Original Article

The Prevalence of Byssinosis among Cotton Workers in the North of Benin

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Abstract

Background: Cotton is the main agricultural export product in Benin. Cotton dust is thus present in the air during the handling and processing of cotton. This dust contains a mixture of substances including ground up plant matter, fibres, bacteria, fungi, soil, pesticides, non-cotton matter, and other contaminants. While cotton processing is decreasing in industrialized countries, it is increasing in developing countries. Cotton processing, particularly in the early processes of spinning, can cause byssinosis.

Objective: To determine the respiratory effects of cotton dust exposure among cotton mill workers in Benin.

Methods: In a cross-sectional study, 109 workers exposed to cotton dust and 107 unexposed workers were studied. The International Commission on Occupational Health (ICOH) questionnaire was used for data collection on respiratory symptoms. For each worker, cross-shift pulmonary function was performed with a dry spirometer. Based on the severity of respiratory symptoms and spirometry byssinosis was defined and classified according to the criteria of Schilling, *et al*.

Results: The mean±SD age of the exposed and unexposed workers was 46.3±7.8 and 37.0±8.3 years, respectively ($p<0.001$). The mean FEV_1 predicted value for the exposed and unexposed workers was 76.3% and 77.3%, respectively. The prevalence of grade 3 byssinosis was 21.1% (95% CI: 13.4–28.9) in exposed workers and 8.4% (95% CI: 3.1–13.7) in unexposed workers ($p=0.006$). On Mondays, the exposed workers had more respiratory symptoms than unexposed workers; for grade 3 byssinosis, the prevalence was 13.8% in exposed and 4.7% in unexposed workers ($p=0.011$).

Conclusion: The prevalence of respiratory symptoms and byssinosis among cotton mill workers in Benin is high and needs prompt attention of health care workers and policymakers.

Keywords: Byssinosis; Cotton fiber; Respiratory function tests; Respiration disorders; Smoking; Occupational exposure; Benin

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Introduction

Agriculture is the main source of income in Benin. This is the major livelihood for 70% of the population. The country's main export product is cotton. It is produced in the northern and central part of the country.

Cotton dust is present in the air during the handling and processing of cotton. This dust may contain a mixture of many substances including ground up plant matter,

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fibres, bacteria, fungi, soil, pesticides, non-cotton matter, and other contaminants. Occupational exposure to cotton dust can cause acute respiratory symptoms such as chest tightness and bronchoconstriction[1] and respiratory diseases including byssinosis[2] characterized by difficulty in breathing and tightness across the chest, which is particularly noticeable on the first day back to work after the worker has been off for a few days.

While early breathing difficulties may be reversible, at later stages of the disease, the damage is permanent and disabling. Workers who develop severe byssinosis may have to retire early because they are so short of breath that they cannot do their normal jobs or even carry out simple tasks.

Today, while the prevalence of byssinosis has decreased significantly in developed countries, it is still high in developing nations. The reported rates among cotton workers vary from 3% in the UK to 30%–50% in Indonesia, Sudan and India.[3-9] Considering the high prevalence of byssinosis in developing countries, it is important to monitor this occupational health hazard, particularly in areas such as Benin where no survey has so far been conducted. We therefore conducted this study to determine the prevalence of respiratory symptoms and byssinosis in cotton factory workers in Benin.

Materials and Methods

This cross-sectional study was carried out from June to July 2008 in Company of Textile of Benin (COTEB), one of the three cotton factories in Benin situated in northern part of the country.

A total of 161 persons working in a cotton mill and 55 workers working out of the cotton mill, but living in the same area, were initially included in the study. Of 161 workers of the cotton mill, 109 were really exposed to cotton dust in their daily work; the remaining 52 had administrative tasks and thus were considered as "unexposed workers." Therefore, we came to 109 workers exposed to cotton dust and 107 unexposed workers (the comparison group). The exposed workers worked in weaving, carding and spinning departments and had to work for 8–10 hours per day.

Data Collection

The participants gave informed consents to participate in the study. During an interview, the participants were asked to answer questions about respiratory symptoms taken from the International Commission on Occupational Health (ICOH) questionnaire. The questionnaire includes symptoms including cough, phlegm, chest tightness, feverishness, wheeze, breathlessness, and sneezing and itchy eyes, as well as family history of allergy. The questionnaire also includes smoking habits, which allowed for a full smoking history. A complete occupational history was also obtained.

Chronic bronchitis was diagnosed in accordance with the British Medical Research Council Guidelines.[10] Persons fulfilling the same criteria without phlegm were diagnosed as having "chronic dry cough."

Byssinosis was diagnosed and classified based on the criteria developed by Shilling, *et al*:[2] Grade 0: occasionally chest tightness on the first day of the working week; grade 1: chest tightness on every first day on the working week; grade 2: chest tightness on the first and more days of the working week; and grade 3: grade 2 plus chronic lung impairment, *ie*, FEV_1 <80% of the predicted value.

