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Respiratory Impairment in Cotton-Ginning Workers Exposed to Cotton Dust

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Dust generated during the handling and processing of cotton causes ill health of ginning workers. The purpose of this study was to determine the prevalence of respiratory symptoms among cotton-ginning workers. This study involved 188 workers of 10 cotton-ginning factories. Forced vital capacity (FVC), peak expiratory flow rate (PEFR), and forced expiratory volume in 1 s (FEV_1) declined significantly with increasing duration of exposure ($p < .001$) *of the cotton-ginning workers. Results of a standard respirator medical evaluation questionnaire indicated that, depending on duration of exposure, 51%–71% of cotton-ginning workers suffered from chest tightness, 55%–62% experienced chest pain, while 33%–42% of the workers reported frequent cough. Blood tests of the workers showed higher values of erythrocyte sedimentation rate, eosinophils, and white blood cells when exposure was longer. Byssinosis symptoms were observed among the workers. We recommend regular periodical medical check-ups, compulsory use of personal protective equipment, and proper ventilation at the workplace.*

dust concentration cotton dust pulmonary function test blood test byssinosis symptoms

1. INTRODUCTION

India is the third largest producer of cotton in the world, accounting for ~14% of the global cotton production. Over the last decade, India has achieved a significant quantitative increase in cotton production. In 2000–2001, cotton fields in India covered 8.58 million ha, with a mean yield of 278 kg/ha and total production of 14.0 million bales/year. By contrast, in 2010–2011, the area under cotton production was already 11.14 million ha, with a mean yield of 496 kg/ha and total production of 32.5 million bales/year. Consequently, India has now sufficient surplus cotton to meet the requirements of importing countries [1].

In India, 20 million workers are involved in textile manufacturing [2], which is one of the oldest Indian industries. Cotton ginning and pressing have been identified as a traditional industry under the unorganized sector, which functions on a seasonal basis [3].

In the state of Maharashtra, India, the textile industry is an important small-scale industry. In 2009–2010, the area under cotton cultivation in the state was 3.5 million ha, with total production of 6.57 million bales/year and a mean yield of 319 kg/ha. Jalgaon is a cotton-growing district in Maharashtra. The existence of favorable factors, like availability of raw cotton, cheap labor, and means of transport in Jalgaon, gave impetus to the development of cotton ginning, pressing, spinning, and weaving [4]. Generally, workers of the local ginning factories are very poor and illiterate. As a result, they are not fully aware of the negative impact of indoor air pollution and cotton dust prevailing in the working environment on their health. Consequently, these

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workers do not use any protective measures against cotton dust at the workplace.

Indoor air pollution is a major problem in developing countries [5]. Its impact has increased due to lack of public awareness, and exposure of workers to inferior air quality at the workplace leads to ill health. In ginning factories, dust levels are high. Jannet and Jeyanthi reported a decrease in pulmonary capacity of workers exposed to the cotton-ginning environment [6]. Christani, Wang, Pan, et al. found that the prevalence of respiratory symptoms was higher among cotton-processing workers than among silk-mill workers [7].

Byssinosis is a breathing disorder that occurs in some individuals exposed to cotton dust [8] or similar dust. India has numerous cotton-ginning and textile mills, employing 48% of all factory workers, and ~55% of mill workers suffer from byssinosis [9]. Its prevalence has decreased in industrialized countries but remains high in developing countries [10]. Memon, Panhwar, Rora, et al. reported cases of byssinosis among cotton, flax, jute, and hemp mill workers [11]. Duration of consistent exposure to cotton dust is an important factor in the causation and development of respiratory symptoms [12]. When breathed in, the air containing cotton dust irritates the lungs and the exposed workers experience chest tightness, difficulty in breathing, frequent cough, and wheezing [5]. Several authors have analyzed the relation between duration of employment and appearance of respiratory symptoms. Wang, Zhang, Sun, et al. reported longitudinal changes in pulmonary function test as annual decline in lung capacity [13]. They showed that cotton-gin workers had more frequent symptoms of chest tightness, chronic bronchitis, and chronic cough. They also reported that long-term exposure to cotton dust resulted in excessive chronic annual loss of forced expiratory volume in 1 s and in higher proportions of persistent respiratory symptoms of diseases.

