Original article

Byssinosis and other respiratory symptoms among factory workers in *Akaki* textile factory, Ethiopia

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Abstract

Background: Textile cotton workers are at risk for occupational lung disease, including Byssinosis and chronic Bronchitis. Byssinosis is primarily associated with exposure to cotton dust.

Objectives: To determine the prevalence of and factors associated with byssinosis and respiratory symptoms among workers in cotton mills of *Akaki* textile factory.

Methods: A cross-sectional study was conducted among 417 randomly selected factory workers. Information was collected through interview using the modified American Thoracic Society standard respiratory symptoms questionnaires. Forced expiratory volume in 1 sec (FEV1), forced vital capacity (FVC) and FEV1/FVC ratio were measured using portable medical spirometers. Area sampling for cotton dust concentration in the work environment was measured using Data RAM 4 real time measurement for 8 hours during a day shift.

Results: The highest prevalence of respiratory symptoms was found in the carding section - cough 77%, phlegm 62%, chest tightness 46% and dyspnea 62%. The Overall prevalence of chronic bronchitis was 32%. Those working in the carding section appeared 13 times more likely to have chronic bronchitis compared to other sections (Adjusted OR=13.4, 95% CI 3.43-52.6). The prevalence of byssinosis was 38%; the highest being recorded in the carding section at 84.6%. High exposure to cotton dust was noted among those in the blowing and carding section at mean dust levels of 32.2 mg/m^3 and 8 mg/m^3, respectively. About 11% of byssinotics developed severe chronic FEV1 changes.

Conclusion: This study provides evidence of a strong relationship between exposure to cotton dust and byssinosis and other respiratory impairments, which is mediated through chronic ventilator impairments. Preventive measures are warranted in order to reduce the high prevalence of byssinosis and other respiratory disorders in textile manufacturing. [*Ethiop. J .Health Dev.* 2010;24(2):133-139]

Introduction

Air pollution is a major occupational problem in various industries. Occupational lung disease is recorded in accounts of ancient history (1-3). Industries associated with the processing of cotton, specifically yarn, thread and fabric mills are most associated with worker exposure to cotton dust (4, 5). The earliest steps of textile processing release a greater deal of dust in the air, and long-term exposure can leave mill workers with respiratory disorders (6).

Invisible small cotton dust particles enter into the alveoli of the lung through inhalation and accumulate in the lymph causing damage to the alveoli and reducing the capacity of retain oxygen. As the cotton dust accumulates, the worker develops a brown lung and suffers from byssinosis (7).

Byssinosis is a respiratory disease primarily associated with exposure to cotton dust, which is characterized by a feeling of chest tightness that is worst on the first day of the working week and improves as the week progress. Symptoms are usually more pronounced when returning to work after a weekend, holiday or vacation and subside as the worker becomes re-accustomed to the environment (8). Documented prevalences of byssinosis were 8% in China, 30% in Indonesia, 37% in Sudan, and up to 50% in India (4).

In Bahir Dar, Ethiopia, the prevalence of byssinosis was higher among blowers at 43% and carders at 37.5% compared to 4-24% among workers in other sections (9). Another study in the same place (Y. Abebe, T. Seboxa) revealed even much higher overall prevalence of byssinosis at 45.5%, the highest of which was found in carding (57.9%) and in ring frames (57.1%) operatives, while the lowest in the weaving preparatory section (32.1%) (10).

In general, information is lacking concerning the health effect of cotton dust exposure and its control strategies among textile workers in Ethiopia. This study is intended to explore the dimensions of the byssinosis problem in a textile factory in order to provide useful information for any possible cotton dust control strategies in the country.

Methods

Study design: A cross-sectional study was undertaken to measure prevalence of byssinosis and other respiratory symptoms among workers in the *Akaki* textile factory, Addis Ababa. At the time of the study i.e. from March 10/07 to April 30/07, there were 765 production workers in different sections of the factory. Their work involves eight main activities/processes - blowing, carding,

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drawing, roving, twisting, ring frame, preparatory and weaving.

