Journal of Medical Sciences

ISSN 1682-4474

science alert

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Research Paper

J. Med. Sci., 6 (3): 458-462
May-June, 2006

Cotton Dust Exposure, Respiratory Symptoms and PEFR in Textile Workers

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The purposes of this study was to measurement cotton dust levels in air workplace, Prevalence of respiratory symptoms and determine of changes in Peak Expiratory Flow Rate (PEFR) before and after during workday among textile workers. This study was done among 31 workers carding and blowing rooms. Using a short questionnaire for demographic characteristics, medical record were collected in a modified questionnaire of Occupational Safety and Health Administration (OSHA) and 12 air samples were collected of work area. The PEFR was measured with a peak flow meter. The mean cotton dust levels in carding and blowing rooms were 0.39±0.03 and 0.20±0.01 mg m^{-3}, respectively. The mean age and year's employment were 45±7.97 and 12.5±6.28, respectively. Thirty three percent of the workers were smoking. The prevalence of respiratory symptoms increased with age and employment years and there were found significantly between age and employment years with cough, phlegm, dyspnea ($p<0.05$, 0.05, 0.05, respectively). The mean PEFR before and after during workday were 362.9±147.8 and 305.8±147.5, respectively and subjects had found significantly ($p<0.0001$). The decline in PEFR was significantly associated with years employment ($p<0.05$), whereas with age and cotton dust levels were found to be non significant. One explanation for the lack of age and cotton dust levels effects in workers may be due to the low number of subjects and samples, respectively. Technological improvement has resulted in reduction of cotton dust exposure levels and respiratory symptoms.

Key words: Textile, cotton dust, respiratory symptoms and PEFR

JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original article in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued six times per year on paper and in electronic format.

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INTRODUCTION

The textile production industry is one of the oldest and most technologically complex of all industries. Textile workers can be exposed to dust (both natural and synthetic) generated from the textile products in various stages during the textile manufacturing process. Raw cotton bales are received and opened and then the cotton may be blended with other fibers. The cotton then goes to the picking machines, which moves the fibers to the cards. During these first stages, fibers may be transported by the use of air currents in a process known as blowing. More than 800000 workers in the textile industries are exposed in the workplace to airborne particles that can cause lung diseases (Greenberg, 1997). In the Pakistan more than 800,000 workers in the cotton, flax and rope making industries are exposed in the workplace to air borne particles (Shafqatullah, 1999). In the United States more than 300000 workers are directly exposed to cotton dust, primarily in the textile industry, but also in cotton ginning, cotton warehousing and compressing, cotton classing offices, cottonseed oil and delimiting mills, bedding and batting manufacturing and utilization of waste cotton for a wide variety of products (Merchant, 2001). Respiratory symptoms in textile workers may be due to inhalation of contaminants processing plants. The last reports emphasized that excess respiratory symptoms occurred chiefly among card room and blowing room operators (Zhang *et al*., 2002).

The PEFR is an accepted marker of pulmonary function and is widely used in respiratory medicine (Chong and Enson, 2000). Peak expiratory flow rate (PEFR) monitoring is relatively simple and inexpensive for the screening and follow-up of subjects (Gautrin *et al*., 1994).

The purposes of this study was to measure cotton dust levels in air workplace, Prevalence of respiratory symptoms and determine of changes in PEFR before and after during workday among textile workers.

MATERIALS AND METHODS

Study population and respiratory symptoms: This was a cross-sectional study in which 31 workers carding and blowing rooms in a textile industry of Iran, were studied by multistage random sampling in 2004. The data were collected by a modified questionnaire of Occupational Safety and Health Administration (OSHA) (1988). Descriptive statistics (mean±Standard Deviation [SD]) were used for age and duration of employment data. Questionnaires were administered face-to-face and consisted of three parts, including: (i) personal and work characteristics, (ii) respiratory health symptoms, which included items, such as symptoms of dyspnea, cough, phlegm, tightness and (iii) smoking habits.
Definitions of respiratory symptoms:

- Chest tightness: tightness or constriction of the chest occurring any time during the work shift and on any workday, without being worse.
- Chronic phlegm: sputum production occurring on most (5) days of the week for a minimum of three months a year for at least two consecutive years.
- Chronic cough: cough without sputum occurring on most (5) days of the week for a minimum of three months a year for at least two consecutive years.
- Dyspnea (2+): having to walk slower than a person of the same age at an ordinary pace on level ground because of breathlessness. Minimum of three months a year for at least two consecutive years, Wang *et al.* (2003).

