Original Articles

Byssinosis among male textile workers in Pondicherry: A case–control study

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ABSTRACT

Background. In India, 20 million workers are involved in the manufacturing of textiles. However, there are few epidemiological studies from India that have assessed the magnitude or the risk factors associated with byssinosis. In Pondicherry, textile mills have been in existence for over a century. This case–control study aimed to find the factors associated with the development of byssinosis in textile workers.

Methods. The sample consisted of 761 men above the age of 30 years who had worked for at least 10 years in a textile factory. All the respondents were interviewed by a pretested questionnaire to gather information regarding the symptoms of byssinosis, certain personal characteristics and occupational history. Byssinosis was identified using the classification proposed by the World Health Organization. Two age-matched controls were selected for each case.

Results. Univariate analysis of the factors for symptomatic byssinosis showed that dusty worksites, heavy smoking and duration of service ³30 years were significant. Logistic regression analysis showed that working in the spinning (odds ratio 6.1) and weaving sections (odds ratio 1.9), heavy smoking (odds ratio 3.9) and ³30 years of service (odds ratio 2.0) were independent significant risk factors.

Conclusion. Efforts to reduce dust levels in the working environment and to discourage smoking among textile workers need to be strengthened to minimize the risk of developing byssinosis.

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INTRODUCTION

In 1956, an epidemiological study in the cotton industry in the UK documented the occurrence of byssinosis.[1] Worldwide, India is the second largest producer of textile goods, which account for 20% of the national industrial output. Twenty million workers are employed in 1175 cotton mills across the country, representing a major occupational group.[2] The Pondicherry region has around 8000 textile workers.[3]

Byssinosis has been reported from most countries with a textile industry. Its prevalence varied from 2% in the USA in the late 1970s[4] to 63% in England in the late 1950s.[5] While the prevalence is decreasing in developed countries, it continues to be high in developing countries. In Turkey it was 14.2% in the past decade.[6]

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There are few studies on byssinosis among cotton textile workers in India.[7–9] Murlidhar *et al.* examined 273 cotton textile workers in Mumbai and found that 54 of 179 workers (30%) in dusty sections and 16 of 94 workers (17%) in non-dusty sections had byssinosis. They also developed a questionnaire for the assessment of byssinosis.[7] In Pondicherry, the textile industry is more than a century old but no study has assessed the magnitude of or the risk factors for byssinosis. We carried out a case–control study to find out the risk factors associated with the occurrence of byssinosis.

SUBJECTS AND METHODS

The Pondicherry Textile Corporation Limited has three textile mills. The largest and oldest is the Anglo-French Textiles, which has three units (A, B and C) with 6800 workers. We included all men >30 years of age who had been working in the factory for at least 10 years. The details of the sample studied are shown in Fig. 1. The analysis was done for 761 workers—96 from the spinning section, 503 from the weaving section and 162 from the non-dusty sections. We detected 150 cases of byssinosis, of whom 48 had associated chronic bronchitis. For the risk factor analysis, 102 cases with only symptomatic byssinosis were included. To choose controls a population of workers with neither byssinosis nor chronic bronchitis was selected (n=529). From this population, two age-matched (+2 years) controls were selected for each case of symptomatic byssinosis. Where more than two controls were available for a case, two controls were chosen by simple random sampling using the random number table. Chronic bronchitis was defined as 'any person having cough with expectoration for >3 months in a year for >2 consecutive years'.

All the sampled individuals were interviewed between October 1998 and March 2000 with the help of an interview schedule prepared by adopting the ATS-DLD-78 Questionnaire[10] and the Byssinosis Questionnaire used by Murlidhar *et al.*[7] Before the interview, an informed consent was obtained from each worker by explaining the nature of the study and the confidentiality of the information required. Information was collected on age, smoking behaviour, occupation, overcrowding and fuel used for cooking at home. Weight was accurately recorded using a standard weighing machine. Height was measured by a stadiometer. For the purpose of the study the WHO definition of byssinosis was used.[9] For the type of fuel used, the predominant fuel used over the past year was considered. Those smoking >10 cigarettes or *bidis* per day for the last 20 years or more were considered heavy smokers (smoking index of 20 pack-years). Overcrowding was classified according to the number of persons per room. Pulmonary function tests done for all the workers included forced vital capacity (FVC), forced expiratory volume in the first second (FEV_1) and FEV_1/FVC. Three readings were taken after explaining and demonstrating the test procedure. The best of three readings was considered for

