

Comparative Study between the Effect of Short Term and Long Term Exposure to Cotton Dust on Pulmonary Function Tests in Cotton Mill Workers

Charulata Kadam¹, Afshan Kausar², Charushila Atul Rukadikar³, N.A. Deokar⁴

¹Asst. Professor Dept of Physiology, SSPM Medical College And Lifetime Hospital, Padve-Kasal, Dist. Sindhudurg, Maharashtra, ²Assistant Professor, Department of Physiology JIIU'S Indian Institute of Medical Science & Research, (JIIU'S IIMSR) Medical College, Warudi, Badnapur, Jalna, Maharashtra, ³Charushila Atul Rukadikar, Asst. Professor Dept of Physiology Zydus medical college and hospital, dahod, Gujarat, ⁴N.A. Deokar, Asso. Professor, Department of Physiology, Government Medical College, Miraj, Sangali, Maharashtra, India

Abstract

Background: Byssinosis is the most common disease affecting the cotton textile workers; symptom complexes like mill fever, weaver's cough, mattress-maker's cough, also occur in textile workers. ¹Cotton workers are at risk for occupational lung disease, including byssinosis and chronic bronchitis³. The present study was done to compare the effect of short term exposure and long term exposure to cotton dust in cotton mill workers and suggest precautions them to prevent this.

Objective: To compare the effect of short term and long term exposure to cotton dust on pulmonary function tests in cotton mill workers.

Method: In this study, one group of fifty workers exposed for short term duration and other sixty four, for long term duration exposure were examined for PFTs of age 25-50 years. PFTs were carried out using spirometer.

Results or observations: The present study found that there is statistically significant difference in PFTs between the short term exposed group and long term exposure group of 25-50 years age.

Discussion & conclusion: The results of the present study helped us to understand and compare the short-term and long term exposure group better and suggest workers to take precautions to avoid more subtle effects that can occur.

Keywords: Cotton dust, PFT, short term exposure, long term exposure.

Introduction

For nearly 300 years, work in textile industry has been recognized as, an occupational hazard. ²Byssinosis 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. ¹

Cotton workers are at risk for occupational lung disease, including byssinosis and chronic bronchitis. The initial phase of byssinosis is characterized by acute reversible symptoms, such as wheezing, chest tightness, shortness of breath, or cough, and is typically evident on the first day back to work after an absence of 48 h or more ('Monday Dyspnea'). These early symptoms are generally accompanied by reversible changes in pulmonary function (across-shift drops in FEV₁). With continued exposure, the disease may progress to a stage

Corresponding Author:

Afshan Kausar

Assistant Professor, Department of Physiology JIIU'S Indian Institute of Medical Science & Research, (JIIU'S IIMSR) Medical College, Warudi, Badnapur, Jalna, Maharashtra

e-mail: dr. afshankausar@gmail.com

in which symptoms are present throughout the work week and may eventually result in severe pulmonary disability.^{3, 4}

Longitudinal studies conducted in recent decades have produced conflicting results in understanding the chronic effects of exposure, especially with regard to functional impairments, although some studies failed to find chronic effects.^{5, 6, 7}

Previous studies suggested that respiratory symptoms in cotton textile workers were reversible, and reporting symptoms varied substantially from survey to survey whereas chronic symptoms persevered.^{5, 8, 9}

In this context, the present study has been undertaken to study, the effect of short term and long term duration exposure, to cotton dust on pulmonary function tests, in cotton mill workers. The results of the present study will help us to understand and compare the short-term and long term exposure group and suggest workers to take precautions to avoid more subtle effects that can occur.

Material and Method

The present study was approved by the Institution Ethical Committee. Pulmonary function tests were done in 50 cotton mill workers exposed for short term duration (1-5 years) and 64 cotton mill workers exposed for long term duration (6-20 years) of age 25-50 years.

The informed written consent was taken from study group after explaining the procedure to them. The study was done at a Spinning Mill with permission from the Management of the mill. The mill processes raw, ginned cotton to yarn.