PEFR: The PEFR was measured with a peak flow meter (Vitalograph Ltd, Buckingham UK), a technician supervised these tests. All values were corrected to conditions of body temperature and pressure saturated with water vapor (BTPS). The PEFR results were expressed both as a percentage of the predicted value for a normal person of corresponding age and height.

Measurement of cotton dust concentrations: Air sampling of workplace is being done to determine compliance with National Institute for Occupational Safety and Health (NIOSH, 1977; OSHA, 1988) standard, suction provided by a pump with flow rate 7.4 L min^{-1} for 60 min. Cotton dust collected on standard filters PVC with 37 mm in diameter and are placed in open-face cassettes, area samples in each distinct work area of the plant should be collected at locations that provide representative samples of air to which the worker is exposed. Twelve air samples were collected of work area (Stephen, 1999).

Statistical methods: Data were statistically analyzed with the SPSS statistical programme. The results of respiratory symptoms were analyzed by chi-square. The PEFR measurements were analyzed by paired t-test and Wilcoxon test when comparing baseline values to predicted values. A level of $p<0.05$ was considered to be statistically significant.

RESULTS

The mean cotton dust levels in blowing rooms (0.39 mg m^{-3}) were more than in carding rooms (0.20 mg m^{-3}) (Table 1).

Table 1: The distribution of cotton dust levels in each work area

Work area	No. of samples	Mean (mg m^{-3})	SD	Min. (mg m^{-3})	Max. (mg m^{-3})
Blowing room	6	0.39	0.03	0.15	0.62
Carding room	6	0.20	0.01	0.06	0.30

Table 2: Distribution of characteristics among survey subjects

Demographics	Workers (N=31) N (%)
Age (years)	$\bar{x}$ = 45 (SD±7.97)
	Min = 27 Max = 60
< 30	2(6)
30-39	6(19)
40-49	14(45)
50 >	9(30)
Duration of Employment (years)	$\bar{x}$ = 12.5 (SD±6.28)
	Min = 1 Max = 22
< 10	140(71.4)
10-19	47(24.4)
20 >	6(3.1)
Cigarette smoking	
Smoker	10(32.3)
Non-smoker	21(67.7)

X- Mean, SD- Standard Deviation

The highest percent of workers were in age and duration of employment ranged from 40 to 49 and 10 to 19 years with 45 and 51.6% years, respectively. Out of 31 workers under study, 10 (32.3%) were smoking (Table 2).

The prevalence of respiratory symptoms increased with age and there was found significantly between age with cough, phlegm, dyspnea ($p<0.05$, 0.05, 0.05, respectively). Also, the prevalence of respiratory symptoms increased with employment years and there was found significantly between employment years with phlegm and dyspnea ($p<0.05$ and 0.05, respectively). The decline in PEFR was significantly associated with years of employment ($p<0.05$), whereas with age and cotton dust levels were found to be non significant. There were significant differences between PEFR and respiratory symptoms such as cough and phlegm ($p<0.03$ and 0.05, respectively) in subjects. But, there were no significant differences between PEFR and respiratory symptoms in blowing and carding rooms workers (Table 3).

The mean±SD PEFR before and after during workday were 362.9±147.8 and 305.8±147.5, respectively (Table 4). The lowest percent of PEFR before and after during workday were among workers with 32.0 and 21.0%, respectively. The mean percent in PEFR after during workday (60.2%) was less than the mean percent in PEFR before during workday (71.8%) ($p<0.0001$).

DISCUSSION

Present results showed that mean cotton dust level in blowing room was more than Threshold Limit Values 2003 (TLV-TWA=0.2 mg m^{-3}) American Conference of Governmental Industrial Hygienists. The results of studies Molyneux and Tomblesson (1970), Cinkotai and Whitacker (1978), Gun *et al.* (1983) and Jiang *et al.* (1995) have been consistent.

