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NOTES

Respiratory Problems of Workers in the Zarda Industry in Kolkata, India

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This study was undertaken to assess the pulmonary and respiratory problems of workers in a zarda factory. A total of 70 permanent zarda workers (50 manufacturing workers and 20 office ones) were studied in a factory in Baguihati, Kolkata, India. The study included (a) completion of a questionnaire (on pulmonary and respiratory problems), (b) measurement of physical parameters, (c) spirometry and (d) measurement of peak expiratory flow rate. At the same time, the worksite was analyzed with an OSHA-recommended ergonomics checklist. Many zarda manufacturing workers complained of respiratory symptoms. Continuous exposure to the tobacco processing environment reduced the workers' lung volume and peak expiratory flow rates. Our study indicates that zarda manufacturing workers may have respiratory and pulmonary disorders related to exposure to tobacco dust in their work environment.

zarda manufacturing workers   respiratory function   tobacco dust

1. INTRODUCTION

The effect of health and safety on productivity cannot be properly discussed without touching on the concept of ergonomics [1]. This term covers a field which in recent years has expanded to an extraordinary degree.

Respiratory disorders among tobacco workers have been reported by several authors. As early as the beginning of the 18th century, Ramazzini [2] wrote about diseases of tobacco workers.

Zarda is a type of chewing product made of tobacco leaves. In a zarda factory workers mix tobacco leaves with different chemicals, then they bake or dry the leaves and pack the product. Many workers are involved in zarda making in Kolkata, West Bengal. Chloros, Sichletidis, Kyriazis, et al. [3] observed that tobacco worker's upper respiratory system was affected due to occupational exposure to tobacco dust. The primary cause of chronic obstructive pulmonary disease (COPD) is exposure to tobacco. Clinically significant COPD develops in 15% of cigarette smokers. Tobacco dust in the working environment increases the risk of respiratory infections, allergic respiratory or nasal diseases, and causes a measurable reduction in the pulmonary function among tobacco processing workers [4]. According to Sekerova [5] work-related temporary disability caused by upper respiratory tract disease was reported in 36.8% of workers in the tobacco industry.

The present study was undertaken to assess the pulmonary and respiratory problems of manufacturing and office workers of a zarda factory in Kolkata.

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2. METHODS

2.1. Selection of Subjects

Seventy male workers from a zarda factory at Baguihati, Kolkata, were randomly selected for this study. Among them 50 workers were directly involved in tobacco processing (manufacturing workers) and 20 workers had office jobs (office workers). The subjects' physical characteristics are given in Table 1.

TABLE 1. Subjects' Physical Characteristics, *M* (*SD*)

Variables	Manufacturing Workers (n = 50)	Office Workers (n = 20)	p Value
Age (years)	49.3 (6.38)	48.7 (4.12)	*ns*
Height (cm)	160.6 (11.23)	161.01 (9.65)	*ns*
Weight (kg)	53.6 (9.90)	55.9 (8.07)	<.05
BMI (kg/m^2)	20.9 (2.32)	22.3 (2.11)	<.05

Notes. BMI—body mass index.

2.2. Questionnaire

A modified questionnaire was prepared in the Ergonomics Laboratory of the University of Calcutta, on the basis of the British Medical Research Council questionnaire on respiratory symptoms [6] with additional questions on occupational lung diseases [7]. 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 and detailed questions on pulmonary disorders.

2.3. Physical Parameters

The subjects' height and weight were recorded with an anthropometer and a measuring tape, and a weighing machine respectively. From the data collected, the body mass index (BMI) was calculated.

2.4. Pulmonary Function Test (PFT)

Measurement of PFT was done with a Spirovit-Sp-10 (Schiller, Switzerland). Three succesive recordings of vital capacity (VC) and forced vital capacity (FVC) were performed in the standing position and the best of the three ratings was recorded.

2.5. Peak Expiratory Flow Rate (PEFR)

Measurement of PEFR was done with a mini Wright peak flow meter (Clement Clarke International, UK). Prior to recording the subjects' PEFR, the use of the instrument was repeatedly demonstrated and explained. The PEFR test was performed in the standing position with the peak flow meter held horizontally. The subjects were asked to take as deep a breath as possible and then to blow out as hard and as quickly as possible. The best of three ratings was recorded.