***Sample size and Sampling method**:* Four hundred eighteen (55%) of the production workers (those involved in the direct processing of textile materials, who have been working in the same textile factory for at least one year) were included in the study. The sample size was calculated using the single proportion formula (11), assuming a 95% confidence level and an anticipated byssinosis prevalence of 45% (10).

Since the working sections had heterogeneous dust concentrations, the study population was divided into homogenous, mutually exclusive groups/strata. Then, independent samples were selected from each working section according to their sizes as ascertained from rosters.

Data collection procedures

Questionnaires: The questionnaire was modified from the American Thoracic Society (ATS) questionnaire (12), translated from English to Amharic, and then translated back to English by a different translator to verify accuracy. It was pre-tested and found to be applicable for the study population. It was administered via a one-on-one interview by trained university graduates. The questions included personal and work characteristics, use of personal protective devices, respiratory health symptoms (such as symptoms of dyspnea, cough, phlegm chest tightness, and chronic bronchitis), smoking habits and detailed occupational history, previous history of asthma, among others.

Ventilatory lung function test: Pulmonary function test were conducted by trained nurses. Forced expiratory spirograms were performed before work shifts on the first day back to work after two days' rest using a handheld protable spirometer (*MicroMedical, UK*). The instrument was calibrated as per the instruction manual. Workers were asked to refrain from smoking for at least 1 hour before performing the test and directed to a test room isolated from the work area. Each worker was told to breathe into a mouthpiece connected to an instrument and instructed to breathe in fully form a normal breathing pattern and then blow into the apparatus, without interruption, as hard, fast, and completely as possible. For each participant, forced vital capacity (FVC), forced expiratory volume in 1 sec (FEV1), and forced expiratory volume in 1 sec to forced vital capacity ratio (FEV1/FVC) were measured. The average of the three best results was taken. The predicted values were used to determine whether the study participants measured values were normal(test results was compared with tables of normal values that use variables such as age, gender, body size and race as a method of standardization) or not. The values measured were adjusted for each individual's height, age, and gender(13).

Environmental Measurements: An area sampler was used to measure dust concentrations in the work environment using the *MIE Data RAM* 4 (*Data-logging Real Time Aerosol Monitor 4, USA*), which is designed to measure the concentration of airborne particulate matter. The configuration has been optimized for the measurement of the fine particle fraction of airborne dust. It was placed and operated centrally about 1.5 meters above the floor of the breathing zone within the area to be monitored, away from localized air currents due to fans, blowers, ventilation intakes, or exhausts (14). A total of six dust samples were collected in the mill house over the 8-h day work shift. The instrument was calibrated as per the instruction manual.

Data Analysis: EPI-Info version 6.04d was used for data entry, cleaning and validation. Data analysis was performed using SPSS version 13.0. About 10% of the questionnaires were double entered to verify accuracy of data entry, and no discrepancies were noted. Prevalence and adjusted odds ratio (OR) were calculated for each respiratory symptom and for byssinosis. Univariate analysis was used to test the significance of relationships between variables, and multivariate logistic regression analysis, to examine independent predicative factors for individual symptoms and byssinosis. One way ANOVA was used to compare the means of pulmonary lung function tests of the observed value of FEV1 and FVC and the predicted FEV1 and FVC.

Grading Byssinosis:

Byssinosis: was defined by Schilling's grading (4).

Grade 0: no symptoms of chest tightness or breathlessness on Monday

Grade ½: occasional chest tightness or breathing difficulty on the first day of the working week

Grade 1: chest tightness and/or breathlessness on Monday only.

Grade 2: chest tightness and/or breathlessness on Monday and other weekdays

Grade 3: grade 2 symptoms accompanied by evidence of permanent impairment in capacity from reduced ventilator defect

Results

Socio-demographic characteristics: Most study participants were males (54.2%). Their mean age was 46.7 years and about 39% were 50 years or older. The majority (80%) were married. Half of them cannot read or write (Table 1).