Eosinophils are a characteristic feature of asthma and respiratory allergic diseases [14]. Acute exposure to cotton dust also results in an increase in leukocyte count [15]. In the present study, an attempt has been made to relate the prevalence of spirometric respiratory impairment and byssinosis symptoms with levels of cotton dust and duration of exposure among ginning workers.

2. MATERIALS AND METHODS

2.1. Study Area

Jalgaon is a major cotton-growing district of the state. About 15 000 workers are involved in cotton processing in the district. During cotton ginning and pressing, ginning workers are exposed to high levels of dust. Most ginning has only a day shift that runs for ~12 h, and workers spend 8–12 h/day in the dusty workplace. The present study was conducted in 10 ginning factories located in the Chopda and Dharangaon tehsils of Jalgaon. The ginning and pressing machines are the major sources of dust in the ginning factories.

2.2. Questionnaire

A health survey was conducted in the ginning factories. Questionnaires are most frequently used to assess health perceptions in epidemiological research [9]. In the present study, a standard respirator medical evaluation questionnaire [16] was modified with respect to the local language and the working conditions. A team of trained interviewers administered the questionnaire to collect information on the workers' type of work, age, time of work, any previous job with high dust levels, and respiratory symptoms: difficulty in breathing, chest pain, chest tightness, and frequent cough. Questions about health history, previous cases of asthma in the family, and his habits, e.g., smoking, were also included in the questionnaire for detailed data collection.

2.3. Selection of Subjects

Initially, 320 workers participated in the survey (participation rate: 90%). However, 102 workers had to be excluded from the study due to a history of asthma, heart or pulmonary operations, because they were chain smokers or drinkers, or because they were over 55 years old, as many studies have reported the effect of aging on pulmonary function. The remaining 188 workers were aged 18–55 years, and had been working for at least 1 year in the cotton-ginning industry. The mean (*SD*) age of the subjects was 35 (10.4) years. Since female workers are rarely involved in this occupation, only male workers were considered as the study subjects. These workers did not use respiratory masks to prevent dust exposure.

A group of 59 villagers aged 21–51 years, employed as bank and school workers and having the same economic status, were the control group. The mean (*SD*) age in the control group was 31 (8.5) years.

All subjects from both groups were tested in the morning, ensuring that they had not been exposed to any high levels of any type of dust for 24 h before the test. The cotton-ginning workers were divided into four groups, depending on the duration of exposure to cotton dust (years of employment were the criterion). Out of the 188 factory workers in the study, 58 had worked in cotton ginning for up to 3 years, 49 for 4–6 years, 42 for 7–9 years, and the remaining 39 workers for over 10 years. They had been exposed to high dust emissions in ginning and pressing rooms. The control group had not been exposed to excessive air pollution and included only nonsmokers with no previous history of respiratory diseases, and no respiratory tract symptoms (e.g., cold or dry cough) during the pulmonary function test.

2.4. Measurements of Exposure to Dust

The exposure of workers to cotton dust was measured with a portable personal dust sampler for 8 h (AS2, Technovation Analytical Instruments, India). The sampling unit contained an air pump powered by an internally sealed lead acid gel battery. Air was drawn at a rate of 1.5–2.5 L/min, with a mean of 1.8 L/min. The sampler was attached to the ginning workers during their work. The dust (PM_{10}, i.e., particles of up to ~10 μm in diameter) was collected by filtration of air through a glass fiber filter (25 mm in diameter). The samples were measured with the gravimetric method; dust exposure was expressed in milligrams per cubic meter.