The procedure of spirometry, a noninvasive investigation to be performed in the study for obtaining lung functions was explained to the subjects in vernacular, in detail. They, having understood the details, unconditionally consented to participate in the study. Workers were treated with due respect during all the meetings, while the tests were being conducted on them. Their work was not disturbed.

They were selected on the basis of following inclusion and exclusion criteria:

Inclusion criteria:

1. Study group individuals (both sex) working of age 25-50 years in cotton mill exposed for short term duration of 1-5 years and long term duration of 6-20 years.

2. Individuals in both groups are working in cotton mill for more than 8 hours per day for 6 days a week.

Exclusion criteria: Subjects having,

1. Previous exposure to cotton or other occupational dust.
2. Those with history of smoking, tobacco chewing and alcohol intake.
3. Those with history of COPD, Bronchial Asthma and any other allergic conditions like allergic rhinitis.
4. Those with history of Cardio vascular diseases, Hypertension and Diabetes Mellitus.

1. Study group 1/Short term group: Fifty cotton mill workers, of age 25-50 years working at cotton mill exposed for 1-5 years duration (short term)⁹

2. Study group 2/Long term group: Sixty four cotton mill workers, of age 25-50 years working at cotton mill exposed for 6-20 years duration (long term)

Method of collection of data: Following parameters evaluated in study groups:

- After taking informed written consent from each subject, a structured questionnaire was given to the subjects, to elicit the detail occupational history and history of past or present respiratory illnesses.

The following Symptoms were asked: any history of (a) Chest Tightness, (b) Difficulty in Breathing, (c) Cough, (d) Wheezing and Phlegm.

• Lung Function Tests:

Procedure: Each subject was made to relax for minimum 5 minutes prior to performing the PFT procedure. The relaxed subject, in a sitting position, was asked to grip the sterile mouth piece as demonstrated to him/her prior to the recording. When the subject was confident and familiar with the procedure, he/she was asked first to perform maximal inspiration after a deep expiration. The subject was then instructed to expire with maximal effort (maximal expiration). The mouth piece was then removed and the actual values were printed for analysis. Each subject (Study groups or Control), was asked to repeat the maximum forced expiratory effort three times, each time with adequate rest in between, and the best reading of the three was considered for analysis. The PFTs data's are analyzed by Spirolab III and a diagnosis of obstructive or restrictive disease is made.

The following parameters were recorded in mill workers (study groups 1 and 2):

1. **FVC:** The maximum volume of air expired after a maximum inspiration.
2. **FEV 1:** Forced expiratory volume in first second) the fraction of vital capacity expired during the first second of a forced expiration.
3. FEV1/FVC ratio.
4. **PEFR:** Peak expiratory flow rate.

Statistical analysis: The data was analyzed by SPSS software, Version 20. Analysis was done by using Un-paired Student's t-test for comparison between short term duration exposure and control group. The values were expressed as mean \pm SD of observed value.

Observations and Results

Table 1: Comparison of FEV1 between study groups 1 & 2.

Parameter	Short term (N=50)	Long term (N=64)	P value
FEV1 (L)	3.09 \pm 0.95	2.2 \pm 0.93	0.001*

Table 2: Comparison of FVC between study groups 1 & 2.

Parameter	Short term (N=50)	Long term (N=64)	P value
FVC (L)	3.65 \pm 0.92	2.83 \pm 1.03	0.001*

Table 3: Comparison of FEV1/FVC between study groups 1 & 2.

Parameter	Short term (N=50)	Long term (N=64)	P value
FEV1/FVC (%)	84.02 \pm 9.68	76.66 \pm 11.68	0.001*

Table 4: Comparison of PEFR between study groups 1 & 2.

Parameter	Short term (N=50)	Long term (N=64)	P value
PEFR (L/min)	528.9 \pm 130.21	466.56 \pm 128.83	0.001*

Discussion

Effects of short term exposure are as follows: 1) Cotton Dust can irritate the eyes on contact. 2) Breathing Cotton Dust can irritate the nose, throat and lungs. And effects of long term exposure are; Repeated exposure can

cause serious, permanent lung damage (*byssinosis*) with increase chest tightness, difficulty breathing, coughing and wheezing throughout work.¹⁰

Comparison between exposure of long term and short term duration group was done by two tailed un-paired Student's t-test, to arrive at the results described.