The mean duration of work in the cotton mill house was about 26 years. Most of the participants (92.6%) did not use protective devices at work. Smoking is not common among the study participants with only 2.6% were currently smoking while 5.7% were ex-smokers.

Table1: **Background characteristics of study participants, Akaki textile factory, Addis Ababa, Ethiopia 2007 (n =417)**

Socio-demographic characteristics	No of participants	Percent
Sex		
Male	226	54.2
Female	191	45.8
Age in years		
<40	110	26.5
40-49	141	33.0
≥50	161	38.8
Marital Status		
Single	15	3.6
Married	335	80
Divorced	35	8.4
Widowed	32	7.7
Educational status		
Cannot read/wrote	74	17.7
Literate	206	49.4
Primary	102	24.5
Junior high school	32	7.7
High school complete	3	0.7
Religion		
Orthodox	379	90.9
Muslim	24	5.8
Protestant	10	2.4
Catholic	1	0.2
Others	3	0.7
Exposure status in years		
<20	124	29.7
20-20	150	35.9
>30	143	34.

Prevalence of respiratory symptoms: The overall prevalence of respiratory symptoms in the study participants were - cough (21%), phlegm (18%), chest tightness (15.0%) and dyspnea (38.1%).The highest proportions of respiratory symptoms (cough 77%, phlegm 62%, chest tightness 46%, and dyspnea 62%) were found in the carding section. After controlling for sex, age, smoking, occupational history and using protective devices, workers in the carding sections were nearly 13 times and 8 times as likely to report phlegm and chest tightness, respectively, compared to those in the weaving section. Workers in the blowing section were 7 times more likely to have dyspnea than those in other sections (Table 2).

Prevalence of Byssinosis: The overall prevalence of byssinosis in the study population was 38.0%. It was higher among workers in the spinning department (61.2%) than those in the weaving (15.7%). This pattern holds for each grade of byssinosis.

Table 2: **Respiratory symptoms and working sections of study participants, Akaki textile factory, Addis Ababa, Ethiopia, 2007(n=417)**

Section	Respiratory Symptoms		Crude OR (95% CI)	Adjusted OR (95% CI)
Cough	**Yes**	**No**		
Blowing	5	16	0.53 (0.15, 1.95)	0.5 (0.04, 4.6)
Roving	21	67	1.90 (0.85, 22.1)	4.8 (0.59, 39.2)
Ring frame	14	26	**3.27 (1.27, 8.5)**	3.1 (0.42, 22.7)
Preparatory	17	97	1.1 (0.46, 2.40)	1.1 (0.14, 9.2)
Weaving	14	85	1.00	1.00
Phlegm	**Yes**	**No**		
Blowing	6	15	3.2 (0.89, 11.35)	3.5 (1.02, 11.9)
Carding	8	5	**12.8 (3.06, 56.46)**	**12.9 (3.32, 50*)**
Drawing	4	14	2.29 (0.53, 9.39)	2.3 (0.58, 8.7)
Roving	18	70	2.06 (0.85, 5.02)	2.7 (1.1, 6.7*)
Reeling	2	20	0.8 (0.11, 4.32)	1.3 (0.23, 7.3)
Ring frame	12	28	**3.43 (1.24, 9.51)**	**4.4 (1.53, 12.8*)**
Preparatory	14	100	1.12 (0.45, 2.81)	1.5 (0.55, 5.3)
Weaving	11	88	1.00	1.00
Chest tightness	**Yes**	**No**		
Blowing	3	18	1.89 (0.36, 9.04)	1.6 (0.35, 7.1)
Carding	6	7	**9.75 (2.22, 44.19)**	**7.8 (1.97, 30.8*)**
Drawing	5	13	**4.38 (1.05, 18.08)**	**3.8 (1.02, 14.4*)**
Roving	22	66	**3.74 (1.49, 9.49)**	**3.3 (1.26, 8.6*)**
Reeling	5	17	3.5 (0.83, 13.26)	2.9 (0.65, 12.5)
Ring frame	6	34	2.01 (0.57, 7.01)	10.9 (0.58, 2.03)
Preparatory	7	107	0.74 (0.23, 2.37)	2.1 (0.21, 2.5)
Weaving	8	91	1.00	1.00
Dyspnea	**Yes**	**No**		
Blowing	4	17	1.13 (0.28, 4.74)	**6.9 (1.91, 25.7*)**
Carding	8	5	2.27 (0.75, 6.77)	2.3 (0.76, 7.1)
Drawing	8	10	**7.72 (1.96, 31.68)**	**2.5 (1.19, 5.3*)**
Roving	38	50	**18.33 (7.11, 48.60)**	1.8 (0.56, 5.9)
Reeling	8	14	0.77 (0.28, 2.07)	0.01 (0.00, 2.2*)
Ring frame	22	18	**5.90 (2.43, 14.48)**	**3.64 (1.45, 9.1)**
Preparatory	54	60	**4.34 (2.19, 8.67)**	2.2 (0.95, 4.9)
Weaving	17	82	1.00	1.00

