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Assessment of Respiratory Disorders among workers in Cigarette Industry

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ABSTRACT

This study was undertaken to determine whether exposure of raw tobacco causes respiratory diseases, lung function impairment and parenchymal changes among workers in cigarette industry. Total subjects studied (n=125), out of which 67 were Non exposed workers or control subjects and 58 were workers exposed to dried tobacco leaves in Cigarette and Beedi Industry of Varanasi-Mirzapur belt, Uttar Pradesh, India. The study included completion of a questionnaire (on pulmonary and respiratory problems, spirometry and measurement of peak expiratory flow rate. At the same time, Paired t-test was done to determine the significant difference between cigarette workers and control subjects. Cigarette workers had significantly lower percentage of predicted values of FVC, FEV_1 and FEV_1% than control subjects (p <0.001). This study indicates that Cigarette workers may have respiratory and pulmonary disorders related to exposure to tobacco dust in their work environment.

Key words: *Respiratory impairments, Cigarette, Beedi Industry, Tobacco dusts, Lung function, Worker.*

INTRODUCTION

Tobacco-related industry is a major commercial enterprise around the world. Over the years, production and consumption of tobacco products has alarmingly increased throughout the world. In India, more than five million individuals are involved in the production of Cigarette and bidi (South Asian Cigarette and a raw form of cigarette) (Shimkhada et al. 2003, Aghi 2003). The respiratory impairments among the exposed workers were reported to be caused by the varieties of dusts in small and large scale industries generated during their production processes (Czeslawa, 1998).The nature of respiratory diseases caused byoccupational dust is influenced by thetype of dust and duration of exposure (Mengesha and Bekele, 1998, Jaiswal, et.al, 2011; Jaiswal, 2012).

A Cigarette / beedi made of dried tobacco flake and it is extremely popular among the non-affluent but it carries greater health risks as it delivers more nicotine, carbon monoxide and tar. Raw tobacco dust can contain bacteria, endotoxins, and fungal spores (moulds), pollen, mites,

insects, particulates, of inorganic materials such as quartz, and residues of pesticides or insecticides (Blair et al. 1983). This process depends on constant humidity; the working environment is humidified and creates conditions for microbial growth. Increased concentrations of microorganisms including moulds, bacteria and endotoxins have been measured in the tobacco industry (Dutciewitz 1985 and Kotimaa 1990).

The Cigarette and Beedi industry employs thousands of people, most of who work under conditions that are as harmful to their health. They spend hours blending or rolling tobacco in unhygienic, dingy and overcrowded places having little facilities for drinking water, toilet, washing or even first aid. The working hours are often interminable and at times even child workers are made to slog for long hours in violation of the law. In Cigarette/ beedi workers, the occupational stress associated with long hours of work, exposure to tobacco dusts and poor working conditions are superimposed on the handicaps of poor socioeconomic and nutritional status. The salient features were that the subjects experienced symptoms like nausea, giddiness, vomiting, headache, tiredness, loss of appetite, weakness, cough and breathlessness. In response to the questionnaire, the problems reported by cigarette workers were- aches and body pain due to continuous work in a static posture; cough, which may be related to their exposure to tobacco dust; stomach-related pains such as cramps, gas and spasmodic pains leading to diarrhea; morning cough; cough throughout the day; chest tightness, etc.

Respiratory diseases in tobacco processing workers have been described by other scholars. Viegi (1986) reported that respiratory or nasal symptoms in cigar and cigarette making workers were significantly higher than controls. Lander and Gravesen (1988) found that 69% of tobacco workers had symptoms of occupational asthma and chronic bronchitis. Uitti (1998) and Mustjbegovic (2003) showed that tobacco workers tended to have lower FVC, FEV_1, FEF_{50}, and FEF_{25}. Gleich (1980) observed that allergy to tobacco products is an occupational hazard and the allergic reactions to tobacco antigens in tobacco leaves might be responsible for the disease. Huuskonen (1984) suggested that exposure to spores of different molds in the manufacture of tobacco products may induce symptoms and signs relating to extrinsic allergic alveolitis.

