Addis Ababa University Faculty of Medicine
Department of Community Health

Assessment of byssinosis and other respiratory symptoms among production workers in Akaki textile factory, Akaki-kality subcity, Addis Ababa, 2006/ 2007.

By: kassahun Alemu

A thesis submitted to school of graduate studies of Addis Ababa University in partial fulfillment the requirement for the degree of masters in public health.

July, 2007
Addis Ababa, Ethiopia.

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Acronyms

AAU: Addis Ababa University.

ANOVA: analysis of variance

ATS: American Thoracic Society.

CI: confidence interval.

EPI info: epidemiologic information.

FEV1: forced expiratory volume per second.

FVC: forced volume capacity.

FEV1/FVC: forced expiratory volume per second to forced volume capacity.

LPM: liters per minute.

LRTS: lower respiratory tract symptom.

Mg/m3: milligram per cubic meter.

NIOSH: National Institute for Occupational Safety and Health.

µg/m3: microgram per cubic meter.

OSHA: Occupational Safety and Health Administration.

OR: odds ratio.

PFT: pulmonary function test.

RAM: real time aerosol measurement.

SPSS: Statistical Soft Ware Package for Social Science.

TWA: time weighted average.

URTS: upper respiratory tract symptom.

UK: United Kingdom

US: United States.

WHO: World Health Organization.

Abstract

Back ground: textile cotton workers are at risk for occupational lung disease, including byssinosis and chronic bronchitis. Byssinosis is a respiratory disease primarily associated with exposure to cotton dust. Respiratory symptoms and impairments in pulmonary function are the major consequences of occupational exposures.

Objective: the aim of the study was to determine the prevalence of respiratory symptoms and byssinosis among production workers in cotton mills of Akaki textile factory, Addis Ababa 2006/2007.

Methodology: a cross-sectional study in which by information on demographic characteristics, cigarette smoking, occupational history and respiratory symptoms, were collected from February to April 2006. Four hundred seventeen production workers were interviewed with modified American Thoracic Society standard respiratory symptoms questionnaires. FEV1, FVC and FEV1/FVC were measured using portable medical spirometer. Dust concentration in the work environment was measured by the Data RAM 4 real time measurement of area sampling. The data entry was performed using EPI INFO version 6.04d and exported to SPSS version 13.0 for analysis. The adjusted odds ratio was calculated for each respiratory symptoms and byssinosis. Multivariate Logistic regression analysis was used to identify the predictors of respiratory symptoms and byssinosis and one way analysis of variance (ANOVA) used to compare means of pulmonary function tests.

Result: The highest prevalence of respiratory symptoms (cough 77.0%, phlegm 62.0%, chest tightness 46.0% and dyspnea 62.0%) were found in the carding section .Workers in carding sections were more likely to contract phlegm 13 times and chest tightness 8 times higher compared to others sections. Workers in blowing sections were seven times more likely to have dyspnea than other sections. The over all prevalence of chronic bronchitis was 23.0% and the highest found in carding section (69.2%) and the lowest in weaving section (16.2%). Workers in carding section were 13 times more likely to have chronic bronchitis compared to other sections (OR=13.4, 95% CI 3.43-52.6). The prevalence of byssinosis was 38.0%. The highest found in the carding (84.6%), drawing (72.2%) and ring frame (63.0%) sections. Workers in the blowing and carding areas were exposed to the high levels of cotton dust with mean dust levels of 32.2 mg/ m3 and 8.0 mg/ m3 respectively.

About 11.0% of byssinotics developed FEV1 severe chronic changes. Of the byssinotic workers, 32% to 45% showed slight to moderate chronic impairment and 52.0% to 54.8% had no chronic impairment.

This study provided important evidence indicating the strong relationship between the high prevalence of byssinosis and other respiratory impairments on exposure to cotton dust. The results also emphasize the importance of applying a pulmonary function test to detect early exposure effects .In view of the above findings, preventive measures like controlling dust, using face masks, and other measures are of supreme importance in minimizing the prevalence of byssinosis and other respiratory disorders in textile manufacturing.

1. INTRODUCTION

Air pollution is a very important occupational problem in a various industries. Increasing amounts of potentially harmful gases and particles are being emitted into the workplace atmospheric, resulting in damage to human health. Inhalation is probably the most important route of exposure in the workplace and is an inescapable route of exposure to toxins in the general environment as well (1).

