Original Article

Effect of cotton dust on peak expiratory flow rate in cotton mill workers

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Abstract

Background: The cotton mill workers are exposed to raw cotton dust. Depending upon the exposure of cotton dust, they show various changes in lung parameters. The PEFR may not detect an early deterioration in ventilatory capacity as the other parameters but it is relatively easy to administer, repeatable and therefore can be used for a bedside assessment of respiratory problems. The present study was done to analyze effect of exposure of cotton dust on peak expiratory flow rate in cotton mill workers. **Material and Methods:** A cotton mill situated at Kadegaon in Sangli district was selected for the study. 287cotton mill workers of different age group between 25-50 years were studied and were grouped according to years of exposure as –Group I - with exposure between 1-5 years, 6-10 years and 11-15 years. A pulmonary function test was recorded using computerized spirometer. **Results:** There was decrease in mean PEFR in exposure of 6-10 years but in 11-15 years no such decrement seen. So, for ring frame, speed frame and winding workers for various exposure periods the PEFR changes were dissimilar but not significant statistically. There was no significant difference in PEFR values in different exposure groups in cotton Go down and Packing as well as lab and other workers. **Discussion:** This study gives an idea about the efficacy of the precautionary measures. On that basis all the precautionary measures are advised or can be made compulsory in all cotton spinning mills to maintain the pulmonary homeostasis.
Key Word: Cotton dust, peak expiratory flow rate, occupational exposure

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INTRODUCTION

The dust generated into the atmosphere as a result of processing the cotton fibers combined with any naturally occurring materials and inorganic matter which may have accumulated on the cotton fibers during growing and harvesting period is known as cotton dust[1].Cotton dust is classified according to size of particle-like trash (above 50 µm in diameter), dust (50–500 µm), micro dust (15–50 µm), and breathable dust (15 µm). Fine particulates with aerodynamic diameter ≤2.5 µm and ≥0.1 µm tend to sediment out in the gas-exchange region of the lung, where air movement is slow. These particles tend to be remained in the respiratory bronchioles within the central part of the acinus[2].The National Institute of Occupational Safety and Health recommends that exposure to cotton dust be reduced to lowest feasible limits which is defined as being exposure limit <200 µg/m^3. The cotton mill workers work in various departments of cotton mill like blow room, carding, ring frame, speed frame, winding, doubling, cotton go down and store during which the workers are exposed to raw cotton dust. Depending upon the exposure of cotton dust, the workers show various changes in lung parameters. The acute exposure can produce feeling of chest tightness, coughing, wheezing and breathing difficulty, whereas, long-term exposure may result in excessive chronic annual loss in peak expiratory flow rate[4].So, it is very important to study the respiratory functions in cotton mill workers time to time to detect any occupational hazards occurring. In Maharashtra, cotton mills are more in Sangli,

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Ichalakaranji, Solapur, Kolhapur, Sangola, Madhavnagar, Miraj, Kadegaon. Therefore, in this area one should not neglect any respiratory symptoms of the cotton mill workers. The present study was done to analyze effect of exposure of cotton dust on peak expiratory flow rate in cotton mill workers.

MATERIAL AND METHODS

A cotton mill situates at Kadegaon in Sangli district was selected for the study. In this community based cross sectional study 287 cotton mill workers, both male and females, of different age group between 25-50 years were included. All these included workers were grouped according to years of exposure as Group I-with exposure between 1-5 years, Group II–with exposure between 6-10 years and Group III–with exposure between 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. Before performing the study prior permission of the main authorities 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. Personal information included name, age, and history of smoking and tobacco chewing. Respiratory symptoms such as dyspnea, cough, and chest tightness were documented. A detailed physical and systemic examination of all included subjects were done. A pulmonary function test was recorded using computerized spirometer. Spirometric parameters studied were peak expiratory flow rate (PEFR) and forced vital capacity (FVC), FEV1.