A significant decrease in forced expiratory volume in 1 second (FEV1) during the work shift and an excess of chest tightness have been reported among non-smoking tobacco workers (Valic 1976). Obstruction of the airways of tobacco workers has been suggested by several research groups (Kjaergaard et al. 1989, Ghosh et al. 1985, Viegi et al. 1986, Mukhtar et al. 1991 and Lander and Gravesen 1988). Findings have not been conclusive mainly due to difficulties in control-ling the confounding effect of smoking or selection. Irritant symptoms of the eyes were reported at comparatively low exposure concentrations in tobacco workers (1.26 mg/m^3total dust) (Kjaergaard and Pedersen 1989). In one study 26% of the examined tobacco workers claimed to have work related respiratory symptoms, and three workers were considered to have allergic alveolitis (Huuskonen et al. 1984).

To further study the possible health effect of tobacco dust, we chose Cigarette factory workers exposed to raw tobacco. Our objective was to assess the prevalence of respiratory symptoms, impaired lung function, and parenchymal changes in chest radiography among the workers.

MATERIALS AND METHODS

Selection of Subjects: 125 (One Twenty Five) male workers from cigarette/ beedi factory at Varanasi, Mirzapur belt, Uttar Pradesh were selected for this study. Among them 67 were control subjects and 58 were workers exposed to cigarette/ beedi. The control subjects were selected from those in the population who were not directly engaged in cigarette/ beedi making but were associated with other jobs in the same area of study.

Questionnaire: The smoking history was taken and the frequency of smoking per day was noted using a questionnaire. The questionnaire consisted of a series of objective-type questions with multiple-choice responses. The questions were grouped into the following major sections:

1. General information about the workers, i.e., their age, years of experience, etc.
2. Work organization and work behaviors.
3. Assessment of stress at work, personal and family history of allergy, medication and detailed questions on pulmonary disorders.

According to smoking habit workers were classified into 3 Categories

a. Smoker: Who smoked at least more than 6cigarette/ beedi per day.
b. Non-Smoker: Who had never smoked throughout their life.
c. Ex-Smoker: Those who had given up smoking.

There were very few ex-smokers; so they were combined with the smoking category and analyzed. The personal histories of the individuals were also noted, giving special attention torespiratory impairments. Duration of work with their past and present work history was also recorded.

Pulmonary Function Tests: The following lung functions indices were recorded for each subject in the study: FVC, $FEV_{1.0,}$ PEFR using Modern Micro plus Medical Spirometer. Before the recordings were taken, all subjects were motivated and properly explained about the motive of taking this measurement and also taking the written consent from each subject, thus ensuring proper recording at optimum levels (Chattopadhayay et. al, 1999; Chattopadhayay and Alam, 1996).Pulmonary function test values were predicted from the standard prediction equation of Varanasi normal subjects (Jaiswal, 2012; Chatterjee et. al, 1988).

Anthropometric Test: Body height and body weight were measured using Anthropometric rod and electronic weighing machine without footwear. Body surface area (BSA) was calculated using Du-Bois and Du-Bois formula ($BSA = (Weight^{0.425} \times Height^{0.725}) \times 0.007184$) (Du Bois and Du Bois, 1916).

Statistical Analysis: Data were analyzed using Microsoft Excel 2007 and SPSS v11.0. Results are presented as percentages, means and standard deviations. Statistical analysis were done by using students paired 't' test to determine whether there was any significant difference between the exposed and control workers.

RESULTS

All subjects (males, n=125) were divided into two categories: control subjects (67) and exposed cigarette/ beedi workers (58). The physical parameters of control and exposed male cigarette/ beedi workers are presented in Table 1. The age, height, weight and body surface area of the control and exposed groups are comparable; no significant differences were noticed.