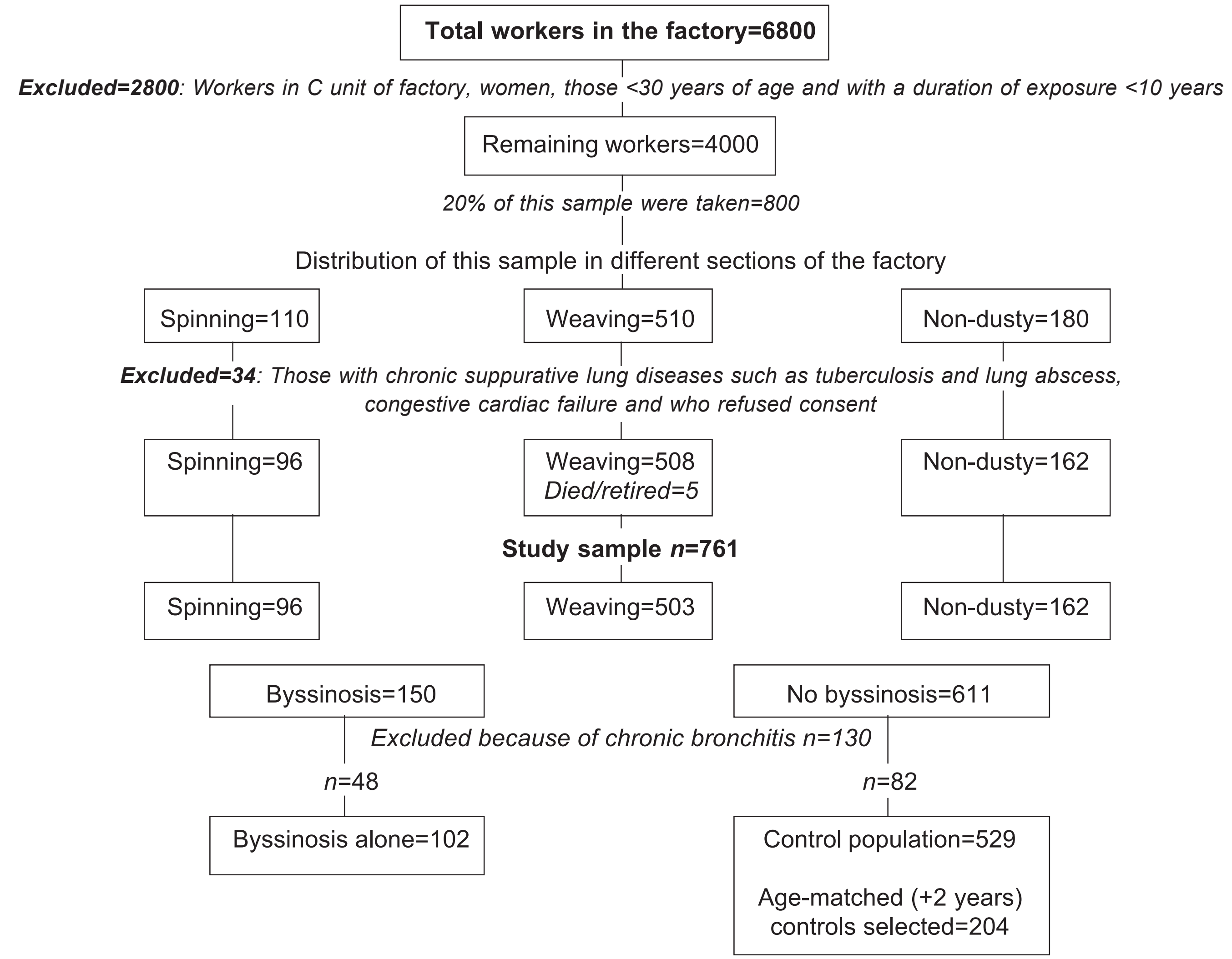

FIG 1. The evolution of the study sample

analysis. The predicted value of FEV_1 for the concerned population was calculated and 80% of the predicted value determined.