Occupational factors contribute to a significant fraction of respiratory disease and symptoms (2). Occupational lung disease is recorded in accounts of ancients' history. Recently, attempts have made to quantify the prevalence and incidence of occupational respiratory disease, but few data exist for estimates of its actual magnitude (3).

Many subsequent investigations have shown that textile workers around the world are affected by their work environment in the textile industry has been associated with many symptoms involving the respiratory tract, but by far the most prevalent and the most characteristic are those of byssinosis. Many but not all vegetable fibers when processed to make textiles may cause byssinosis (4).

As would be expected, industries associated with the processing of cotton, specifically yarn, thread and fabric mills are most associated with worker exposure to cotton dust (5.). After cotton is picked and seeded, it is taken to mills where it is blown open and further cleaned, carded, combed, and spun into threads. The earliest steps of the process release a great deal of dust in the air, and long-term exposure can leave mill workers with respiratory disorders (6).

Cotton dust is a mixture of substances including cotton fibers, plant matter, bacteria, fungi, soil and other contaminants. Inhalation of cotton dust has been shown to cause byssinosis. The invisible small dust particles enter into the alveoli of the lung through inhalation. The alveoli are in close contact with the blood that flows into the lungs. The dust particles get accumulated in the lymph and it damages the alveoli and reduces the capacity to retain oxygen. As the cotton dust accumulates the worker develops a brown lung and suffers from byssinosis (7).

In the early stages of the diseases the victim suffers from cough, tightness in the chest and shortness in the breath when he returns to work on the first day of the week. Later the symptoms extend to other days of the week and become more severe and continuous resulting in total and permanent disability. The criteria used for diagnosis are (1) Symptoms of tightness in the chest after being exposed to cotton dust. (2) The level of Forced Expiratory Volume/ Forced Vital Capacity (FEV/FVC) percentage per second and (3) Department of work and number years of service (8).

Byssinosis is a respiratory disease primarily associated with exposure to cotton dust. It 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 reaccustomed to the environment. As many as 25% of workers with byssinosis have symptoms that continue or recur throughout the workweek. More severe breathing problems seem to result both from exposure to high levels of dust and from longer dust exposure (9).

Epidemiological studies have shown that the prevalence of byssinosis in the UK has been falling since the first systematic study undertaken in the 1950s by Schilling and his colleagues. They found a rate of around 50% in workers in the dustiest parts of the cotton spinning processes. Recent studies reported a prevalence rate of 10% among these high-risk workers (10).

Textile manufacture in the developed world appears now to be associated with less prevalent and less severe disease, this is not the case for developing countries. High prevalence's of byssinosis can still be found worldwide, particularly where governmental standards are lax or non-existent (11). Documented prevalence's of byssinosis were 8% in China 30% in Indonesia 37% in Sudan, 40% in Ethiopia, and up to 50% in India (5).

Information regarding cotton dust exposure impacts on workers and its control strategies is missing among textile employers, management and employees in Ethiopia. This study could contribute the dimensions of the byssinosis problem moreover; provides an overview of the issue with the aim to facilitate textile mill employers and management to establish cotton dust control strategies to save their workers from its harmful health impacts.

2. LITERATURE REVIEW

For nearly 300 years, work in the textile industry has been recognized as hazardous. Ramazzini (1864) described a peculiar form of asthma among those who card flax and hemp. The "foul and poisonous dust" which he observed "makes the workmen cough incessantly and by degrees brings on asthmatic troubles". That such symptoms did in fact occur in the early textile industry was illustrated by Bouhuys and colleagues (1973) in physiological studies at Philipsburg Manor (4).

While numerous authors throughout the 19th and early 20th centuries in Europe described the respiratory manifestations of work-related illness in textile mills with increasing frequency, the disease remained essentially unrecognized in the United States until preliminary studies in the middle of the 20th century under the direction of Richard Schilling (1981) indicated that, despite pronouncements to the contrary by both industry and government, characteristic byssinosis did occur (4).

