Original Article

Assessment of lung function among cotton mill workers

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Abstract

Background: The number of Cotton mill industries in Western Maharashtra with large work force is on the rise. Occupational respiratory related problems are also increasing in the community. Considering this fact, the cotton mill workers in Kadegaon in Sangli district were studied to determine the respiratory problems and impaired lung functions. **Material and Methods:** A community based cross sectional study was conducted in a cotton spinning mill at Kadegaon. A total of 278 Cotton mill workers, both male and females, of different age group between 25-50 years were grouped according to years of exposure as with exposure between 1-5 years, 6-10 years and 11-15 years. A pulmonary function test was recorded using computerized spirometer. **Results:** PFT of cotton mill workers in our study were statistically non significantly reduced because of the precautionary measures taken by mill management. Maximum numbers of mildly affected non significant workers were found in carding and blowing sections of mill. **Discussion:** The mill which we have studied has taken proper precautionary measures. Preventive measures are of paramount importance in minimizing the prevalence of respiratory disorders in cotton textile workers.

Key Word: Cotton mill workers, lung function test, respiratory problems

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INTRODUCTION

One of the greatest problems that the world is facing today is that of environmental pollution increasing with every passing year and causing grave and irreparable damage to the earth as well as livings on the earth. As cotton mill industries are going on increasing now a day in Western Maharashtra, respiratory related problems are also increasing in the community. The people who are exposed to cotton dust in cotton mill suffer more than general population from occupational hazards like byssinosis, respiratory diseases etc. Occupational exposure to the raw materials, cotton dust and its by-products had been associated with respiratory tract infections, bronco constriction, cough, excessive mucus, nasal stuffiness, and nocturnal asthma[1,2]. Cotton is widely cultivated in many places in India. In Maharashtra, cotton mills are more in Sangli, Ichalakaranji, Solapur, Kolhapur, Sangola, Madhavnagar, Miraj, Kadegaon. So, in this area one should not neglect any respiratory symptoms of the cotton mill workers. There are different departments or sections in the cotton mill as blow room, carding, ring frame, speed frame, winding, doubling, cotton go down and store. Depending upon the exposure of cotton dust, the workers show various changes in lung parameters. So, it is very important to study the respiratory functions in cotton mill workers time to time to detect any occupational hazards occurring. Pulmonary function test provides an objective and quantifiable measure of lung functions. It permits an accurate and reproducible assessment of the functional state of the respiratory system and allows quantification of severity of disease. These functions depend on the integrity of the airways, pulmonary vascular system, alveolar septa, respiratory muscles and respiratory control mechanisms[3].

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Considering the fact that cotton mill workers as one of the major employers of labor as well as the means of livelihood for many people in Kadegaon, we therefore conducted this study to determine the respiratory problems and impaired lung functions among cotton mill workers.

MATERIAL AND METHODS

A community based cross sectional study was conducted in a cotton spinning mill at Kadegaon. Cotton mill workers both male and females of different age group between 25-50 years were grouped according to years of exposure as with exposure between 1-5 years, 6-10 years and 11-15 years. Cotton mill workers with exposure less than 1 year and workers with illness as ischemic heart disease, bronchial asthma smokers and below age 20 years were excluded from the study. A cotton mill situated at Kadegaon in Sangli district was selected for the present study. Before performing the study prior permission of the main authorities (Managing Director) of the mill was taken and also the workers were informed about the importance of test. There were 700 workers in this cotton mill and 75 were office workers. Selected workers in cotton mill and in office were included in this study after obtaining the informed consent. A detailed assessment was done and various parameters were recorded which includes personal details including department of work, smoking history, personal history, history of duration of exposure to cotton dust particles. A detailed physical and systemic examination of all included subjects were done. A pulmonary function test was recorded using computerized spirometer. Spirometry was done in the sitting position for all the subjects. Age, height, and weight of the subjects were measured and entered in the software before performing the test. Spirometric parameters studied were forced vital capacity (FVC), FEV1, ratio of FEV1 and FVC, and peak expiratory flow rate (PEFR).

RESULTS

Out of 775 labor and office workers in a cotton mill, 287 workers fulfilled the inclusion criteria.272 (94.8%) male and 15 (5.2%) female workers were included. Table 1 shows distribution of workers in different departments.

