

Original Research Article

A Statistical study to estimate the effects of smoking and cotton dust exposure on lung function of cotton workers of Varanasi district, Uttar Pradesh, India

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ABSTRACT

Background: Occupational health has been included in National Health Policy, with a mission of providing safe healthy environment for the cotton textile workers by Government of India. With large population being agriculture dependent, the cotton textiles sector is the second largest provider of employment in India. Workers of these cotton and related industries are exposed to cotton dust in mills during carding, blowing, spinning and weaving of cotton fibers. Smoking is another causative factor for aggravating these respiratory symptoms in workers as most of them are habitual to smoking due to work load. Following studies was initiated with an objective to evaluate the interaction between cotton dust exposure and smoking on the lung function of these subjects

Methods: Five hundred (500) male weavers, from Varanasi, the state of Uttar Pradesh, North India working in various spinning outlets, were approached for this study with work duration of 10-15years. These subjects selected were in the age group of 28-41 years with no chronic medical history and lung ailments. Some of the workers had smoking history varying from 5-18 years. After segregating them in various groups (G1-G4), lung functions were monitored by evaluating the peak expiratory flow rate (PEFR) in workers of all the groups in lit/min.

Results: As lung functions were evaluated in terms of PEFR as main parameter. The results of the present study indicate significantly low values of PEFR (lit/min) in cotton spinning workers (G-3) as compared to normal healthy individuals (G-1), which got further impaired due to prevalence of smoking in subjects of cotton spinners (G-4). The level of significance ($p < 0.05$) for altered lung functions in smoking workers was much higher than those in nonsmoking workers suggesting involvement of larger airways.

Conclusions: Present results of this study; indicate that smoking potentiates the effects of cotton dust exposure on the respiratory functions of spinners by indicating the prevalence of enhanced lung symptoms as well as byssinosis.

Keywords: Byssinosis, Cotton dust, Pulmonary function, Respiratory symptoms, Smoking

INTRODUCTION

Rapid industrialization and globalization has changed the occupational morbidity drastically with the new pathologies like stress, geriatrics, psychological

disorders, heart and respiratory diseases are on raise. With this new transition pose challenges to population with a need for new concepts of environmental legislation, ethical issues, new safety regulation, insurance and high cost of health care system.¹ With large

population being agriculture dependent, the cotton textiles sector is the second largest provider of employment in India. Therefore, Indian textiles industry has an overwhelming presence in the economic life of the country.

Workers of these cotton and related industries are exposed to cotton dust in mills during carding, blowing, spinning and weaving of cotton fibers. Cotton textile workers are susceptible to various morbid conditions ranging from nutritional deficiency to chronic respiratory diseases like bronchial asthma, byssinosis, and chronic obstructive lung diseases (COPD) due to cotton dust inhalation.

Thousands of workers are exposed to cotton dust while busy in collecting cotton from the fields, in mills during carding, blowing, spinning and weaving of cotton fibers. Cotton textile workers are susceptible to various morbid conditions by virtue of workplace and working conditions. These morbid conditions may range from anemia because of nutritional deficiency to chronic respiratory diseases (like bronchial asthma, byssinosis, chronic obstructive lung diseases etc.) due to cotton dust inhalation.² Authors have reported relationship between relative losses of pulmonary functions and cotton related work in these subjects producing serious and irreversible changes in lung functions. Byssinosis symptoms may appear as quickly as couple of hours after exposure and diminish when leaving the manufacturing environment. Long term exposure to cotton, hemp, flax or jute fibers dusts may cause permanent scarring of the lungs and airways leading to debilitating lung disease.³

Occupational hazard with cotton workers begin with mild symptoms like wheezing, shortness of breath, tightness of chest coughing. These occur due to smooth muscle contraction after histamine release induced by dust containing bacterial endotoxins.