Table 1: Anthropometric and physical parameters of exposed and control male cigarette/beedi workers (mean ± SD)

Parameters	Cigarette/ Beedi workers (n=58) (mean ± SD)	Control subjects (n=67) (mean ± SD)	Percentage difference	P values
Age (years)	34.86 ± 12.27	36.54 ± 14.55	-4.43	NS
Height (cm)	162.58 ± 15.62	162.55 ± 14.52	0.76	NS
Weight (kg)	51.38 ± 5.54	53.51 ± 7.94	-4.32	NS
BSA (m^2)	1.52 ± 0.32	1.76 ± 0.14	-1.52	NS
BMI	19.45 ± 3.78	19.98 ± 3.94	-3.93	NS

BSA = Body surface area, BMI = Body mass index, NS = Non significant

The lung function (Forced vital capacity (FVC), Forced expiratory volume in one second ($FEV_{1.0}$), and Peak Expiratory Flow Rate (PEFR) of the control and exposed male cigarette/beedi workers are presented in Table 2. It was found that the mean values of the lung volumes and flow rates of control subjects were higher than the exposed workers. Only the PEFR showed significantly higher values in control subjects compared to the exposed workers.

Table 2: Pulmonary/Lung function tests of exposed and control male cigarette/ beedi workers (mean ± SD)

Parameters	Cigarette/Beedi workers (58) (mean± SD)	Control subjects (n=67) (mean± SD)	Percentage changes	P values
FVC(l)	3.78±0.78	3.99±0.75	-2.36	NS
$FEV_{1.0}$ (l)	3.56±0.74	3.68±0.58	-3.16	NS
PEFR (l/min)	471.56±96.15	509.56±69.26	-7.64	<0.05

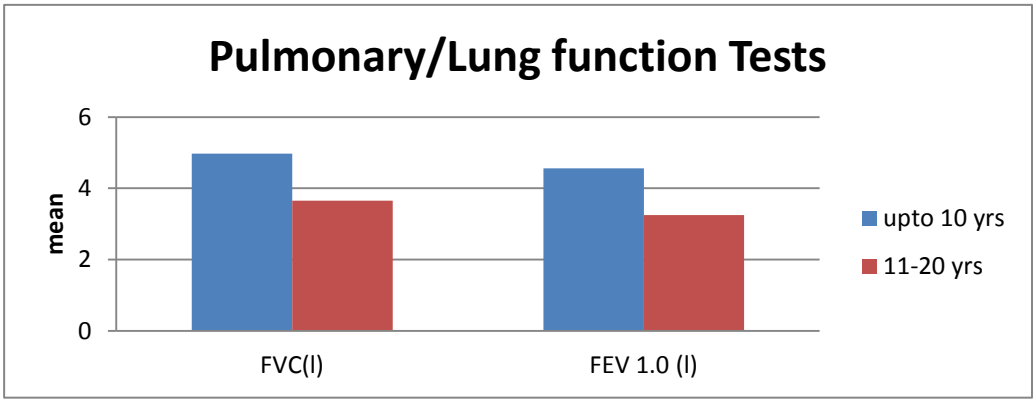

Figure 1: Comparison of lung volumes of male cigarette/ beedi workers according to duration of exposure.

The different lung volumes and flow rates of both control and exposed male cigarette/ beedi workers according to the Pulmonary/Lung function tests and duration of exposure are presented in Figures 1 and 2 respectively.

Figure 2: Comparison of lung volumes of male cigarette/beedi workers according to duration of exposure

The duration of exposure was categorically divided into three groups: up to 10 years, 11-20 years and above 20 years. A trend of gradual decrement of lung volumes was found in exposed subjects as the duration of exposure increased. A gradual decrement of lung volumes was noticed as the duration of exposure increased.