2.5. Pulmonary Function Test

The cotton-ginning workers and the control group underwent a pulmonary function test. Before the test, their age, height, and weight were entered in the spirometer (Medspiror, Recorder and Medicare Systems, India). The spirometer gives two values: one is the observed value, the other is the expected value. The observed values of forced vital capacity (FVC), forced expiratory volume in 1 s (FEV_1), and peak expiratory flow rate (PEFR) are based on the subjects' maximal inspiration and expiration. The expected values are calculated from prediction equations:

$$FVC\ (\mathrm{L}) = 0.050\,H - 0.014\,A - 4.49,$$
$$FEV_1\ (\mathrm{L}) = 0.040\,H - 0.021\,A - 3.13,$$
$$PEFR\ (\mathrm{L/s}) = 0.071\,H - 0.035\,A - 1.82,$$

where FVC = forced vital capacity, H = height (cm), A = age (years), FEV_1 = forced expiratory volume in 1 s, $PEFR$ = peak expiratory flow rate.

The pulmonary function test was conducted when the subjects were sitting comfortably in a chair. There were three tests, the subjects were assisted to improve their efforts. The best of the three performances of FVC, FEV_1 and PEFR were taken into account for statistical analysis.

Results of the pulmonary function test were assessed according to the criteria given in the Medspiror manual. The tests were performed to compare observed and expected values of the pulmonary function test in exposure and control groups. The respiratory impairment of the subjects was analyzed with the observed lung parameters FVC, FEV_1/FVC, and PEFR expressed as percentage of expected values. The frequency of the normal, mild, moderate, and severe impairment categories among the subjects was calculated. FEV_1 of up to 60% and FEV_1/FVC of up to 75% were considered as symptoms of byssinosis [8].

2.6. Biochemical Analysis of Blood

We organized a health campaign at the ginning factories in co-operation with a pathological expert and a medical expert team. A blood sample from each worker was collected by venipuncture. The blood samples were next analyzed at the pathology laboratory for eosinophils, erythrocyte sedimentation rate (ESR), white blood cell (WBC) count, and other hematological parameters.

2.7. Statistical Analysis and Risk Assessment

The spirometric data on FVC, FEV_1, and PEFR were processed for mean, standard deviation, and one-way analysis of variance (ANOVA) with Microsoft Excel. Data on respiratory impairment symptoms (frequent cough, difficulty in breathing, etc.) and other information on the health of the exposure groups were processed in the same way. The risk for these symptoms was calculated for each exposure group and the control group. Sackett, Straus, Richardson, et al. reported that the attributable risk was a measure of excessive risk accounted for by exposure to a particular factor, whereas relative risk measured the strength of exposure to the risk [17].

Agreement between self-reported respiratory impairment symptoms and spirometric impairment was also investigated. Positive and negative predicted values (PVs) were calculated to determine the accuracy of the respiratory test. A positive PV of a test is the probability that the question will correctly identify a person with respiratory impairment. A negative PV of a test is the probability that the negative results will correctly identify a person whose respiratory system is not impaired.

3. RESULTS

3.1. Working Environment and Subjects

Table 1 shows the working conditions in the ginning factories. The working environment was humid, with high dust concentration. Table 2 reports the general characteristics of the subjects considered for the spirometric pulmonary function test.

3.2. Byssinotic Symptoms

The collected data on self-reported respiratory symptoms (from the standard questionnaire) and spirometric respiratory impairment reveal that the prevalence of symptoms significantly increased with duration of exposure in cotton-ginning workers (Table 3). Depending on the exposure group, chest tightness was reported by 51%–71% of workers of the ginning factories, compared to 55%–62% for chest pain and 33%–42% for frequent cough. In as many as 51% of workers exposed for over 10 years, FEV_1 was under 60%.