Smoking is another causative factor for aggravating these respiratory symptoms in workers as most of them are habitual to smoking due to work load. It has been reported that people who smoke suffer most severe impairment from byssinosis since combination of both dust/fiber and smoke both impair the lung airways irreversibly.³⁻⁵ Although causes and factors contributing to occupational health hazards related to cotton workers and its deleterious effects on respiratory pathway are known to some extent but not enough insight is available on the status of respiratory functions in cotton workers of developing nations especially in India. Moreover, focus on respiratory ailments induced by cotton dust exposure and related complications due to smoking habits in these workers have also not been explored fully.

Aims and Objectives

The present study is oriented with aims and objectives which are as follows:

- To study the prevalence of byssinosis in workers related to cotton spinning.
- To evaluate the interaction between cotton dust exposure and smoking on the lung function of these subjects.
- To ascertain the probable association of impaired lung functions with confounding factors like work areas, overtime and smoking habits.

METHODS

Five hundred (500) male cotton spinners/weavers, from Varanasi, Uttar Pradesh, North India working in various spinning outlets, were approached for this study with work duration of 10-15 years. These subjects selected were in the age group of 28-41 years with no chronic medical history and lung ailments. Some of the workers had smoking history varying from 5-18 years. Some normal control subjects with no spinning and no smoking history were also selected for this study to see individual effects of spinning and smoking.

All the subjects were asked to fill the consent forms and were examined by medical professional to rule out any chest disease by filling of clinical history form. ICMR guidelines were strictly followed for ethical considerations. Subjects were segregated in to the following four groups.

G-1 Non cotton spinner + nonsmoker = 125 subjects

G-2 Non cotton Spinner + smokers = 125subjects

G-3 Cotton Spinner + nonsmoker) = 125 subjects

G-4 Cotton workers + smoker = 125 workers

Since, pulmonary function test is a sensitive indicator of lung disease, measurement of peak expiratory flow in these subjects was done using peak flow meter (Medicare equipment India limited) to evaluate forced vital capacity (FVC) and forced expiratory volume (FEV) in litres/min.

Data obtained was statistically analyzed using computer software SPSS (Version 22) and results obtained were interpreted using Analysis of Variance and Post Hoc Test.

RESULTS

From the above table there are four groups G-1 (non cotton spinner + nonsmoker), G-2 (non cotton spinner + smokers), G-3 (cotton spinner + nonsmoker), G-4 (cotton workers + smoker) in which G-3 (cotton workers + smoker) has maximum peak expiratory flow rate value with mean and standard deviation as 473.2 and 31.18 respectively with minimum peak expiratory value 400 shows significant result. Then after, group G-1 (non cotton spinner + nonsmoker) has minimum peak expiratory flow rate value with mean and standard

deviation as 251.0 and 54.86 respectively with maximum value 350 which is equivalent to G-2 also shows significant result.

Table 1: ANOVA table for group wise comparison of PEFR.

Group	Min. PEFR	Max. PEFR	Mean PEFR	SD. PEFR	P-Value
G-1	160	350	251.0	54.86	0.000
G-2	240	350	294.2	38.34	
G-3	400	530	473.2	31.18	
G-4	250	400	319.6	44.58	

From the below table it shows that tukey test for comparison of group 1 (non-spinner+ non-smoker) with other three groups (non-spinner + smoker, spinner + non-smoker, spinner + smoker) shows significance with 95% confidence interval. Similarly, on comparison of group 2 (non-spinner + smoker) with other three groups (non-spinner + non-smoker, spinner + non-smoker, spinner + smoker) indicates significance except on comparing group 2 with group 4 it shows insignificant.

Table 2: Post hoc test (Tukey test) for Inter group comparison.

Group		Mean PEFR	SD. PEFR	Group value
G1	G2	294.2	38.34	0.003
	G3	473.2	31.18	0.000
	G4	319.6	44.58	0.000
G2	G1	251.0	54.86	0.003
	G3	473.2	31.18	0.000
	G4	319.6	44.58	0.166
G3	G1	251.0	54.86	0.000
	G2	294.2	38.34	0.000
	G4	319.6	44.58	0.000
G4	G1	251.0	54.86	0.000
	G2	294.2	38.34	0.166
	G3	473.2	31.18	0.000

On comparison of group 3 (spinner + non-smoker) with other three groups shows significant result and the last one when we compare group 4 (spinner + smoker) with other three groups shows significant results except with group 2 with 95% confidence interval. In this table it was also indicated that peak expiratory flow rate in both between groups and within groups shows significance (p<0.05).