Table 1: Distribution of workers in different departments

Department	Male	Female	Total
Blow room / Carding	40 (100%)	0	40 (100%)
Mixing	23(74.2%)	8(25.8%)	31(100%)
Ring Frame	53(88.3%)	7(11.7%)	60(100%)
Speed Frame	23(100%)	0	23(100%)
Winding	40(100%)	0	40(100%)
Cotton Godownand Packing	28(100%)	0	28(100%)
Lab and Others	65(100%)	0	65(100%)
Total	272 (94.8%)	15(5.2%)	287(100%)

For blow room workers, there was decrease in mean PEFR in exposure of 6-10 years than in group with exposure of up to 5 years. There was no such decrement seen in group with exposure 11-15 years. Thus, carding workers for various exposure periods the PEFR changes were dissimilar but not significant statistically ($p< 0.005$; Significant). For mixing workers, there was no significant decrease in mean PEFR in exposure of 6-10 years and in 11-15 years than in group with exposure of up to 5 years. Thus, for various exposure periods the PEFR changes were dissimilar but not significant statistically. However, PEFR was significantly differing for various exposure periods. For ring frame workers, there is decrease in mean PEFR in exposure of 6-10 years but in 11-15 years no such decrement seen. Thus, for various exposure periods the PEFR changes were dissimilar but not significant statistically. For speed frame workers, there was no decrease in mean PEFR in exposure of 6-10 years but in 11-15 years decrement seen. So, for various exposure periods the PEFR changes were dissimilar but not significant statistically. For winding workers, there is no decrease in mean PEFR in exposure of 6-10 years and11-15 years. So, for various exposure periods the PEFR changes were dissimilar but not significant statistically. For cotton go down and packing workers as well as lab and other workers, there was no significant difference in PEFR values in different exposure groups (Table 2 and 3).

Table 2: Lung functions test by nature of work

Department	Mean FEV1	Mean FVC	Mean PEFR	P value
Blow room / Carding	2.63	3.37	5.44	0.915
Mixing	2.61	3.15	4.95	0.020
Ring Frame	2.95	3.51	4.62	0.386
Speed Frame	3.14	3.77	4.94	0.120
Winding	2.93	3.48	5.41	0.738
Cotton Godown and Packing	2.89	3.50	5.08	0.171
Lab and Others	2.73	3.42	10.0	0.666

Table 3: Mean values of Lung function tests by duration of work

Department/Groups	Mean FEV1	Mean FVC	Mean PEFR
Blow room / Carding			
0-5 yrs	2.68	3.63	5.52
6-10 yrs	2.62	3.2	5.31
11-15 yrs	2.59	3.3	5.49
Mixing			
0-5 yrs	2.49	2.97	3.43
6-10 yrs	2.47	3.0	4.49
11-15 yrs	2.88	3.5	6.95
Ring Frame			
0-5 yrs	3.01	3.56	4.99
6-10 yrs	2.8	3.33	4.46
11-15 yrs	3.06	3.64	4.42
Speed Frame			
0-5 yrs	3.19	3.78	4.59
6-10 yrs	3.32	4.02	4.97
11-15 yrs	2.91	3.52	5.44
Winding			
0-5 yrs	2.81	3.31	4.96
6-10 yrs	2.95	3.54	5.11
11-15 yrs	3.05	3.59	6.18
Cotton Godownand Packing			
0-5 yrs	2.89	3.44	4.64
6-10 yrs	2.95	3.56	4.82
11-15 yrs	2.83	3.51	5.79
Lab and Others			
0-5 yrs	2.86	3.59	12.58
6-10 yrs	2.72	3.31	8.03
11-15 yrs	2.62	3.37	9.39

DISCUSSION

In present study lung functions in the cotton textile mill workers were investigated with the help of following measurements.

1. Forced vital capacity (FVC) in liters
2. Forced expiratory volume in 1 second (FEV1) in percentage
3. Peak expiratory flow rate (PEFR) in L/min.