TABLE 1. Background Characteristics of the Cotton-Ginning Environment

	Ginning Room		Pressing Room	
Parameter	*M* (*SD*)	Range	*M* (*SD*)	Range
Humidity (%)	57 (12)	34–70	57 (12)	34–70
Temperature (°C)	22 (3)	19–27	22 (3)	19–27
Area (m^2)	151.5 (39.0)	116.1–232.2	133.3 (33.8)	92.9–195.0
Dust concentration (mg/m^3)	4.2 (1.2)	2.0–6.0	3.2 (1.3)	1.2–5.0

TABLE 2. General Characteristics of Cotton-Ginning Workers and the Control Group (*n* = 59)

	Exposure Group									
	A		B		C		D		Control Group	
Parameter	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range
Age (years)	27 (7)	18–42	35 (9)	20–50	35 (8)	23–53	39 (10)	27–55	31 (8)	21–51
Weight (kg)	52 (8)	37–90	50 (12)	25–80	52 (10)	35–74	59 (13)	34–88	65 (8)	45–82
Height (cm)	162 (7)	150–175	156 (10)	125–178	162 (8)	140–175	163 (8)	140–177	163 (8)	143–176

Notes. A = <3 years of exposure, *n* = 58; B = 4–6 years of exposure, *n* = 49; C = 7–9 years of exposure, *n* = 42; D = >10 years of exposure, *n* = 39.

By contrast, in the control group, only up to 13% of subjects had symptoms of respiratory diseases and none of them met the diagnostic criteria of byssinosis in the spirometric pulmonary function test.

3.3. Risk Assessment

Table 4 shows the results of risk assessment from self-reported respiratory impairment data. Odds ratios are given for three symptoms: frequent cough, chest tightness, and difficulty in breathing. An odds ratio over 1.0 indicates that there is a positive association between exposure and risk. In the factory workers, odds ratios increase with an increase in the duration of exposure to cotton dust in the ginning industry. Workers exposed to high dust levels for over 10 years had the highest odds ratios for frequent cough, chest tightness, and difficulty in breathing. Table 4 also summarizes the agreement between self-reported respiratory impairment symptoms (frequent cough, chest tightness, and difficulty in breathing) and spirometric impairment. Sensitivity over .70 and specificity over .60 were observed for all symptoms in all exposure groups, which shows positive agreement between self-reported respiratory impairment symptoms. Positive PVs in the exposure groups ranged from .43 to .47 for frequent cough, from .51 to .71 for chest tightness, and from .55 to .72 for difficulty in breathing. A negative PV of .86 was observed for frequent cough, .91 for chest tightness, and .88 for difficulty in breathing in all exposure groups. A high negative PV shows a high probability of a self-reported negative result correctly identifying a person with no spirometric respiratory impairment.

3.4. Pulmonary Function Test

Results of the pulmonary function test show a decline in FVC, FEV_1, and PEFR of the cotton-ginning workers with increasing duration of exposure, as compared to the control group

TABLE 3. Prevalence (%) of Byssinotic Symptoms Among Cotton-Ginning Workers and in the Control Group (*n* = 59)

	Exposure Group				Control
Byssinotic Symptom	A	B	C	D	Group
chest tightness	51	53	59	71	9
chest pain	55	58	60	62	10
frequent cough	33	34	40	42	13
difficulty in breathing	55	58	60	62	12
FEV_1 < 60%	15	18	20	51	0
FEV_1/FVC ≤ 75%	12	15	17	28	0

Notes. A = <3 years of exposure, *n* = 58; B = 4–6 years of exposure, *n* = 49; C = 7–9 years of exposure, *n* = 42; D = >10 years of exposure, *n* = 39; FEV_1 = forced expiratory volume in 1 s; FVC = forced vital capacity.