Those who suffered from work-related chest tightness without the usual symptoms occurring on the first weekday of working were diagnosed as having "non-specific chest tightness."[11]

Asthma was diagnosed if the person

For more information on respiratory diseases in agate grinding workers in Iran see www.theijoem.com/ijoem/index.php/ijoem/article/view/350

TAKE-HOME MESSAGE

- Cotton handling and processing, particularly in the early processes of spinning, can cause byssinosis.
- The prevalence of byssinosis varied according to the type of cotton, the work area, the level of cotton dust, and the age of worker.
- Prevalence of byssinosis is high in developed countries and increasing in developing countries.
- The reported prevalence of byssinosis in developing countries varied from 10.5% in Pakistan to 45.5% in Ethiopia.
- Exposure to cotton dust can decrease FEV_1, and increase the prevalence of respiratory symptoms or diseases.

had wheezing and dyspnea in relation to exposure to either a known allergen or to a non-specific agent, *eg*, cold air, exercise, *etc*.[11]

Pulmonary function test was done with a dry spirometer (Vitalograph, Buckingham, UK). Before entering the workshop, forced expiratory volume in one second (FEV_1) and forced expiratory capacity (FVC) of each worker were recorded in accordance with the American Thoracic Society (ATS) guidelines.[12] The procedure was modified, and the better of two well-performed trials was recorded, if the subject performed well on the first two attempts. The lung function test was repeated after work. Predicted values of FEV_1 and FVC were calculated using Danish national standards.[13] The predicted equation for FEV_1 was adjusted for Africans ($preFEV_1 \times 0.88$).[14] The best of the pre- and post-shift values was subsequently used to calculate the percent predicted values.

Table 1: Demographic data of participants. Values are either mean±SD or frequency and percentage.

Parameter	Exposed to cotton dust (n=109)	Unexposed to cotton dust (n=107)	p value
Age (yrs)	46.3 ± 7.8	37.0±8.3	<0.001
Male sex	109 (100%)	97 (90.7%)	<0.001
Height (cm)	168.5±6.6	169.4±7.5	0.395
Weight (kg)	66.5±10.3	68.5±8.8	0.113
Baseline FEV_1			
Value (L)	2.45 ± 0.66	2.59 ± 0.66	0.135
% Predicted value	76.3%	77.3%	0.675
Baseline FVC			
Value (L)	3.15±0.74	3.38±0.77	0.034
% Predicted value	134%	143%	0.048
Smokers	16 (14%)	15 (14%)	0.89

Statistical Analysis

SPSS® for Windows® ver 13.0 (SPSS Inc, IL, USA) was used for data analysis. Categorical variables were presented as frequencies. Continuous variables were presented as mean±SD. χ^2 was used for comparison of categorical variables. *Student's t* test for independent samples was used for comparison of means between two groups. A p value <0.05 was considered statistically significant.

Results

Workers exposed to cotton dust were significantly older than the unexposed workers (Table 1). The baseline FVC in the exposed group was significantly ($p<0.05$) lower than that in unexposed workers; FEV_1 was not (Table 1).

The exposed workers had significantly more respiratory symptoms compared to the unexposed workers (Table 2). Of the symptoms studied, the prevalence of phlegm for more than two years was not significantly different between the two groups.

On Monday, the exposed workers had significantly more respiratory symptoms than the unexposed group (Table 3). Of

Table 2: Prevalence of respiratory symptoms among the studied workers

Symptom	Exposed to cotton dust, n (%)	Unexposed to cotton dust, n (%)	p vaue
Chronic cough (3 months/year)	24 (22.0)	14 (13.0)	<0.001
Cough on a particular day	19 (17.4)	10 (9.3)	<0.001
Cough on Monday	9 (8.3)	2 (1.8)	<0.405
Chronic phlegm (3 months/year)	15 (13.8)	11 (10.8)	<0.001
Phlegm more than 2 years	10 (9.2)	4 (3.7)	0.246
Chest tightness or breathing becomes difficult	30 (27.5)	16 (15.0)	0.024
Chest tightness this particular day	23 (21.1)	10 (9.3)	0.011
Shortness of breath during work	19 (17.4)	8 (7.5)	<0.001
Shortness of breath when hurrying or walking	38 (34.9)	22 (20.6)	0.010

216 workers studied, 32 (14.8%; 95% CI: 10.1–19.6) had grade 3 byssinosis; the prevalence of grade 3 byssinosis was 21.1% (95% CI: 13.4–28.9) in exposed workers and 8.4% (95% CI: 3.1–13.7) in unexposed workers (p=0.006).

Besides, having chest tightness or difficulty in breathing on any particular day of the week, 4.6% (5 of 109) of the exposed workers and 3% of unexposed workers had FEV_1 <60% of the predicted value; 9.2% and 1.9% of the workers had FEV_1 between 60% and 80% of the predicted value, respectively (p=0.015). There was no significant difference in cross-shift change in FEV_1 in the studied workers.