Statistical analysis

The data were analysed using EPI Info version 6.0 and SPSS (Statistical Package for Social Sciences) version 7.5. Chi-square and odds ratios (ORs) with 95% confidence intervals (CI) were calculated for univariate analysis. Subsequently, the significant factors on univariate analysis were entered into a logistic regression model and the adjusted ORs with 95% CI obtained. Independent sample *t*-test was used for the analysis of pulmonary function tests.

RESULTS

The study population consisted of 102 cases and 204 controls. The socioeconomic status of all the workers was similar. Univariate analysis of the risk factors for byssinosis showed that dusty worksites such as the spinning and weaving sections, heavy smoking and duration of service >30 years (Table I) were significant. Body mass index (BMI), fuel used for cooking and overcrowding were not found to be statistically significant. A logistic regression analysis (backward step-wise) showed that dusty worksites such as the spinning and weaving sections, heavy smoking and duration of service >30 years were independent significant risk factors. Workers in the spinning sections had 6.1 times (95% CI: 1.9, 19.6) and those in the weaving section had 1.9 times (95% CI: 1.1, 3.6) higher risk of developing byssinosis compared with those working in the non-dusty sections. Workers with a smoking index of >20 pack-years (heavy smokers) had a 3.9 times (95% CI: 1.7, 8.0) higher risk for byssinosis. Also, workers with a duration of service >30 years had a 2-fold (95% CI: 1.1, 3.6) higher risk compared with those with <30 years of service.

Analysis of pulmonary function tests showed that there was a marginal but statistically insignificant difference in all the parameters between the cases and controls (Table II).

DISCUSSION

Though cotton dust has been established as the causative agent for byssinosis, it is important to determine the other risk factors associated with the occurrence of the disease so as to implement comprehensive preventive measures. We used the WHO definition of byssinosis and excluded all those who had chronic bronchitis. Kamath *et al.* have reported that chronic bronchitis is a separate entity among cotton textile mill workers.[11] Gupta[12] in a review of byssinosis found that many studies did not exclude patients with chronic bronchitis and this might affect the results.

TABLE I. Univariate analysis of risk factors for byssinosis

Factor	Byssinotics (%) (*n*=102)	Controls (%) (*n*=204)	Chi-square	Odds ratio (95% CI)
Work site				
Dusty section	96.0	86.7	6.5*	3.7 (1.3, 10.9)
Non-dusty section	4.0	13.3		1
Sections				
Spinning	24.5	12.7	11.0*	6.5 (1.9, 21.3)
Weaving	71.5	74.0	5.0*	3.3 (1.1, 9.7)
Non-dusty	4.0	13.3		1
Smoking				
Heavy smokers	15.6	4.4	11.5*	4.1 (1.7, 9.5)
Others	84.4	95.6		1
Duration of service				
>30 years	50.0	36.2	5.3*	1.8 (1.08, 2.8)
<30 years	50.0	63.8		1
Body mass index				
>30	19.0	5.8	1.6	1.7 (0.7, 4.2)
<30	91.0	94.2		1
Fuel used for cooking				
Wood and kerosene	46.0	53.9	1.7	0.7 (0.5, 1.8)
Gas	54.0	46.1		1
Overcrowding				
Present	60.7	65.1	0.6	0.8 (0.5, 1.3)
Absent	39.3	34.9		1

*p<0.05

TABLE II. Analysis of pulmonary function tests

Test	Mean	p value*
Forced vital capacity (FVC)		
Cases	2.61	0.2
Controls	2.66	
Forced expiratory volume in 1 second (FEV_1)		
Cases	2.15 l/s	0.6
Controls	2.20 l/s	
FEV_1/FVC (%)		
Cases	82	0.2
Controls	82	
% of predicted FEV_1		
Cases	85.9	0.9
Controls	85.8	