Table 3: Lung volumes and Flow rates of exposed male cigarette/ beedi workers according to smoking habits (mean ± SD)

Parameters	Smoking habits	Beedi workers	Smoking habits	Control subjects	Percentage difference	P values
FVC (l)	Non-smoker n=19	4.01 ± 0.44	Non-smoker n=35	4.20 ± 0.88	4.52	NS
	smoker n=39	3.56 ± 0.65	smoker n=32	3.81 ± 0.85	6.56	NS
$FEV_{1.0}$ (l)	Non-smoker n=19	3.72± 0.38	Non-smoker n=35	3.79 ± 0.88	1.85	NS
	smoker n=39	3.24 ± 0.75	smoker n=32	3.62 ± 0.53	10.49	NS
PEFR (Liter/sec)	Non-smoker n=19	480.31 ± 75.38	Non-smoker n=35	508.73 ± 90.55	5.51	NS
	smoker n=39	450.34 ± 92.78	smoker n=32	501.64 ± 68.35	10.18	<0.05

Lung volumes and flow rates of both control and exposed subjects according to smoking habits are presented in Table 3. It is has been found that the smokers have lower pulmonary function values compared to the nonsmokers. The mean pulmonary function tests values of the control nonsmokers and smoker subjects are found higher compared to the exposed nonsmokers and smoker subjects. Among the comparisons, PEFR between smoker controls and exposed showed significant differences. FVC, $FEV_{1.0}$in lung volumes of nonsmoker exposed subjects and control nonsmokers subjects and in flow rates was found to be little higher compared to the smoker exposed and control subjects of respective categories.

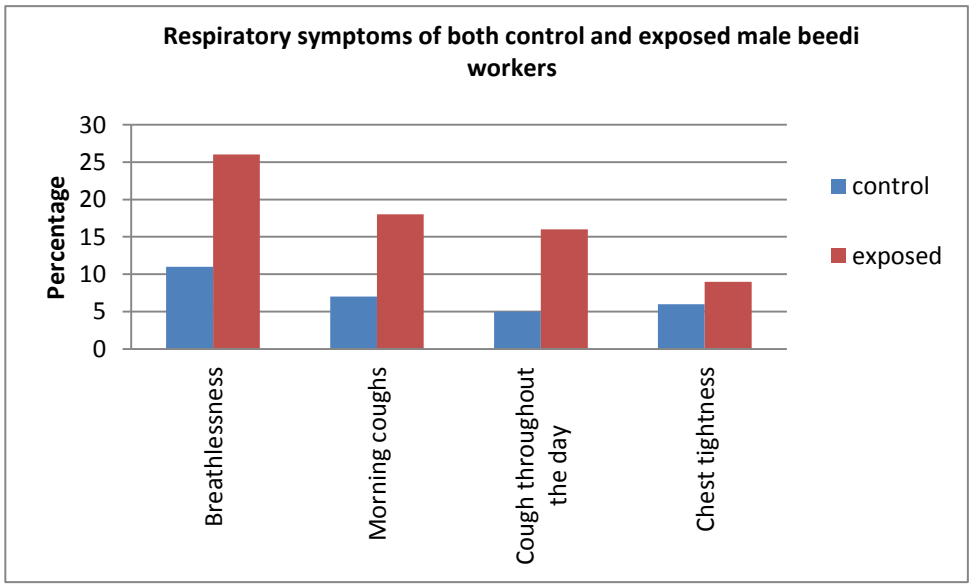

Figure 3: Distribution of other respiratory symptoms of both control and exposed male cigarette/beedi workers

The respiratory symptoms as reported by the control and exposed subjects are presented in Figure 3. The respiratory symptoms like cough with breathlessness, morning coughs, cough throughout the day, chest tightness are reported. The percentage figures of these symptoms are significantly higher in exposed subjects compared to the control. Cough with breathlessness was found to be higher among all the symptoms in exposed as well as control subjects.

The spirometric assessment of the respiratory function impairments among the exposed workers and control subjects are presented in Figure 4. The respiratory impairments of restrictive, obstructive and 'combined restrictive and obstructive' type among the exposed workers as a whole are much higher (27.52%) compared to control (5.86%). According to category, in exposed workers, the restrictive type of impairment is 6.88%, obstructive type is 13.86% and combined type is 6.78%; the corresponding figures in control subjects