Cotton workers are at risk for occupational lung disease, including byssinosis and chronic bronchitis. The initial phase of byssinosis is characterized by acute reversible symptoms, such as wheezing, chest tightness, shortness of breath, or cough, and is typically evident on the first day back to work after an absence of 48 h or more. These early symptoms are generally accompanied by reversible changes in pulmonary function (across-shift drops in FEV1). With continued exposure, the disease may progress to a stage in which symptoms are present throughout the work week and may eventually result in severe pulmonary disability (12).
The pathology behind chest tightness has not been explained. It has been suggested that the symptoms are due to an increased adhesiveness of platelets which accumulate in the lung capillaries and increase the pulmonary artery pressure. It is likely that chest tightness involves some kind of cell sensitization, as it takes repeated exposures for the symptom to develop. This hypothesis is supported by results from studies on blood monocytes from cotton workers (Beijer et al. 1990). A higher ability to produce procoagulant factor, indicative of cell sensitization, was found among cotton workers as compared to controls (13).

Cotton dust is a mixture of substances including cotton fibers, plant matter, bacteria, fungi, soil and other contaminants. Inhalation of cotton dust has been shown to cause byssinosis, which is already prescribed under the IIB scheme. Cigarette smoking interacts with the effect of the dust. Early studies in the 1970s showed that exposure to cotton dust is associated with symptoms of chronic bronchitis that tend to coexist with byssinosis and that there was a drop in FEV1 over 6 hours on a Monday following 2 days away from work (Gars hick et al., 1996) (14).

The cotton textile industry has always followed a steady progression toward cheaper labor and operations from industrial centers in the U.S. and the U.K. in the early 1900s to small towns in the American South, and then to Egypt, Mexico, and Asian countries. Now in countries like China, mills in the cities are closing and moving to rural towns, mimicking the U.S. experience. As the industry follows this ongoing march, the new sites inherit some of the health impacts that come with working in a cotton mill-symptoms that have been called in turn "Monday fever," "brown lung," and byssinosis (6).

The study in Lancashire textile weavers revealed that the FEV1 and FVC were reduced in workers with respiratory symptoms (non-specific chest tightness, shortness of breath, persistent cough, and wheezing) as well as in preparation room workers, current and former smokers, Asians, those working with predominantly cotton fiber (> 50% cotton) and starch size. Non-specific chest tightness was predicted by low dust concentrations and persistent cough by high dust concentrations. The FEV1 and FVC were impaired in smokers and those exposed to high dust concentrations in the personal breathing zone (15).

Grade 3 byssinosis indicates that, in addition to symptoms, textile workers demonstrate changes in respiratory function. The progression from early byssinosis (grade 1) to late byssinosis (grade 3) is suggested by the association of lung function loss with the higher grades of byssinosis in cross-sectional studies of textile workers. Several of these cross-sectional studies have given support to the concept that across-shift changes in lung function (which correlate with the acute findings of chest tightness) are related to chronic irreversible changes (4).

The study conducted in Bangladesh indicated that a statistically significant low peak expiratory flow rate was identified among 52.9 percent of workers. Among them, 42.9 percent had symptoms of cough with or without phlegm; 5.7 percent had a history of chronic bronchitis and/or asthma, and 4.3 percent experienced chest tightness or breathlessness. This study showed a high degree ($p < .001$) of respiratory-related illness symptoms present among the workers in the blow/card rooms and the workers in the spinning section (16).

The survey of both environmental and occupational determinants of health in three comparable modern Chinese cotton textile mills revealed that Odds ratios for prevalence of current frequent symptoms in those working in production jobs, after adjustment for home exposure to passive tobacco smoke and coal heating, were frequent cough 2.23 (95% CI, 1.05-4.75), frequent phlegm 3.24 (1.54-6.84), shortness of breath 4.54 (1.40-14.72), and wheeze 2.96 (1.16-7.55) (17).

The study conducted in Singapore stressed that exposure to dusts from cotton, wood, metal, minerals, and/or asbestos was associated with non chronic cough and/or phlegm (OR) = 1.19, 95% confidence interval (CI): 1.08, 1.30), chronic bronchitis (OR = 1.26, 95% CI: 1.01, 1.57), and adult-onset asthma (OR = 1.14, 95% CI: 1.00, 1.30). Cotton dust was the major contributor to respiratory symptoms (2).

