for FEF50 % while 4.18 L/S was the mean value recorded for FEF 25-75% by Roger Larson et al (1981).(6 ) When our results were compared with few other studies we observed following things.

FVC value of our control group was 2.22 Lit while in workers of carding section FVC was 1.83 Lit. (Table No. 2) Our workers of carding section showed a 20% a reduction in FEV1 which was highly significant. Yekoye Abebe al in 1995 (9) also reported a significant fall in FVC and FEV1 in workers of textile mill. Mean FVC value for control was 3.3 lit and for workers of carding section, was 3.1 lit and the difference was statistically significant. They found in the same study that highest prevalence of Byssinosis was seen in carding section and association of chronic bronchitis in exposed workers as compared to controls.

Gerald Hayes et al 1994 ( 10), EugenijaZuskin et al 1975 (5), James A. Merchant et al 1975( 11), J. R. Parikh et al 1990 ( 12), Yekoye Abebe et al 1995(9) , David Fishwick et al 1996( 13) had reported significant across shift decline in FVC and FEV1 in textile mill workers.

In a study of effects of organic dusts (tea, coffee, fur etc) on respiratory function, Eugenija Zuskin et al 1993 (14 ) observed significant decline in FVC and FEV1 in workers of respective industries.

The decline in FVC and FEV1 was attributed to action of cotton dust on respiratory airways leading to obstructive changes.

In one more study by V.L.N. Rao et al at 1979, ( 3 ) asymptomatic textile mill workers showed significant reduction in FVC and FEV1. Symptomatic workers were excluded from the study. Our findings are in accordance with above observation. They also said that workers exposed to cotton dust are liable to develop pulmonary disorders which are preceded by varying degree of decline in lung function. On the contrary , Roger Larson et al 1981(6) found no significant decrease in FVC and FEV1 in cotton gin workers which was attributed to seasonal short duration of exposure and process of self selection by workers .

PEFR was decreased highly significantly in workers of all departments. Workers in Blowing section showed highest reduction in PEFR of 35% as compared to other sections. (Table No. 2) . Similar significant decline in PEFR was observed by RN Tiwari et al 1998(7) , James A Merchant1975(10) , J C Gilson 1961(14).

Both the parameters FEF 25-75% and FEF 50% decreased by a significant value in Blowing and carding section only. Gerald Hayes et al 1994(10) recorded forced expiratory spirogram and observed across shift decline in FEF 25 -75 % in cotton mill workers . James A. Merchant et al (1975)(11) and EugenijaZuskin et al 1993 (13)noticed similar results for FEF 50% in workers exposed to cotton dust and various organic dusts, respectively.

In addition to this, our study showed highly significant reductions in flow rates like FEF 0.2-1.2 and FEF 25% in workers of all departments.

No statistically significant decrease was observed in FEF 75% in our workers as compared to control group. Highest reduction of 11% was seen in blowing section. But it is curious to know that a highly significant decrease in FEF 75 % was seen in workers exposed to organic dusts other than cotton as reported by Eugenija Zuskin et al 1993.(13)

Except in blowing departments all the workers in other departments showed significant reduction in MVV. The workers in various sections of mill also exhibited highly significant fall in FVC

and FEV1 showing hazardous effects of cotton dust inspite of varying concentrations of dust in different sections. Higher dust content of air in blowing and carding sections probably appears to be the cause for affection of many parameters in the workers of these departments in the mill.

FEF 25-75% and FEF 50% are effort independent and indicate airflow in peripheral airways where diseases of chronic airflow obstruction begin (15) Constant inhalation of cotton dust causes some nonspecific respiratory irritation leading to hypersecretion of mucus, forming mucus plugs causing obstruction of airways. (1) Smooth muscle hypertrophy and mucus gland hyperplasia is a constant finding in Byssinotic lungs (16). So pulmonary dysfunction observed in cotton mill workers may be attributed to all above mechanisms.

### Conclusion-

In blowing and carding sections, workers showed declines in FVC, FEV1, PEFR, FEF 25-75 %, FEF 0.2-1.02, FEF 25%, and FEF 50% while in spinning, Draw Frame and Ring-Frame section, all above parameters except FEF 25-75% and FEF 50% were reduced.