The present study has shown that there is decrease in FVC, FEV1, FEV1/FVC and PEFR with increase in duration of exposure cotton dust.

FEV1: there is highly significant decrease in mean value of FEV1 in long term exposed workers than short term exposed workers. (P<0.001) This finding is matched with few studies no. 4, 11, 12, 13, 14, 15, 16, 17 and however Jing Shi et al (18) observed no change in FEV1.

FVC: there is highly significant decrease in mean value of FVC in long term exposed workers as compared to short term exposed workers (P< 0.001). This finding is matched with few studies no. 4, 11, 16, 17, 19.

FEV1/FVC: there is highly significant decrease in mean value of FEV1/FVC in long term exposed workers than short term exposed workers (P< 0.001). This finding is matched with few studies 11, 14.

PEFR: there is highly significant decrease in mean value of PEFR in long term exposed workers as compared to short term exposed workers (P< 0.001). This finding is similar with observations of few studies 15, 16, 20.

Therefore pulmonary function tests of workers exposed for long term duration are markedly decreased than workers exposed for short term duration. A precise knowledge of the pulmonary function tests helps to understand and apply some preventive measures for cotton mill workers, to minimize the hazardous effects of cotton dust exposure.

Conclusion

Occupational respiratory diseases are usually caused by extended exposure to irritating or toxic substances that cause acute and chronic ailments.¹⁰ The incidence depends upon the chemical composition of dust, size of the particles, duration of exposure and the individual susceptibility. Though developed countries are very careful about occupational health, it is quite neglected in developing countries like India.¹⁴ Occupational exposure

to cotton dust leads to development of various pulmonary disorders, byssinosis being the most important of them.²

This study was conducted to enlighten and compare the effects of short term (1-5 years) and the long term (6-20 years) exposure (study groups), to cotton dust, on the pulmonary functions in cotton mill workers.

Pulmonary function tests were carried out on cotton textile workers and controls using 'Spiro lab III'.

Comparison between Short term and Long term duration exposure groups was done by unpaired Student's t-test (by calculating mean and standard deviation, SD).

Following conclusions are drawn from the study:

1. Dynamic lung volumes and capacities (FEV1 and FVC) were compared between long term exposed group and the short term exposed group, they were significantly affected with increasing years of exposure to cotton dust.
2. Also the mean values of PEFr were lower in long term exposed group than the short term exposed group, suggesting more decline with increasing years of exposure to cotton dust in these workers.
3. Above results point towards an obstructive airway pathology probably affecting the larger airways in cotton textile workers.^{28, 29}

Hence, we conclude in our study that the short term duration exposure (1-5years) as well as long term duration exposure (6-20 years) produces changes in the lung functions of cotton mill workers and with increasing duration of exposure, there is decreasing levels of lung functions.

Precautions in the form of yearly medical examinations of the workers and decreasing the dust levels in the industry have to be undertaken to prevent the development of chronic and irreversible lung diseases.