* Independent sample *t*-test p<0.05 considered significant

In the past decade, studies from Turkey and China have shown that dust levels above the recommended values are associated with a high prevalence of byssinosis.[6,13] The risk factors identified in our study such as working in the spinning and weaving sections, long exposure and heavy smoking have been reported by others as well. A study from France showed an OR of 7.3 for an exposure of 20 years compared to an OR of 2 for an exposure of 30 years in our study. Similarly, they had an OR of 4.9 for the dustiest sections compared with 6.1 and 1.9 found in our study for the spinning and weaving sections, respectively. The French study did not find any association with smoking though our study did.[14] A study from Lancashire, UK reported that the prevalence of byssinotic symptoms was significantly related to years worked in the cotton industry, exposure to dust, quality of cotton used, work area, ethnic origin and smoking habits.[15] However, another study from Lancashire showed that byssinosis was rare among workers engaged in cotton weaving.[16] In a study from Kanpur, only dustiness and length of exposure were important contributory factors to the occurrence of byssinosis. The risk of byssinosis among workers in the card room, blow room and waste plant sections and those who had an exposure of >5 years was nearly 3 times higher compared to workers in other sections of the mill and/or those with <5 years of exposure.[8]

Besides the above-mentioned studies, there are also descriptive and comparative studies, in which some attempt has been made to identify the risk factors. In a study from Kishangarh, India it was reported that a majority of workers had developed the disease after 16 years of exposure, unlike in our study where the risk was high among those with 30 years of exposure. The disease was more common among smokers and severe among those who were consuming 15 pack-years of cigarette/*bidis*,[9] comparable with our results. This variation of results may be due to varying definitions of the disease. In another study from Mumbai, it is reported that the incidence of byssinosis was 30% among workers in dusty departments such as spinning, winding and weaving, compared with 17% in those working in the less dusty sections. Similarly, our observation of exposure of 30 years (OR=2) as a risk factor is comparable with the finding of the Mumbai study in which 45% of the workers who had >30 years of service had byssinosis compared with 24% among those who had <10 years of service.[7]

Pulmonary functions showed a decline in the workers having byssinosis, but it was not statistically significant. Other studies have reported either an insignificant decline in pulmonary functions or a decline independent of the symptoms of byssinosis. A study from California analysed the acute effect of cotton gin environment on lung functions and found no correlation between the symptoms of byssinosis and objective decrease in FEV_1.[17] The same researchers conducted a prospective, longitudinal study over a period of 4 years and reported an insignificant decline of FEV_1, FEV_1/FVC and FEF (forced expiratory flow)$_{25\%–75\%}$. They failed to find any detrimental effect of the cotton gin environment on the rate of decline and reported the decline to be independent of the symptoms of byssinosis.[18] In a study from France, only peak expiratory flow was taken into consideration and the absence of a constant link between Monday tightness and drop of peak expiratory flow was reported.[14] In textile industries in north Portugal, workers exposed to cotton fibres in spinning areas had the highest prevalence of symptoms and reduction of the FEV_1. There were no cases of byssinosis among workers in the weaving areas. Smoking habits were related to a reduction in FEV_1 and severity of respiratory illness but not to the presence of byssinosis.[19] A 15-year longitudinal study from Shanghai, China reported that cotton workers had small, but significantly greater, adjusted annual declines in FEV_1 and FVC than did silk workers. Years worked in cotton mills, high level of exposure to endotoxins, and across-shift drops in FEV_1 were found to be significant determinants of a longitudinal change in FEV_1, after controlling for appropriate confounders. Moreover, there were statistically significant associations between excessive decrease in FEV_1 and byssinosis, chest tightness at work and chronic bronchitis in cotton workers. It appears that longitudinal studies of 10–15 years' duration may be required to study the effect of byssinosis on lung functions.[13]

The results of our study confirm the findings of some previous studies. There is a need for textile mills to reduce the dust levels in the spinning and weaving sections. Workers should be encouraged to use protective measures such as face-masks. Since heavy smoking is a risk factor for byssinosis, measures should be taken to reduce smoking among textile workers. Rotating workers from dusty to non-dusty sections on a regular basis might reduce the length of exposure to higher dust levels, thereby reducing the risk.

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