TABLE 4. Results of Risk Assessment of Frequent Cough, Chest Tightness, and Difficulty in Breathing (Diff.) Among Cotton-Ginning Workers

	Exposure Group											
	A			B			C			D		
Parameter	Cough	Chest	Diff.	Cough	Chest	Diff.	Cough	Chest	Diff.	Cough	Chest	Diff.
Odds ratio	4.8	11.57	9.10	5.0	13.7	11.14	5.30	17.50	13.40	7.43	27.49	18.90
Sensitivity	.76	.86	.82	.73	.85	.81	.70	.84	.79	.69	.84	.80
Specificity	.61	.66	.66	.65	.71	.72	.69	.77	.78	.71	.83	.82
Positive PV	.43	.51	.55	.44	.56	.60	.45	.62	.64	.47	.71	.72
Negative PV	.86	.91	.88	.86	.91	.88	.86	.91	.88	.86	.91	.88

Notes. A = <3 years of exposure, *n* = 58; B = 4–6 years of exposure, *n* = 49; C = 7–9 years of exposure, *n* = 42; D = >10 years of exposure, *n* = 39; PV = predicted value. Odds ratio (relative risk) over 1.0 indicates an association between exposure and risk.

(Table 5). The mean observed FVC expressed as percentage of the expected value for the control group was 91%, whereas it was 65% for the exposure group of over 10 years. A significant decline in this exposure group was observed also in the mean observed value of FEV_1 (100% versus 60%, respectively) and PEFR (84% versus 65%, respectively). The most important spirometric parameters, FVC and FEV_1, were markedly lower in all groups of cotton-ginning workers than in the control group.

3.5. Respiratory Impairment

The data on respiratory impairment show a significant relationship with the duration of exposure (Table 6). Moderate airflow obstruction and restrictive defect in cotton-ginning workers increased with extended duration of exposure. Among the workers exposed to cotton dust for over 10 years, we frequently detected severe airflow obstruction (13% of the group) and severe restrictive defect (28% of the group). We observed that a large number of cotton-ginning workers suffered from restrictive defect and airflow obstruction. The decrease in PEFR was also moderate-to-severe.

3.6. Blood Test

Results of blood tests show increased values of eosinophils, ESR, and WBCs in the cotton-ginning workers with increasing duration of exposure, as compared to the control group (Table 7). A significant relationship is recorded between duration of exposure and elevated blood test results: eosinophils, ESR, and WBCs ($p < .001$). The highest results were observed in workers exposed to cotton dust for over 10 years.

4. DISCUSSION

The workers who participated in this study were mostly illiterate and unaware of the unhygienic conditions and occupational health hazards. Industrial workers in developed countries are very careful about occupational health, but this issue is quite neglected in developing countries [5]. Due to poor ventilation, dust concentration was high (1.2–6.0 mg/m^3) in the ginning factories, whereas the permissible exposure limit for cotton dust in India is 0.2 mg/m^3 according to the Factories Act, 1948[1] [18]. The workers in the present study spent 8–12 h/day in the ginning

TABLE 5. Results of Pulmonary Function Tests Among Cotton-Ginning Workers and the Control Group (*n* = 59)

	Exposure Group								
	A			B			C		
Parameter	Exp.	Obs.	%	Exp.	Obs.	%	Exp.	Obs.	%
FVC	3.22 (0.42)	2.45 (0.50)	76	2.71 (0.66)	2.02 (0.61)	74	3.08 (0.53)	2.12 (0.63)	68
FEV_1	2.77 (0.36)	2.19 (0.73)	79	2.25 (0.61)	1.67 (2.55)	74	2.54 (0.60)	1.78 (0.47)	70
PEFR	8.45 (0.95)	6.11 (1.56)	73	7.35 (1.66)	5.05 (1.86)	70	8.53 (2.24)	5.90 (2.24)	69

	Exposure Group						
	D			Control Group			
Parameter	Exp.	Obs.	%	Exp.	Obs.	%	p^a
FVC	3.12 (0.47)	2.04 (0.72)	65	3.10 (0.47)	2.83 (0.53)	91	<.001
FEV_1	2.43 (0.70)	1.47 (0.81)	60	2.50 (0.40)	2.53 (0.63)	100	<.001
PEFR	7.85 (1.69)	5.13 (1.71)	65	8.07 (1.01)	6.78 (1.48)	84	<.001

Notes. A = <3 years of exposure, *n* = 58; B = 4–6 years of exposure, *n* = 49; C = 7–9 years of exposure, *n* = 42; D = >10 years of exposure, *n* = 39; FVC = forced vital capacity; FEV_1 = forced expiratory volume in 1 s; PEFR = peak expiratory flow rate; Exp. = expected value, *M* (*SD*); Obs. = observed value, *M* (*SD*); % = observed value expressed as percentage of expected value. The values are *M* (*SD*) of all samples in a specific exposure period; a = *F* test was performed for multiple comparison of selected variables for significance of differences between exposure groups and the control group, where *F* values in one-way analysis of variance (ANOVA) were significant ($p < .05$).