Conflict of Interest: Nil

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References

1. Anndrew Churg, Francis HY Green. Pathology of Occupational Lung Disease. 2nd edition. Williams and Wilkins; 1998.
2. Rosen stock L., Cullen MR, Carl AB, Carrie AR. Textbook of Clinical Occupational and Environmental Medicine, 2nd edition. Elsevier Saunders; 2005.
3. Bouhuys A, Beck GJ, Shoenberg JB. Priorities in prevention of chronic lung disease. *Lung*, 1979; 156:129-48.
4. C. Christiani David, Xiao-Rong Wang, Lei-Da Pan, Hong-Xi Zhang, Bi-Xiong Sun, Helian Dai, et al. "Longitudinal Changes in Pulmonary Function and Respiratory Symptoms in Cotton Textile Workers". *American Journal of Respiratory and Critical Care Medicine* 2001; 163 (4):847-853.
5. Fox AJ, Tombleson SBL, Watt A, Wilkie AG. A survey of respiratory disease in cotton operatives: Part I. Symptoms and ventilation results. *Br J Ind Med* 1973; 30:42-47.
6. Larson RK, Barman ML. A longitudinal study of pulmonary function in cotton gin workers in the San Joaquin Valley. *Chest* 1989; 96:819-23.
7. Berry G, Mckerrow CB, Molyneux MKB, Rossiter CE, Tombleson JBL. A study of the acute and chronic changes in ventilatory capacity of workers in Lancashire cotton mills. *Br J Ind Med* 1973; 30:25-36.
8. Molyneux MKB, Tombleson JBL. An epidemiological study of respiratory symptoms in Lancashire mills, 1963-1966. *Br J Ind Med* 1970; 27:225-34.
9. Fox AJ, Tombleson SBL, Watt A, Wilkie AG. A survey of respiratory disease in cotton operatives: Part II. Symptoms, dust estimation, and the effects of smoking habits. *Br J Ind Med* 1973; 30:48-53.
10. Kasper DL, Braunwald E, Fauci AS, Husee SL, Longo DL, Jemesen JL. Environmental lung disease. In, Harrison's principle of internal medicine, 16th edition. New York: McGraw Hill 2008; 1521-27.
11. Zuskin E, Ivanovic D, Schachter EN, Theodore JW. A Ten Year Follow-Up Study of Cotton Textile Workers. *Am Rev Resir Dis* 1991; 143:301-5.
12. Glindmeyer HW, Lefante JJ, Jones RN, Rando RJ, Hassan M, Kader A et al. Exposure Related

- Declines in the Lung Function of Cotton Textile Workers. *Am Rev Respir Dis* 1991; 144:675-83.
13. Glindmeyer HW, Lefante JJ, Jones RN, Rando RJ, Weill H. Cotton Dust and Across-Shift Drop in FEV1 as Predictors of Annual Change in FEV1. *Am J Respir Crit Care Med* 1994; 149:584-90.
 14. Jiang CQ, Lam TH, Kong C, Cui CA, Huang HK, Chan DC et al. Byssinosis in Guanzhou. *Occup Environ Med* 1995; 52 (4):268-72.
 15. Ramaswamy P, Sambandam S, Ramalingam A, Arnold J, Balakrishnan K, Thanasekharan V. Pulmonary Functions of Workers in Textile Units of Tamil Nadu, India. *Epidemiology* 2003; 14 (5):S76.
 16. Saadat Ali Khan Aiza Saadia. Pulmonary Function Studies in Pakistani Cotton Ginners. *Pak J Physiol* 2006; 2 (1).
 17. Hasan Kahraman, Mustafa Haki Sucakli, Talat Kilic, Mustafa Celik, Nurhan Koksall, Hasan Cetin Ekerbicer. Longitudinal pulmonary functional loss in cotton textile workers: A 5-year follow-up study. *Med Sci Monit*, 2013; 19:1176-82.
 18. Abebe Y, Seboxa T. Byssinosis and Other Respiratory Disorders among Textile Mill Workers in Bahr Dar North-West Ethiopia. *Ethiop Med J* 1995; 33 (1); 13 (2):33-49.
 19. Larson, Barman ML. Longitudinal Study of Pulmonary Function in Cotton Ginners in the San Joaquin Valley. *Chest* 1989; 96:819-23.
 20. Tiwari RR, Zodpey SP, Deshpande SG, Vasudeo ND. Peak Expiratory Flow Rate in Handloom Weavers. *Ind J Physiol Pharmacol* 1998; 42 (2):266-70.
 21. Crapo RO, Jensen RL. Standards and Interpretive Issues in Lung Function Testing. *Res Care* 2003; 48:764-72.
 22. Crapo RO, Becklake Margaret. Lung Function Testing: Selection of Reference Values and Interpretative Strategies. *Am Rev Respir Dis* 1991; 144:1202-18.