The average value of forced vital capacity (FVC) in a normal healthy man of age ranging from 20-30 years is 4800ml i.e., 4.8 liters[4].The forced expiratory volume in one sec in expressed in percentage. Its normal range is 85-87%[5]. Peak expiratory flow rate (PEFR) in L/min represents the percent of volume of forced vital capacity expired at the end of first second and the peak expiratory flow rate is expressed in L/min. Its normal range is from 400-600 lit/sec[5]. A comparative study of PFT on cotton mill workers with the years exposed to the cotton dust (work duration) were compared among themselves, and also in between different departments. About 287 workers were selected for present study, out of that 272 (94.8%) were males and 15(5.2%) were females. The age of workers was selected for this study ranges from 25-50 years. All workers came under same economic category. In the present study, recorded pulmonary function tests, in cotton mill workers in different departments exposed to cotton dust were compared among themselves. Spirometric results in our study showed non significant decrease in FVC, FEV1, PEFR and FEV1/ FVC Ratio. This could be attributed to the modern technological precautions taken by the mill management. In mixing department, 8 females were studied, showing no decrease

in FVC, FEV1/FVC, PEFR but FEV1 values were decreased which were non significant. In ring frame department, 7 females were studied, showing non significant decrease in lung parameters as FVC, FEV1, FVC/FEV1, PEFR. Narsimha Rao and Tandon, in their study of lung functions of textile workers found statistically larger decline with greater duration of work (15-30years) than shorter duration (10 years). They found statistically significant decline in FEV1, which is more sensitive indicator of airway obstruction[4]. Compared to this study in our study results, the decrease in all parameters were statistically non significant. Mengesha Y A studied lung functions on 69 non-smoking subjects and found significant decline in FVC and FEV1 due to prolonged exposure to cotton dust[6]. Mishra AK *et al*., in their study of lung functions on 761 workers of textile mill of Pondicherry found that workers with chronic bronchitis of age up to 40 years showed FEV1 less than 80% and PEFR less than 400L/min. This indicates that there was 7.6 times more risk for the workers with age 40 years[7].Christians DC and Wang XR, in their study of lung functions (FEV1) on 384 cotton textile workers and 403 silk workers found that there was significant decrease in FEV1, in cotton works than silk workers, this was due to larger exposure of workers to cotton dust[8].It was observed that this highly decrease in mean values of FVC and PEFR, may be due to larger exposure to cotton dust i.e., as the duration of working in the mill increase there is highly decrease in the mean values of FVC, FEV1, PEFR. But in our study, decrease in FVC, FEV1, PEFR mean values were statistically non significant. Raza SN *et al* studied lung functions and personal breathing zone dust concentrations in Lancashire textile workers, found reduced values of FEV1 and FVC more in card room than other rooms of the mill. They observed that this was due to smoking and presence of high dust concentration in personal breathing zone[9].Parikh JR *et al*, in their study on 929 workers of three textile mill at Ahmadabad India found that mean prevalence of byssinosis in blow room was 29.62% and card room was 37.13%, this indicate that dust concentration was high in blow room and card room[10]. From all above studies it may be concluded that in the blowing and carding departments of the mill, as the cotton fibers are separated and further cleaned, the cotton dust concentration will be more and thus the exposure of workers to cotton dust in these two departments will be high. So, there may be highly decrease in lungs functions (FVC, FEV1, PEFR) in these two department than other departments of the mill. This indicates that prevalence of by ssinosis (subjective feeling of chest tightness) will be more in these two departments. The study carried out by Gupta and Gupta in Delhi[11] in a mill processing a coarse variety of cotton found the following prevalences: blowroom 37%, cardroom 47%, spinning 17%, weaving 22%, and finishing 7%. The study used only questionnaires to detect cases and neither pulmonary function tests nor dust measurements were included. The another study was carried out in Kishangarh, Rajasthan[12], in a mill processing coarse and synthetic yarn. Among 616 workers examined the prevalence of by ssinosis found was blow room 28%, card room 30%, draw frame 26%, ring frame 20%, and winding 25%. The higher prevalence rates reported in sections other than in blow rooms and card rooms could have been due to the coarse variety of cotton or the closeness of these sections to card rooms.The above studies also showed that the duration of exposure was shown to have no significant correlation with lung functions measurement among the exposed workers. The results of some studies upto 2011 had shown statistically difference in most of parameters of pulmonary function tests. After that nowadays, many precautionary measures have been taken by the mill management. The mill which we have studied also has taken proper precautionary measures. Preventive measures are of paramount importance in minimizing the prevalence of respiratory disorders in cotton textile workers. This includes measures aimed at the improvement of working conditions, pre-employment and periodic medical examination of workers.

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