The study investigates the respiratory health profile of textile mill workers in Bangladesh. The subjects who had a considerably low peak expiratory flow rate (< 290 liters/min), and had symptoms of chronic respiratory illness, underwent X-ray examination. A statistically significant low peak expiratory flow rate was identified among 52.9 percent of workers. Among them, 42.9 percent had symptoms of cough with or without phlegm; 5.7 percent had a history of chronic bronchitis and/or asthma, and 4.3 percent experienced chest tightness or breathlessness. This study showed a high degree ($p < 0.001$) of respiratory-related illness symptoms present among the workers in the blow/card rooms and the workers in the spinning section (18).

The prevalence of respiratory abnormalities in the cotton workers were typical Monday symptoms 9.0%; FEV1 fall by > or = 5% after a shift 16.8%; FEV1 fall by > or = 10% after a shift 4.2%; FEV1 < 80% predicted 6.1% FEV1/FVC < 75% 4.0%; (f) cough or phlegm 18.2%; chronic bronchitis 10.9%; and byssinosis, 1.7%. Most of the prevalence increased with increasing age, duration of exposure, and cumulative inhalable dust exposure. All the pooled relative risks of respiratory abnormalities were raised for cotton exposure. It concluded that cumulative inhalable cotton was likely to be the cause of byssinotic symptoms, acute lung function decrements, cough, or phlegm, and chronic bronchitis (19).

The synergistic effect of smoking on cotton dust exposure was also evaluated. A significant trend existed between the cotton dust levels and the frequency of abnormal lung function. The significant trend was also noted in both smokers and nonsmokers. The frequency of respiratory symptoms and the prevalence of severe byssinosis in the second survey (14.9% and 12.6%, respectively) were significantly lower than that in the first survey (39.7% and 21.9%, respectively). The reduction of symptoms was due to remodeling of this old cotton mill (20).

Among cotton workers, the cumulative incidence of byssinosis and chest tightness was 24% and 23%, respectively, and was significantly more common in smokers than in non-smokers. A high proportion of symptoms were found to be intermittent, rather than persistent. Chronic bronchitis, cough, and dyspnoea were more common and persistent in the cotton group than in the silk group. Multivariate analysis indicated a trend for higher cumulative exposure to endotoxin in relation to a higher risk for byssinosis (21).

Technical prevention is very important, which the situation in the USA proves. The technical and technological improvements have practically brought to reduction and finally to disappearance of the prevalence of byssinosis.There are different highest admitted concentrations of textile dust in different countries. In the USA the National Institute for Occupational Safety and Health (NIOSH) recommends time-weighted averages (TWA) for cotton dust bellow 0.2 mg/m3. Occupational Safety and Health Administration (OSHA) recommends TWA from 0.1 to 1 mg/m3 according to performed operation, personal exposure limits (PEL) 1 mg/m3. In Germany TWA makes 1.5 mg/m3, in Sweden and the UK it is 0.5 mg/m3, in Switzerland 0.3 mg/m3 (23,24).

Study in Egypt revealed that the workers in the blending and picking department, carding and spinning department and combing and twisting department suffer from cough (68.3%, 60.2% and 73.7% respectively), chest pain (68.3%, 57.6%, and 64.9% respectively), and dyspnea (70.7%, 68.1% and 71.9% respectively). The difference from other departments was significant. Only 63.8% of workers were performed periodic medical examination. It was found that 13.4%, 11.1% and 2.3% were suffering from chronic bronchitis, chronic bronchitis with emphysema and bronchial asthma respectively (25).

Health and safety guidelines in the United Kingdom described the recommended procedures and set the permissible exposure level at 0.5 mg/m3 (26). Committee of Hygiene standards in 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 down to less than 0.5 mg/m3, as measured by the work area sampling technique. In the United States, cotton dust standard was 0.2 mg/m3 for the areas of packing, carding and spinning, and 0.75 mg/m3 for the slashing and weaving area (27).

The relationships between occupation and occupational pulmonary contaminants and respiratory symptoms in community based studies have been studied since the late 1970s. In many of the general population studies, an association with exposure to dust, gases and fumes has been found with odds ratios ranging from 1.3 to 2.5 for exposed versus no exposed workers (28).

A cross-sectional study of work-related symptoms and cotton dust exposure was made in the study in Sudan-Khartoum revealed that the prevalence of byssinosis was 67% among blowers, 40% in carders and draw-frame workers, 42% in simplex workers and 37% in ring-frame workers. The prevalence of chronic bronchitis ranged between 29 to 47% in all groups. A significant fall in FEV1 was recorded in carders and draw- and ring-frame workers. There was also a statistically significant decrease in FVC after shift in all groups except in the ring-frame group (32).