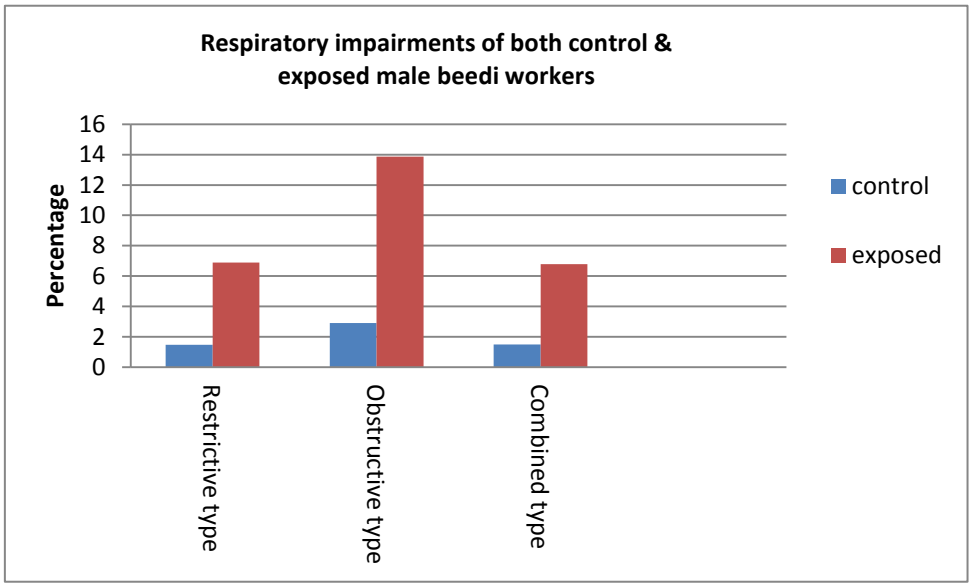

Figure 4: Comparison of respiratory impairments of both control and exposed male cigarette/beedi workers

DISCUSSION

Cigarette and Bidi manufacturing is the second largest industry in India (Shimkhada et al. 2003). It provides employment to millions of women and children mostly from the poor socioeconomic strata (Shimkhada et al. 2003 andAghi 2003). Investigations show that these tobacco-processors are exposed to extremely high levels of inspirable tobacco particulates (Bhisey et al. 1999 and Bagwe and Bhisey 1993). Considering the high content of nicotine and other chemicals in bidi tobacco (compared with cigarette tobacco), these workers are at an extremely high risk of developing systemic illness (Malson et al. 2001).

Tobacco dust contains various immunological active as well as toxic substances. It has been established that occupational chronic exposure to the dust of tobacco leaves is associated with significant increases in the occurrence of mild obstructive ventilatory disturbances (Ignacak et.al, 2002).Nicotine is a major component of tobacco, and has potential adverse health consequences. In addition, tobacco has about 4000 active chemical compounds of which more than 50 are carcinogenic; the list includes nitrosamines, polycyclic aromatic hydrocarbons, radioactive elements, and cadmium (Robert 1988).Tobacco dust mainly contains nitrosamines, which are readily absorbed by the body tissues like skin, respiratory epithelium and mucus membrane of mouth, nose and intestines. Exposure to tobacco dust is known to affect the respiratory tract in humans (Umadevi et.al, 2003, Jaiswal, 2012).This study was designed to investigate the cigarette/beedi tobacco dust exposure and its effect on pulmonary function status. The present study shows an association between pulmonary function impairments and exposure to cigarette/beedi tobacco dust.

In this study no significant difference in the prevalence of respiratory symptoms between the tobacco workers and the referents was found. The fact, that the currently smoking referents turned out to be heavier smokers than the smoking tobacco workers, may have affected the comparison of bronchitic symptoms. According to the questionnaire we found five tobacco workers fulfilling the criteria of allergic alveolitis. Four of them had reported delayed onset of symptoms, two workers were able to relate their symptoms to visits to humidified departments inside the factory.