So our observations indicate mainly the affection of large airways in early ages and involvement of small airways as the age and duration of exposure progresses. Workers of blowing and carding department seemed to be affected more than other departments. Workers in blowing and carding sections were affected more which indicates the quantitative effects of dust. Transfer to a less dusty department should be advised if the worker shows pulmonary dysfunction. Our study was cross-sectional. But a longitudinal study along with microbiological, immunological and biochemical studies will be helpful to understand the Patho-Physiology of the effects of such exposure to cotton dust.

### References :

1. A.B. Raffle, P.H. Adams, Baxter, W.R. Lee 'Hunter's Diseases of Occupations'. 8th edition, 1994 page no. 458-469
2. J. E. Cotes, 'Lung function assessment and application in medicine' Fourth edition 1979, 19-130, 314-450
3. V. L. NarasimhaRao and H.C. Tandon. 'A Study of dynamic lung functions in textile workers' Ind. J. PhysiolPharmac. 1979 October-December vol. 23, No. 4, 342-346
4. Bryan Gandevia and James Milne, 'Ventilatory capacity changes and exposure to cotton dust and their relevance to Byssinosis in Australia' Brit. J. Industr. Med. 1965 22-295-303. 5
5. Eugenija Zuskin. F. VALIC, D. Butkovic and A. Bouthuys. 'Lung Function in textile workers', 'British Journal of Industrial medicine-1975, 32, 283-288.
6. Roger K. Larson, Martin L. Barman, David W. Smith and Larry Nicol. Study of Respiratory effect of short and long-term cotton Gin Exposure. Chest (1981) 79;4 April supplement.
7. Rajanarayan R. Tiwari, Sanjay Zodepy, Sanjay G. Deshpande and Nayanara D. Vasudeo. 'Peak Expiratory flow rate in Handloom weavers' Indian J. Physiol. Pharmacol. 1998; 42(2): 266:270.
8. Yekoye Abebe, Teshale Sehora. 'Byssinosis and other respiratory disorders among textile mill workers in Bahr Dar North West Ethiopia' Ethiop. Med. J. 1995, 33:37-47.
9. Gerald B. Hayes, Ting-Ting Ye, Pei-Lian Lu, He-Lian Dai and David C. Christaini. 'Respiratory disease in cotton textile workers: Epidemiological assessment of small airway function'. Environmental Research 66, 1994, 31-43
10. James A. Merchant, Gerald M. Halprin, Arnold R. Hudson, Kaye H. Kilburn, Wayland N. Mckenize, Daniel J. Hurst, Paul Bermazohn. 'Responses to cotton dust', Arch Environ. Health/Vol 30-(1975)
11. R. Parikh, P. K. Majumdar, A. R. Shah, N. Mohan Rao and S. K. Kashyap. 'Acute and chronic in pulmonary functions among Indian Textile workers'. J. Soc. Me-1990-40,7
12. David Fishwick, Angela M Fletcher, Anthony C Pickering, Robert M C L Niven E Brian Faragher. " Lung function in Lancashire cotton and man made fiber spinning mill operatives" Occupational and environmental medicine 1996, 53, 46-50
13. EugenijaZuskin; E. Neil Schachter, Bozica Kanceljak Theodar J. Witek Jr; and Edward Fein. 'Organic dust disease of airways', Int. Arch. Occup. Environ. Health (1993) 65-135-140.
14. J. C. Gilson, H. Stott, B.E.C. Hopwood, S. A. Roach C. B. Mckerrow, and R. S. F. Schilling, 'Byssinosis : "The acute effect on ventilator capacity of dusts in cotton Gineries, Cotton, Sisal, and Jute mills." Brit.J. Industr. Med. 1962, 18-9
15. Murray Nadel 'Textbook of Respiratory Medicine' Second edition 1994 Volume 1 page p-803.
16. C. Ed. wards, J. Macarthey, G. Rooke, and F Ward. 'The Pathology of lung in Byssinotics' Thorax 1975, 30, 612-622