In this study, duration of exposure and years of employment were 12.5±6.28 years for exposed to cotton dust. Also, we found a significantly higher prevalence of respiratory symptoms such as cough, phlegm and dyspnea related to age in workers upper than 40 years (61, 74 and 74%, respectively) and duration of employment in workers upper than 10 years (52.6, 71.5 and 71.5%, respectively). Exposure to cotton dust thus provokes respiratory effects, (Kilburn, 1998). The effects of exposures to cotton dust are usually evaluated as changes in respiratory symptoms over shift or terms of decline over the years, (Zhang *et al.*, 2002). Duration of consistent exposure of cotton dust is an important factor in the causation and development of respiratory symptoms. But exposure period to cotton dust varies from person to person and the type of environment prevails in the working place to cause respiratory symptoms and decline in PEFR (Venkatakrishna-Bhatt *et al.*, 2001). In a similar study of respiratory symptoms among workers at a textile industry were reported that more

Table 3: Relationship between age, year employment and PEFR with respiratory symptoms in the workers

		Cough			Phlegm			Tightness			Dyspnea		
Demographics	N	n	%	p-value	n	%	p-value	n	%	p-value	n	%	p-value
Age (years)				<0.05			<0.05			NS			<0.05<
40	8	2	25.0		4	50.0		3	37.5		4	50.0	
40 >	23	14	61.0		17	74.0		9	39.0		17	74.0	
Duration of employment (years)				NS*			<0.05			NS			<0.05<
10	10	5	50.0		6	60.0		6	60.0		6	60.0	
10 >	21	11	52.6		15	71.5		6	29.0		15	71.5	
PEFR (l/min)				<0.03			<0.05			NS			NS
< 75	24	14	58.3		17	70.8		8	33.3		16	66.7	
75 >	7	2	28.6		4	57.0		4	57.0		5	71.4	

*NS= Not Significant

Table 4: Results of PEFR

	$PEFR_{pre}$[a]	$PEFR_1$[b]	$PEFR_2$[c]	$PEFR_1/PEFR_{pre}$%	$PEFR_2/PEFR_{pre}$%
Mean	498.6	362.9	305.8	71.8	60.2
Standard Deviation	32.9	147.8	147.5	28.1	26.7

[a]$PEFR_{pre}$ = Peak Expiratory Flow Rate (predicted), [b]$PEFR_1$ = Peak Expiratory Flow Rate (before), [c]$PEFR_2$ = Peak Expiratory Flow Rate (after)

workers in cotton textile consistently respiratory symptoms (Chrisriani *et al*., 2001). Some studies also reported chronic cough in workers exposed to cotton dust (Altin *et al*., 2002) and prevalence of respiratory symptoms from 2-5.5% in cotton workers (Raza *et al*., 1999). Also, our findings showed no significant difference between smokers and non-smokers in the prevalence respiratory symptoms. One explanation for the lack of a smoking effect in workers may be due to the low number of subjects. Whereas, in epidemiological studies of respiratory disease, smoking has been found to be a powerful risk factor for cough and phlegm and for measures of dyspnea (Merchant, 2001).

The results of this study show the decline in PEFR that may be due to the effects exposure with cotton dust. Exposure to environmental and occupational pollution and socioeconomic status also may influence interindividual variation (ATS, 1991). The accuracy of the PEFR monitoring was regularly checked by measuring the PEFR of control technicians for reproducible values; the spirometer (Vitalograph) was regularly calibrated using ATS standards (1995). The outcomes revealed a negative association between years of employment and PEFR in workers. Tiwari *et al*. (1998) presented that PEFR in handloom weavers was significantly associated with longer duration of exposure. Present results show relation between prevalence of respiratory symptoms such as cough and phlegm and decline in PEFR in workers. Boezen *et al*. (1995) reported that PEFR were decreased with increasing numbers of symptoms. Subjects with three or more symptoms had an increased risk of having a PEFR value of < 70%.

In summary, present results show that mean cotton dust level in blowing room was more than TLV- ACGIH. Age and employment years may be increasing respiratory symptoms. The results also indicate that exposure to cotton dust may be drop in PEFR by baseline. Dust control equipment should be properly maintained and upgraded to avoid inconvenience for the workers. Workers should be provided with dust masks and their use should be enforced in the blowing and carding area.

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