* Significance at P<0.05

High prevalence of byssinosis was documented in the carding (84.6%), drawing (72.2%) and ring frame (63.0%) sections. The highest prevalence of grade I byssinosis was found in the twisting (50%), carding (46.2%) and drawing (44.4%) sections. Likewise, highprevalence of grade II byssinosis was found in the carding section (15.4%). After controlling for age, sex, smoking status, occupational history and use of protective devices of factory workers, those who had worked in the twisting, ring frame, carding and drawing sections were 21 times, 16 times, 12 times and 12 times, respectively, more likely to have grade I byssinosis than those in weaving section. Those in the carding section were 27 times more likely to have grade ½ byssinosis (Table 3).

Of those who had byssinosis, 36.8% were non-smokers, while eight of eleven smokers had byssinosis. No significant difference was found in the prevalence of byssinosis between smokers and non-smokers. Although the prevalence of byssinosis appeared to increase with age, the difference was not statistically significant (Table 4). There was no significant association between years of exposure and grade of byssinosis.

Table 3: **Prevalence of byssinosis by working section, Akaki textile factory, Addis Ababa, Ethiopia, 2007**

Section	Grade of byssinosis		Crude OR (95% CI)	Adjusted OR (95% CI)
Grade ½	**Yes**	**No**		
Blowing	2	19	5.1 (0.4, 55.2)	12.8** (1.21, 135.8)
Carding	3	10	14.5 (1.7, 145.00)	27.3*** (2.81, 265.7)
Drawing	2	16	6.0 (0.56, 66.51)	0.1 (0.00, 3.9)
Roving	4	36	5.3 (0.80, 44.56)	11.8** (1.68, 83.4)
Twisting	3	19	7.6 (0.95, 71.4)	24.7** (1.87, 327.8)
Ring frame	2	38	2.5 (0.25, 26.55)	0.0 (0.000, 2.7)
Preparatory	2	112	0.8 (0.09, 8.79)	8.3 (0.000,2.7)
Weaving	2	97	1.00	1.00
Grade I	**Yes**	**No**		
Blowing	5	16	1.4 (0.39, 4.84)	4.8*** (1.25, 18.8)
Carding	6	7	3.8 (1.00, 14.95)	12.3*** (3.0, 50.4)
Drawing	8	10	3.6 (1.10, 11.77)	12.4*** (3.3, 45.7)
Roving	32	8	18.0 (6.56, 51.19)	9.6*** (3.48, 26.3)
Twisting	10	12	3.7 (1.26, 11.20)	21.6*** (5.56, 83.6)
Ring frame	18	22	3.6 (1.53, 8.93)	16.2*** (5.20, 50.5)
Preparatory	7	107	0.2 (0.11, 0.79)	3.5** (1.2, 10.8)
Weaving	18	81	1.00	1.00
Grade II	**Yes**	**No**		
Blowing	2	19	2.5 (0.29, 17.73)	1.9 (0.29, 13.1)
Carding	2	11	4.3 (0.48, 33.02)	3.3 (0.01, 21.9)
Drawing	3	15	4.7 (0.75, 29.04)	3.8 (0.71, 21.1)
Roving	10	30	7.9 (2.07, 37.68)	2.0 (0.55, 7.7)
Twisting	1	21	1.1 (0.13, 9.58)	0.7 (0.07, 8.6)
Ring frame	5	35	3.3 (0.73, 16.18)	2.4 (0.53, 11.3)
Preparatory	4	110	0.8 (0.18, 4.24)	0.5 (0.11, 3.1)
Weaving	4	95	1.00	1.00