[1] http://www.ilo.org/dyn/travail/docs/663/

TABLE 6. Prevalence (%) of Various Types of Respiratory Impairment Among Cotton-Ginning Workers and in the Control Group (n = 59)

Respiratory Status	Exposure Group A	Exposure Group B	Exposure Group C	Exposure Group D	Control Group
Airflow obstruction					
normal, FVC > 80%	38	31	26	23	88
mild, 60% < FVC ≤ 80%	45	47	48	31	12
moderate, 40% ≤ FVC < 60%	12	16	19	33	0
severe, FVC < 40%	5	6	7	13	0
Restrictive defect					
normal, FEV_1 > 80%	57	43	29	28	95
mild, 60% < FEV_1 ≤ 80%	26	37	50	23	5
moderate, 40% ≤ FEV_1 < 60%	9	10	12	21	0
severe, FEV_1 < 40%	7	10	10	28	0
Expiratory flow rate					
stable asthma, PEFR > 80%	43	41	38	36	78
warning asthma, PEFR 50%–80%	50	47	48	43	20
fatal asthma, PEFR <50%	7	12	14	21	2

Notes. A = <3 years of exposure, n = 58; B = 4–6 years of exposure, n = 49; C = 7–9 years of exposure, n = 42; D = >10 years of exposure, n = 39; FVC = forced vital capacity; FEV_1 = forced expiratory volume in 1 s; PEFR = peak expiratory flow rate.

TABLE 7. Results of Blood Tests Among Cotton-Ginning Workers and the Control Group (n = 59)

Parameter	Exposure Group A *M* (*SD*)	A Range	Exposure Group B *M* (*SD*)	B Range	Exposure Group C *M* (*SD*)	C Range
Haemoglobin (g/dL)	14.60 (1.59)	11.4–16.5	13.88 (2.02)	7.9–16.1	13.29 (2.78)	6.5–15.0
WBCs (%)	7.83 (1.54)	6.5–15.0	8.90 (1.62)	5.3–11.6	8.99 (1.52)	6.4–12.8
Eosinophils (%)	4.82 (2.84)	1–11	15.86 (4.30)	10–22	16.17 (4.03)	9–22
ESR (%)	19.04 (4.14)	12–26	19.95 (7.81)	8–31	21.31 (12.24)	9–34

Parameter	Exposure Group D *M* (*SD*)	D Range	Control Group *M* (*SD*)	Control Group Range	*p*
Haemoglobin (g/dL)	14.70 (1.53)	12.1–15.9	14.80 (3.09)	12.6–16.1	<.021
WBCs (%)	9.80 (2.22)	6.0–13.1	4.92 (1.14)	3.9–6.8	<.001
Eosinophils (%)	24.33 (6.92)	10–35	2.36 (2.90)	1–8	<.001
ESR (%)	23.91 (3.64)	17–35	07.04 (4.14)	4–16	<.001

Notes. A = <3 years of exposure, n = 58; B = 4–6 years of exposure, n = 49; C = 7–9 years of exposure, n = 42; D = >10 years of exposure, n = 39; WBC = white blood cells; ESR = erythrocyte sedimentation ratio.

industry without any personal protective equipment. As a result, their health was at risk. The present study shows that 51%–71% of workers reported chest tightness and 55%–62% of workers reported difficulty in breathing (Table 3). Similarly, Christiani et al. reported cases of byssinosis, complaints of chest tightness, and chronic bronchitis in cotton-processing workers [7].