RESULTS

There were 775 labor and office workers in a cotton mill. Out of these, 287 workers fulfilled the inclusion criteria. 272 (94.8%) male and 15 (5.2%) female workers were included. 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. So, for blow room, carding workers for various exposure periods the and PEFR changes were dissimilar but not significant statistically ($p< 0.005$; Significant).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. So, for mixing workers for various exposure periods the PEFR changes were dissimilar but not significant statistically. However, PEFR was significantly differing for various exposure periods. There was decrease in mean PEFR in exposure of 6-10 years but in 11-15 years no such decrement seen. So, for ring frame, speed frame and winding workers for various exposure periods the PEFR changes were dissimilar but not significant statistically. There was no significant difference in PEFR values in different exposure groups in cotton Godown and Packing as well as lab and other workers (Table 1).

Table 1: The mean PEFR values in workers by various departments

Department	Number	PEFR (Mean± SD)	ANOVA F value	P value
Blow room / Carding				
0-5 yrs	07	5.52 ± 2.97		
6-10 yrs	22	5.31 ± 2.29	0.171	0.915
11-15 yrs	09	5.49 ± 2.07		
Total	40	5.34 ± 2.26		
Mixing				
0-5 yrs	07	3.43 ± 1.64		
6-10 yrs	18	4.49 ± 2.38	4.535	0.020
11-15 yrs	06	6.95 ± 1.89		
Total	31	4.73 ± 2.40		
Ring Frame				
0-5 yrs	17	4.99 ± 1.73		
6-10 yrs	34	4.46 ± 1.94	1.030	0.386
11-15 yrs	09	4.42 ±1.83		
Total	60	4.69 ±1.84		
Speed Frame				
0-5 yrs	06	4.59 ± 1.84		
6-10 yrs	09	4.79 ± 0.43	2.212	0.120
11-15 yrs	06	5.44 ± 0.63		
Total	23	5.06 ± 1.12		
Winding				
0-5 yrs	08	4.96 ± 2.17		
6-10 yrs	25	5.11 ± 2.16	0.422	0.738
11-15 yrs	05	6.18 ± 1.87		
Total	40	5.19 ± 2.09		
Cotton Godownand Packing				
0-5 yrs	05	4.64 ± 1.88	1.817	0.171
6-10 yrs	08	4.82 ± 1.73		
11-15 yrs	11	5.79 ± 1.32		
Total	28	5.41 ± 1.55		
Lab and Others				
0-5 yrs	13	25.73±12.58		
6-10 yrs	33	13.25±8.03	0.526	0.666
11-15 yrs	11	12.31±9.39		
Total	65	15.56±8.68		

For up to 5 years, 6-10 years, 11-15 years exposure periods the PEFR were similar and non significant.

DISCUSSION

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]. 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. The PEFR may not detect an early deterioration in ventilatory capacity as the other parameters[6] but this is a test which a relatively easy to administer, and is fairly repeatable[7] and therefore can be used for a bedside assessment of people with respiratory problems. Mishra AK *et al*, studied lung functions in 761 workers of textile mill of Pondicherry and found that workers with chronic bronchitis of age up to 40 years showed PEFR less than 400L/min. This indicates that there was 7.6 times more risk for the workers with age 40 years[8]. Christians DC *et al* studied lung functions in 384 cotton textile workers and 403 silk workers and observed highly decrease in mean values of PEFR. It may be due to larger exposure to cotton dust as the duration of working in the mill increases there is highly decrease in the mean values of PEFR[9]. But in our study, decrease in PEFR mean values were statistically non significant. It was observed that in the blowing and carding departments of the mill, where 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 byssinosis (subjective feeling of chest tightness) will be more in these two departments. This correlates with the findings of Gupta and Gupta in their study carried out in Delhi. They found high prevalence of byssinosis that is 37% in blow room and 47% in card room[10]. The statistically non significant results in our study can be explained on the basis of the above precautionary measures. This study is also able to give us an idea about the efficacy of the precautionary measures. On that basis all the precautionary measures are advised or can be made compulsory in all cotton spinning mills to maintain the pulmonary homeostasis.

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