* Model adjusted for sex, age, smoking status, occupational history and work exposure
** Significant at P<0.05, *** significant at P<0.001

Table 4: **Prevalence of byssinosis by ages, Akaki textile factory, Addis Ababa, Ethiopia 2007 (N=417).**

Section	Grade of byssinosis		Crude OR (95% CI)	Adjusted OR (95% CI)
Grade ½	**Yes**	**No**		
<40	2	108	1.00	
40-49	8	132	3.2 (0.63, 28.81)	(0.03, 1.75)
≥50	10	155	3.4 (0.70, 23.51)	(0.02, 1.53)
Grade I	**Yes**	**No**		
<40	20	90	1.00	
40-49	38	104	1.6 (0.86, 3.17)	(0.64, 3.41)
≥50	48	117	1.8 (0.99, 3.48)	(0.55, 3.63)
Grade II	**Yes**	**No**		
<40	5	105	1.00	
40-49	11	131	1.7 (0.54, 6.03)	(0.48, 8.56)
≥50	15	150	2.1 (0.69, 6.84)	(0.5, 11.1)

* Model adjusted for sex, age, working sections, occupational history and work exposure.

Table 5: **Prevalence of chronic bronchitis according to selected factors, Akaki textile factory, Addis Ababa, Ethiopia 2007 (n=417)**

Factors	Chronic bronchitis		Crude OR (95% CI)	Adjusted OR (95% CI)
	Yes	No		
Sections				
Blowing	3	18	0.8 (0.18, 3.65)	0.9 (0.2, 3.8)
Carding	9	4	11.6 (2.80, 52.37)	**13.4 (3.4, 52.6*)**
Drawing	6	12	2.5 (0.74, 8.97)	2.7 (0.8, 8.8)
Roving	23	65	1.8 (0.85, 3.99)	2.3 (1.0, 5.2)
Reeling	4	18	1.1 (0.29, 4.31)	1.2 (0.8, 9.8)
Ring frame	14	26	2.7 (1.11, 7.04)	1.5 (0.6, 3.8)
Preparatory	21	93	1.1 (0.54, 2.54)	1.00
Weaving sec.	16	83	1.00	
Exposure				
< 20 years	19	97	1.00	1.00
20-29years	45	113	2.0 (1.07, 3.80)	**2.5 (1.1, 5.6*)**
> 30 years	32	111	1.4 (0.75, 2.90)	1.5 (0.6, 3.9)
Age in years				
<40	18	93	1.00	1.00
40-49	39	102	1.9 (1.00, 3.84)	1.2 (0.3, 2.2)
> 50	49	125	1.5 (0.82, 3.11)	0.9 (0.3, 2.2)
Smoke				
Non-smokers	92	312	1.00	1.00
Smokers	4	7	1.9 (0.47, 7.57)	2.1 (0.6, 7.6)

* Significant at p<0.05

Prevalence of chronic bronchitis: The prevalence of chronic bronchitis was highest in the carding section (69.2%) and lowest in the weaving section (16.2%). After adjusting for sex, age, smoking status, occupational history and use of protective devices, workers in the carding sections were 13 times more likely to have chronic bronchitis than those in the waving section. The prevalence of chronic bronchitis was higher in the spinning department than the weaving department (29.4%vs.17.0%)(Table5).