2.6. Worksite

The factory worksite was analyzed with the OSHA-recommended ergonomics checklist [8]. The checklist helps to assess jobs with respect to the demands placed on workers by their jobs.

2.7. Working Environment

The working environment of the factory was assessed. The wet bulb globe temperature (WBGT) index was calculated [9]. It is a weighted average of the natural wet bulb temperature (NWB), globe temperature (GT) and dry bulb temperature (DB).

The formula for calculating the WBGT index for indoor conditions is

$$\text{WBGT}_{\text{indoor}} = 0.7 \bullet \text{NWB} + 0.3 \bullet \text{GT}.$$

2.8. Statistical Analysis

For a statistical analysis of the quantitative variables under normal data distribution, Student's t test was used, whereas for an analysis of the association between the variables, the χ^2 test was used. Biostatistical analysis was performed using SPSS version 10.1.

3. RESULTS AND DISCUSSION

The χ^2 test was used to establish whether there was any work nature effect in the responses (to the questionnaire), i.e., respiratory discomfort or no discomfort during each individual zarda processing activity (experienced by manufacturing or office workers). It was found that there was a significant association between feelings of respiratory discomfort. Seventy percent of manufacturing workers reported respiratory discomfort, whereas only 5% of office workers experienced it (Table 2). These responses show that respiratory discomfort was dominant in manufacturing workers. This finding is supported by Edwards [10], who found that tobacco users and tobacco workers were easily affected by respiratory disorders.

TABLE 2. Subjects' Respiratory Discomfort

Subjects	Discomfort	No Discomfort	χ^2	*p* Value
Manufacturing workers (*n* = 50)	35	15	51.345	<.05
Office workers (*n* = 20)	1	19		

From the assessment of the worksite (with the ergonomics checklist), it was found that manufacturing workers in this zarda factory worked in alternately dry and humid environments with exposure to tobacco dust, mold and mildew. Tobacco leaves arrived at the plant as raw material; they were initially stored in large rooms. During initial processing, the leaves were separated manually according to their quality. The tobacco leaves were shaken by hand and then lightly beaten to remove dirt and other foreign matter that coated the leaves. The leaves were then mixed with several chemicals. They were then placed on open drier tables, baked and dried. This part of the operation was very dusty. These steps in the processing of tobacco in this plant were performed without hoods or other engineering controls. Protective masks were provided to the workers but were worn only occasionally. Mukhtar, Rao, Gamra, et al. [11] studied tobacco workers and found that tobacco dust could cause the constriction of smaller airways.

The working conditions were also ill-ventilated and damp. The permissible heat exposure threshold limit value, recommended by OSHA in 1974 [12], is based upon the WBGT value for a workplace with a moderate workload, and is 27.8 °C. On comparing this value with the calculated WBGT index in the present study (Table 3), it is observed that the WBGT index values for the three workshops exceed the threshold limit value by a margin of about 2.4 and 11.0 °C at the office and manufacturing site, respectively.

TABLE 3. Working Environment in the Factory

Worksite	WBGT Index (°C)	RH (%)
Office	30.2	66
Manufacturing site	38.8	81

Notes. WBGT—wet bulb globe temperature, RH—relative humidity.

Table 4 lists the problems experienced at work by the subjects as revealed by the questionnaire. Similar observations were made by Mustajbegovic, Zuskin, Schachter, et al. [13], who said that the health effects that tobacco workers complained of included headache, cough, nausea and vomiting. Ghosh, Parikh, Gokani, et al. [14] also described nonrespiratory occupational health complaints among tobacco-processing workers such as vomiting, giddiness and headache that were associated with high urinary nicotine and cotinine levels. Gleich Welsh, Yunginer, et al. [15] reported a case of allergy and asthma developed after work in a tobacco processing factory.