During our survey, over 55% of workers reported difficulty in breathing, whereas only 12% of workers in the control group reported the same problem. Woldeyohannes, Bergevin, Mgeni, et al. showed that 50.6% of the study population of cotton mill workers had one or more respiratory track problems [19]. Mishra, Rotti, Sahai, et al. reported chronic cough and prevalence of respiratory symptoms in male cotton mill workers at Pondicherry [2]. In the present study, in the exposure groups, observed FVC expressed as percentage of expected value, ranged between 76% and 65%, while FEV_1 between 79% and 60%, and PEFR between 73% and 65%. These values were markedly lower than in the control group (91%, 100%, and 84%, respectively), showing a negative impact of exposure to cotton dust. The decline in FVC and FEV_1 is probably due to the accumulation of cotton dust particles in the airways, which reduces the force applied by the subject during inhalation and exhalation. Bobhate, Darne, Bodhankar, et al. also reported a decrease in FVC, FEV_1, and PEFR with increasing exposure among cotton mill workers, during their study at Nagpur [20]. Žuškin and Valić, too, found that exposure to cotton dust over the shift caused a significant reduction in mean FEV_1, FVC, and PEFR in cotton workers [21]. A significant decrease in FVC, FEV_1, and PEFR among all the workers was observed with increasing duration of exposure. Khan and Saadia made similar observations among cotton ginners in Pakistan [22]. Results of the present study indicate reduced pulmonary function efficiency among cotton-ginning workers.

We found the highest prevalence of byssinotic symptoms, e.g., chest tightness, chest pain, and frequent cough, in workers exposed for over 10 years to cotton dust (71%, 62%, and 42%, respectively). This confirms earlier reports that working in an atmosphere containing cotton dust causes byssinosis [8]. Altin, Ozkurt, Fisekçi, et al. recorded byssinosis in 14.2% of cotton-processing workers, while chest tightness in 20.3% [10]. Higher prevalence of byssinosis, ranging from 30% to 50% of cotton mill workers, was reported in Indonesia, Sudan, Ethiopia, Turkey, and India [5]. There is a statistically significant association between excessive decrease in FEV_1, byssinosis, chest tightness, and chronic bronchitis in cotton-processing workers [6]. Woldeyohannes et al. reported similar results in Ethiopia [19]. Bobhate et al. found that 102 out of 173 examined cotton mill workers at Nagpur suffered from byssinosis [20].

Results of blood tests showed that consistent exposure to cotton dust for long periods resulted in an increase in WBCs (7.83–9.80), eosinophils (4.82–24.33), and ESR (19.01–23.91). Holness, Taraschuk, and Goldstein also reported significantly higher WBC count and temperature among cotton mill workers [15]. Interestingly, Hospers, Schouten, Weiss, et al. observed subjects with eosinophilia who had a lower level of lung function in a general population sample in Vlaardingen, The Netherlands [23].

5. CONCLUSIONS

Cotton-ginning workers, mostly those working in ginning and pressing rooms, are exposed to high concentrations of cotton dust. The pulmonary function test shows a significant reduction in lung capacity, with increasing duration of exposure among cotton-ginning workers. Levels of eosinophils, ESR, and WBCs, which show characteristic features of respiratory impairment or allergy, are also high among workers exposed to cotton dust. In this study, we observed a high prevalence of moderate-to-severe chronic obstructive disease in workers exposed for longer periods. The results of this study also show a significant decline in FEV_1, FVC, and PEFR with extended duration of exposure. The study also shows a strong relationship between the duration of exposure and risk of respiratory impairment symptoms among the workers.

This study indicates that cotton-ginning workers are vulnerable to respiratory impairment due to exposure to cotton dust in the working environment. We recommend that cotton-ginning workers use a mask to avoid dust entering the respiratory tract. Pictorial information about the use of masks should be displayed in the workplace to make illiterate workers aware of this need. Regular medical check-ups of workers is also important for early identification of workers experiencing breathing problems that may be related to the working environment.

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