In India, workers engaged in the processing of tobacco for the manufacture of cigarette/beedis (the indigenous substitute for cigarettes) are chronically exposed to tobacco flakes and dust via the cutaneous and nasopharyngeal routes (Mahimkar and Bhisey, 1995).Earlier studies reported that in India over 3 million workers employed in the cigarette industry receive massive chronic exposure to un-burnt tobacco, mainly by the cutaneous and nasopharyngeal routes, which may develop pulmonary function impairments among the workers exposed to that environment (Bagwe and Bhisey, 1993; Jaiswal, et.al, 2011; Jaiswal, 2012).

Working in a cigarette factory or exposure to tobacco dust has been suggested to affect the respiratory system; a tendency towards lower spirometric values among tobacco workers has been suspected in several studies (Kjaergaardet al. 1989, Ghosh et al. 1985, Viegi et al. 1986 and, Mukhtar et al. 1991). In the crude comparison of the study groups we noted a similar tendency. However, in the multivariate analysis including pack-years of smoking and other covariates all differences in the spirometric results and in the results of diffusing capacity between the exposed and unexposed groups disappeared

The predicted FVC %, FEV_1 % and FEV_1/FVC % values of tobacco factory workers were lower

as compared to those of controls. It seems that the total employment time in the tobacco factory had a significant effect on the respiratory function of the workers. It was found that FEV_1 was mainly dependent on the employment time and at a minor degree on the smoking habits of the workers. This finding, that the respiratory function and especially the small airways are affected by employment, in general, is in-line with the findings of other authors (Viegi 1986, Kjaergaard et al. 1989, Mukhtar 1991, Speziale 1994).The ventilator capacity in tobacco workers showed a reduction in $FEV_{1.0,}$ FVC in relation to their predicted value (Mustajbegovic et.al, 2003; Jaiswal, 2012). Only the difference of PEFR between control and exposed workers was shown to be significant ($P<0.05$). In the present study, the age, height, weight, body surface area and body mass index were comparable among cigarette workers and the control subjects.

A low prevalence of chronic respiratory symptoms was found in control workers and the prevalence of cough with breathlessness, morning cough were higher among workers exposed to tobacco dust than the control (Valic et.al, 1976; Jaiswal, et.al, 2011; Jaiswal, 2012).In the present study, findings of the symptomatic changes, i.e., cough, cough throughout the day, chest tightness were noticed to be higher in exposed workers than the control subjects, which is highly corroborated by the study results of Kjaergaard et.al, 1989.

Mostly the small airways are affected much by the exposure to tobacco dust (Mukhtar et.al, 1991).The spirometric assessment showed a tendency of restriction and obstruction type changes, especially in small airways of tobacco industry workers (Huuskonen et.al, 1984).In the present study, the respiratory impairments as a whole were found higher among the exposed subjects (27.52%), in which 6.88% were restrictive, 13.86% were obstructive and6.76% were of the 'combined restrictive and obstructive' type. These types of pulmonary function impairments might be due to their exposure to tobacco dust during cigarette/ beedi-making.

CONCLUSION

In view of the deleterious effects of tobacco dust on the respiratory system, we suggest that preventive measures need to be taken. These measures include control of the dusty environment and wearing personal protective masks. Medical surveillance should be part of this preventive program and it should include lung function testing before the beginning of employment and regularly during employment in this industry. Workers with respiratory disorders or atrophy should be closely monitored while working in the tobacco industry. Finally, since smoking is clearly an additional risk factor affecting the respiratory system in this setting, tobacco workers should be strongly discouraged from smoking.

Our conclusion is based on health hazards, so the subjects were aware about the harmful effect of tobacco dust and use. There is a need to improve knowledge of the dangers of smoking among the disadvantaged segments of the population. Results of the present study prove that Cigarette and beedi tobacco is very harmful for the workers who actively or passively inhale tobacco during beedi rolling. The health impact on beedi workers is visible on all subjects.

Various welfare schemes are being implemented by the Government. for the welfare of bidi workers in the field of health, education, housing, recreation and social security etc. The Government has sanctioned some new hospitals and dispensaries for workers of dried tobacco industry. Government has also extended Rashtriya Swasthaya Bima Yojna (RSBY) for these works. (Ministry of labour and employment, 12, Dec 2011)

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