Distribution of cotton dusts in the work area: Workers in all working areas were exposed to the highest level of cotton dust with overall mean dust level of (14,02 mg/m^3).The highest was in blowing section (32.2 mg/m^3) and the lowest was in weaving section(2.0 mg/m^3). Cotton dust particle over all diameter was 4µm aerodynamic with the highest (blowing section; 4.07 µm) and lowest (carding section, 0.9 µm). The concentrations of cotton dust in working sections were not normally distributed (skewed to positive direction). This means that it has a long tail in the positive direction (Table6).

Table 6: **Cotton dust concentrations in working sections of Akaki textile factory, Addis Ababa, Ethiopia, 2007**

Sections	Mass in mg/m^3		Median	Diameter in µm	
	Maximum	Mean		Maximum	Mean
Blowing	61.44	32.20	34.78	4.10	4.07
Carding	21.03	8.00	8.88	4.13	.90
Drawing	7.43	5.62	5.99	4.13	3.96
Ring frame	4.81	3.30	3.24	4.13	3.99
Preparatory	2.42	2.00	1.75	4.13	3.91
Weaving	3.20	2.00	1.50	4.13	3.98
All combined (overall)		14.02			3.96

***Lung function* measurements**: According to the World Health Organization (WHO) classifications of Lung diseases, 11% of the study participants had severe lung impairment. Of the byssinotic workers 32% to 45% showed slight to moderate chronic impairment and 52.0% to 54.8% had no chronic impairment (Table 7).

Discussion

The relationships between type of occupation and pulmonary contaminants and respiratory symptoms have been studied since the late 1970s (15). In this study, the authors studied the prevalence of byssinosis and other respiratory symptoms among textile cotton mill house production workers in *Akaki*, Addis Ababa. In this study, the prevalence of respiratory symptoms were high in the spinning department, and workers in the spinning department were more likely than others to have cough, phlegm, chest tightness and dyspnea. Respiratory-related illness symptoms were highly prevalent among the workers in the blow/card rooms(15) and about twice as many workers in the spinning department had respiratory symptoms as in the weaving department (16).

Table 7: **Chronic changes in FEV 1 by years of exposure in among production workers in Akaki textile factory Addis Ababa, Ethiopia 2006/2007**

Grade of Byssinosis No. of participants		**Chronic FEV 1 changes**		
		Normal (>80% of pred. FEV1	**Moderate (60-80% of pred. FEV 1)**	**Severe (<60% pred. FEV 1)**
Grade ½	11	6 (54.5%)	5 (45.5%)	-
Grade I	62	34 (54.8%)	20 (32.3%)	8 (12.9%)
Grade II	19	10 (52.6%)	7 (36.8%)	2 (10.5%)
Total	212	50 (25.3%)	32 (34.8%)	10 (10.0%)

The highest prevalence of respiratory symptoms (phlegm 62%, chest tightness 46% and dyspnea 62%) were found in the carding section comparing with other sections, and workers in these sections were 13 times and 8 times more likely to contract phlegm and tightness, respectively. Workers in blowing sections were seven times more likely to have dyspnea than the other sections. This study showed higher prevalence of respiratory symptoms than in other textile studies, for example those in China (frequent cough 2.23%, frequent phlegm 3.24%, shortness of breath 4.54% (17), Bangladesh (4.3%) chest tightness or breathlessness (16). The study done by Mehdi in South Tehran, Iran, studied in industries, found a significantly higher prevalence of respiratory symptoms among textile industrial workers (cough 30.8%, phlegm 53.8% and dyspnea 65%) and the risk of respiratory disorders was also raised (1).