TABLE 4. Problems Experienced at Work by the Subjects

Subjects	Odor	Dust	Headache	Nausea and Vomiting
Manufacturing workers (*n* = 50)	28 (56%)	32 (64%)	10 (20%)	5 (10%)
Office workers (*n* = 20)	4 (20%)	1 (5%)	—	—

The spirometry findings as well as the level of statistical differences between manufacturing workers and office ones are listed in Table 5. Office workers were not directly exposed to the processing environment. However, they were occasionally exposed to it when maintenance and inspection work was going on. Those office workers had higher lung volumes compared to the continuously exposed group (i.e., manufacturing workers). This indicates that continuous exposure in the tobacco processing environment can change lung volumes. Similarly, Kjaergaard, Pedersen, Fryndenberg, et al. [16] reported a significant decrease in FEV_1 (Forced Expiratory Volume in 1 s) and FVC values in tobacco workers compared to controls.

TABLE 5. Subjects' Pulmonary Functions, *M* (*SD*)

Pulmonary Functions	Manufacturing Workers (*n* = 50)	Office Workers (*n* = 20)	*t* Value	*p* Value
VC	2.75 (0.81)	3.78 (0.70)	4.412	<.05
FVC	2.13 (0.64)	3.18 (0.63)	4.971	<.05

Notes. VC—vital capacity, FVC—forced vital capacity.

By measuring PEFR of the manufacturing and office workers it was found that the manufacturing workers, at 418 L/min (*SD* 83.98), had significantly lower PEFR than the office workers, 447 L/min (*SD* 89.86); $t = 11.843$, $p = .05$.

Different pulmonary functions and PEFR of the manufacturing and office workers according to their working experience are presented in Table 6. The workers were grouped according to the length of their experience: under 5, 6–10, 11–15 and over 15 years. A significant gradual reduction of lung volumes and peak expiratory flow rates was found as duration of exposure increased in manufacturing workers. Among office workers working experience did not significantly alter pulmonary functions and peak expiratory flow rate. Viegi, Paggiaro, Begliomini, et al. [17] also reported that tobacco workers experienced a decrease in expiratory flow which was associated with work duration.

TABLE 6. Subjects' Pulmonary Functions According to their Working Experience, *M* (*SD*)

Subjects	Experience (years)	VC	FVC	PEFR
Manufacturing workers (*n* = 50)	under 5*	3.02 (0.34)	2.80 (0.44)	441 (93.98)
	6–10	2.95 (0.18)	2.67 (0.22)	430 (83.18)
	11–15	2.70 (1.02)	2.09 (0.95)	428 (103.02)
	over 15*	2.50 (0.38)	2.40 (0.51)	425 (73.95)
Office workers (*n* = 20)	under 5	3.88 (0.46)	3.78 (0.70)	452 (63.00)
	6–10	3.59 (0.98)	3.77 (101.03)	439 (93.23)
	11–15	3.75 (0.38)	3.33 (0.25)	445 (53.02)
	over 15	3.82 (0.41)	3.80 (0.47)	450 (65.11)

Notes. *—significant at $p < .05$; VC—vital capacity, FVC—forced vital capacity, PEFR—peak expiratory flow rate.

4. CONCLUSION

It was concluded that manufacturing workers may develop respiratory changes. A large number of zarda manufacturing workers complained of respiratory symptoms. They were also exposed to high ambient air temperatures as well as to high relative humidity. In this setting, respiratory impairment is not unexpected. Workers in zarda manufacturing also have non-respiratory occupational health problems like headaches and tendencies to vomit. Similarly Mustajbegovic et al. observed that 35% of women and 27% of men complained of nausea and vomiting apparently related to the specific smell of tobacco [13]. Consequently continuous exposure to a tobacco processing environment affects the lung volumes of the workers, which may lead to pulmonary abnormalities. The prevalence of lung function abnormalities/impairment and respiratory disorders in workers occupationally exposed to tobacco dust in a tobacco-processing plant was significantly higher than that in control workers ($p < .05$) [3, 13]. Popovic, Arandelovic, Jovanovic, et al. [18, 19] and Yanev [20] reported lower results of lung function tests, mostly of the obstructive type, in tobacco workers compared to control subjects. As duration of exposure increased, there was a reduction in lung volumes and peak expiratory flow rates among manufacturing workers, so it can be concluded that zarda manufacturing workers may have respiratory and pulmonary disorders related to exposure to tobacco dust in their working environment.

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.

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