DISCUSSION

As occupational health has been included in National Health Policy, with this mission Government of India had launched various “National Programs for Control and Treatment of Occupational diseases” in 1998-2002 for this the National Institute of Occupational Health,

Ahmadabad (ICMR) has been identified as the nodal agency. With 58% employment is in India is agriculture based and cotton is one of the main cash crops, India is one of the largest producer of cotton textile goods worldwide.

The cotton textiles sector is the second largest provider of employment after agriculture. Therefore, Indian Textiles Industry has an overwhelming presence in the economic life of the country. Currently, it contributes about 14 percent to industrial production, 4 percent to the GDP, and 17 percent to the country's export earnings. It provides direct employment to over 35 million people. Thus, the growth and all round development of this industry has a direct bearing on the improvement of the economy of the nation.⁶⁻⁸ The workers in the blowing, carding, weaving and spinning areas are constantly exposed to highest levels of cotton dust. The overall results in occupational groups (G-3 and G-4) indicate that raw cotton carded and spun by workers on machines that were not equipped with dust control devices, pose a serious health risk. The pulmonary functions of these workers are impaired in the form of byssinosis (Chest tightness, chronic bronchitis, cough and dyspnea). Most of these workers are illiterate and from poor socioeconomic background and are also habitual to smoking which is known cause of chronic obstructive pulmonary disease (COPD). The results of the present study indicate significantly low values of PEFR (lit/min) in cotton spinning workers (G-3) as compared to normal healthy individuals (G-1) , which got further impaired due to prevalence of smoking in subjects (G-4). As PEFR was the main parameter of lung function. The level of significance of altered lung functions in smoking workers was much higher than those in nonsmoking workers suggesting involvement of larger airways.

The results of our studies are in linearity with the observations of the Singh SH et al who reported significantly lower peak expiratory flow rate PEFR and Forced vital capacity (FEV) in cotton spinners.⁹ Similarly Wang et al reported high proportion of prevalence of respiratory symptoms and cumulative incidence of byssinosis in cotton group workers than silk workers.¹⁰ These findings were further substantiated by results of the another epidemiological studies by Ming SU et al; monitoring the lung functions (PFT) in 175 cotton textile workers (CTW) of Taiwan with additive effects of smoking and cotton dust exposure.¹¹ These authors also attributed the impaired lung functions (PFT) in these subjects including reduced FVC, FEV and PEFR due to high exposure and inhalation of cotton dust deteriorated further due to smoking.

In conclusion, the difference of abnormal pulmonary function between smokers and nonsmokers increased with increasing cotton dust exposure. These results revealed that smoking had impact on lung function in the high cotton dust exposure. Smoking was found to show an additive respiratory effect on cotton dust exposure.

Technological improvement has resulted in reduction of cotton dust exposure levels and respiratory symptoms. Anti-smoking campaign, occupational health education and training program to reduce the dust exposure, and periodical medical examination are needed to control byssinosis in India.

CONCLUSION

Occupational long term exposure to cotton dust reduces the lung capacities in workers of cotton spinners as indicated by significantly low values of PEFR as compared to non spinners in current findings. Higher prevalence of respiratory symptoms in cotton spinners has been attributed to both occupational specific and non-specific causes in which byssinosis has been more strongly associated with involvement of endotoxins from chronic exposure to dust. Present results of this study; indicate that smoking potentiates the effects of cotton dust exposure on respiratory functions and byssinosis. Cessation of exposure to cotton dust may improve respiratory health of these workers along with anti-smoking campaign, occupational health education and training programs to reduce the dust exposure. Technological improvements and periodic medical examinations are needed to control byssinosis in these workers.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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