Schilling and his colleagues undertook the first epidemiologic studies on byssinosis in the 1950s. It is known that the prevalence of byssinosis is decreasing in industrialized countries while it remains at high levels in developing countries (5, 15).The overall prevalence of byssinosis among cotton mill workers in this study was 38.0%, which was lower than in the studies conducted in Bahir Dar by Woldyohanis et al (43%)(9) and Abebe et al (45%) (10), or in Khartoum, Sudan (46%) (13).

This investigation showed higher prevalence of byssinosis in the carding (84.6%), drawing (72.2%) and ring frame (63.0%) sections compared to the study conducted in Bahir Dar (carding 57.9%,and ring frame 57.1%), or in Khartoum (67% among blowers, 40% in carders and draw-frame workers, (9, 10, 13). The high prevalence of byssinosis in these sections may be because the sections were not segregated from the card room, or because of older style machines. The lowest prevalence of byssinosis in this study was in the preparatory (11.4%) and weaving (24.0%) sections. However, in Lancashire textile weavers, the prevalence of byssinosis was 0.3% which is 38 to 84 times lower than this investigation (15).

Chest tightness and breathing difficulty on Monday (grade I byssinosis) were more common in the reeling (50%), carding (46.2%) and drawing (44.4%) sections. Similarly, chest tightness or breathing difficulty on Monday and other days (grade II byssinosis) were higher in the carding section (15.4%). Production workers worked in reeling, ring frame, carding and drawing sections were 21 times, 16 times, 12 times and 12 times more likely to have grade I byssinosis than the other sections, respectively ($p < 0.001$). Others have suggested that prevalence of byssinosis is common particularly among those exposed to high concentration of dusts for a longer time than other factors (18).

This study revealed that of those who had byssinosis (147/157) 94.9% were non-smokers, while eight smokers of eleven had byssinosis. No significance difference was observed in the prevalence of byssinosis between smokers and non-smokers, but this may be because the numbers of smokers were small in this study. In Taiwan, smoking potentiated the effect of cotton dust exposure on respiratory symptoms and byssinosis. Moreover, and the prevalence of impaired lung function in smokers was significantly higher than in non-smokers (19).

There was a non-significant increase in prevalence of byssinosis with age. Other studies have found that severity of byssinosis increases with duration of exposure which was a population-based cohort of adults aged 45–74 years and different from on the study design and age categories (2, 14).

Workers in all working sections were exposed to the high level of cotton dust less than 4 μm diameter (blowing 32.2 mg/m3, carding 8.0 mg/m3, drawing 5.62 mg/m3, ring frame 3.3 mg/m3, preparatory 2.0 mg/m3 and weaving 2.0 mg/m3). These levels are 4 to 64 times above the permissible threshold limit value (TLV, 0.5 mg/m^3) in the health and safety guidelines used in the United Kingdom (20). The Committee of Hygiene Standards of the British Occupational Hygiene Society enforced the standard and concluded that the prevalence of byssinosis could be reduced to less than 4% if cotton dust exposure was reduced to less than 0.5 mg/m^3, as measured by the work area sampling technique (21). In the United States, cotton dust standard levels are 0.2 mg/m^3 for the areas of packing, carding and spinning, and 0.75 mg/m^3 for the slashing and weaving areas (22).

Particularly the mean of twisting, carding, preparatory, roving and drawing sections were slower than the other sections. The study done in Bahir Dar Textile reported that the mean measured values of ventilatory capacity (FEV1 and FVC) were significantly reduced in the exposed groups compared with controls (P<0.01) (9).

More importantly, 11% had severe impairment. Of the byssinotic workers, 32% to 45% showed slight to moderate chronic impairment and 52.0% to 54.8% had no chronic impairment. The small sample size was the limitation which affected the confidence interval.

Conclusion

The prevalence of byssinosis and other respiratory symptoms were high. The concentrations of cotton dust in all sections were found to be above the permissible limits value (TLV). All in all, preventive measures are of supreme importance in minimizing the prevalence of byssinosis and other respiratory disorders using appropriate protective device, work rotation, and controlling dust.

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