Discussion

To the best of our knowledge, this is the first study on byssinosis in Benin. All the workers exposed to cotton dust in the spinning and weaving mills were included and compared with workers unexposed to cotton dust. We found that the prevalence of symptoms and byssinosis among workers exposed to cotton dust was significantly higher than those in the unexposed cotton workers.

The exposed workers had more symptoms, especially respiratory symptoms, possibly for irritation of the respiratory tract with causing chronic cough, phlegm, chest tightness and dyspnea. The preva-

Table 3: Prevalence of respiratory symptoms on Monday morning among the studied workers

Symptom	Exposed to cotton dust, n(%)	Unexposed to cotton dust, n (%)	p value
Troubled by shortness of breath, when hurrying or walking	31 (28.4)	15 (14.0)	0.005
Get short of breath walking with other people at ordinary pace	15 (13.8)	9 (8.4)	0.169
Have to stop for breath when walking at the own pace	14 (12.8)	7 (6.5)	0.098

lence of symptoms in this study is comparable to the findings of Docker, *et al*,[15] who found 34.5% of exposed subjects had respiratory symptoms—the cotton workers had a higher prevalence of bronchitis (25%) than unexposed workers (12.7%). In a study conducted in Nigeria, Nagoda, *et al*, also found that the prevalence of breathlessness in exposed workers (24.5%) was higher than that in a comparison group.[16] Jing, *et al*, reported that cotton workers are at increased risk of developing chronic bronchitis, chronic cough, and dyspnea compared to silk workers (OR: 1.54; 95% CI: 1.26–1.86).[17]

For more information on pulmonary problems among quarry workers of stone crushing industrial site in Nigeria see www.theijoem.com/ijoem/index.php/ijoem/article/view/152

On the other hand, the prevalence of respiratory symptoms in our study was higher than that reported by Nafees, *et al*, who found that 7.5% of cotton workers had chronic cough, 12.9% chronic phlegm, 22.3% wheeze with shortness of breath, and also 4% had asthma.[18] This difference can be due to worse hygienic workplace conditions in our study. For example, no one in our series used personal protective equipment.

Several studies have reported that the negative impact of exposure to cotton dust on pulmonary function depends on the concentration of the dust in the workplace, the duration of exposure, and also the individual factors such as age and smoking.[19-23]

In our study, the exposed workers had more persistent respiratory symptoms and a lower FEV_1 compared to the comparison group of unexposed workers. Our results are comparable with earlier reports that have established a relationship between exposure to cotton dust and impaired pulmonary function. Wang, *et al*, found that occupational exposure to cotton dust was associated with both acute and chronic airway obstruction. The acute airway response was typically expressed as a cross-shift drop in FEV_1, which may or may not be accompanied by byssinosis.[24] Some researchers found that the mean FEV_1 and FVC in those exposed to cotton dust were significantly lower than those in a comparison group.[16,22,25] Chattopadhyay, *et al*, reported typical symptoms of byssinosis along with acute cross-shift as well as chronic changes in FEV_1 among workers exposed to cotton.[26] Xiaorong, *et al*, in their study indicated that workers exposed to cotton dust had larger and more frequent drops in FEV_1, as well as excessive chronic declines in FEV_1 compared to silk workers. They also showed a relationship between cross-shift decline and chronic declines in FEV_1.[27] Sigsgaard, *et al*, on the other hand, reported a borderline change in the mean cross-shift FEV_1 and FVC.[28] We also found no cross-shift change in FEV_1.

In the above-mentioned studies, the prevalence of byssinosis varied according to the type of cotton, the work area, the level of cotton dust, and the age of worker. The highest prevalence of byssinosis was found in developed countries. For example, Schilling reported a rate of 63% in the United States.[2] In our study, the overall prevalence of grade 3 byssinosis was 14.8%; the rate was 21.1% in exposed workers and 8.4% in unexposed workers. The reported prevalence of byssinosis in developing countries varied from 10.5% in Pakistan to 45.5% in Ethiopia.[18, 20, 29-34]

The wide range of the prevalence reported could be attributed to several reasons—the studied population did not originate from similar workplaces or departments (big preparation, spinning mills, carding, weaving, *etc*); the definition of "byssinosis" was also not identical among the studies. In some studies, "byssinosis" was referred to the acute respiratory manifestations; in other studies it was referred to both acute and chronic respiratory manifestations. The difference in the prevalence could also be explained by the exposure level, and condition and the way the questionnaire was administered.

In conclusion, exposed cotton textile

workers in Benin had significantly more respiratory symptoms than non-exposed workers. Furthermore, this cross-sectional study indicates that exposure to cotton dust may result in decreased FEV_1, and higher proportions of persistent respiratory symptoms or diseases. This results call for preventive dust reducing initiatives in the cotton industry in Benin, including increased use of personal protective equipment.

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