The study conducted in Bahir Dar showed that the prevalence of byssinosis was high among blowers (43%) and carders (37.5%) in comparison to 4 to 24% prevalence among workers in other sections. There is a statistically significant difference ($p<0.001$) in the prevalence of byssinosis in the different sections and over an eight fold increase in developing the problem in the blowing and carding sections as compared to the weaving and preparatory (33).

The other study in Bahir Dar (Y. Abebe, T.Seboxa) revealed that the over all prevalence of byssinosis was 45.5%.The highest prevalence was founding carding (57.9%) and in ring frames (57.1%) operatives and the lowest in weaving preparatory section (32.1%).unlike bronchial asthma, chronic cough and chronic bronchitis were significantly higher ($p<0.01$) in cotton dust exposed subjects compared with control. The mean measured values of ventilatory capacity (FEV1 and FVC) were significant extent reduced in the exposed groups compared with controls ($P<0.01$) (34).

Conceptual Framework

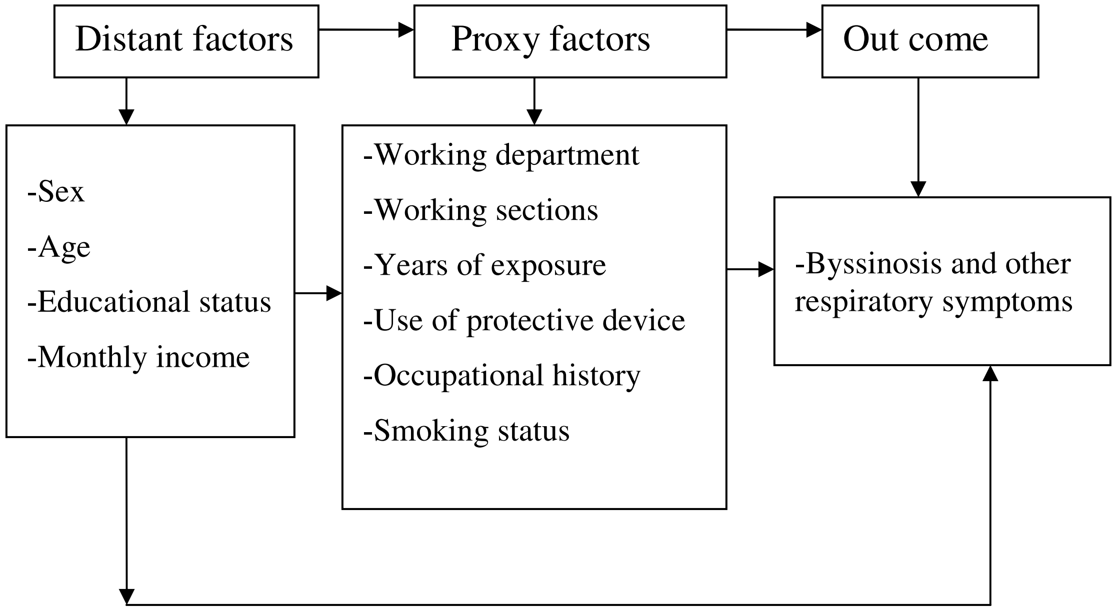

Fig .1. Conceptual framework

3. OBJECTIVES

3.1 GENERAL OBJECTIVE:

To assess the prevalence of byssinosis and other respiratory symptoms among workers in Akaki textile cotton mill house, Addis Ababa, Ethiopia, 2007.

3.2 SPECIFIC OBJECTIVES:

1. To determine the prevalence of byssinosis and other respiratory symptoms
2. To measure ventilatory lung function tests
3. To identify the possible determinant factors for byssinosis and other respiratory symptoms.

4. MATERIALS AND METHODS

4.1. **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, 2006/2007**.**

4.2. Study Area: Akaki textile factory is located in Akaki-Kality sub city, Addis Ababa.

4.3. Study Population: all production workers in Akaki textile factory .There were about 765 production workers (defined as those involved in the direct processing of textile materials) in different sections of the factory. Processing consists of eight main activities.

(i). Blowing
(ii). Carding
(iii). Drawing
(iv). Roving
(v). Twisting
(vi). Ring frame
(vii). Preparatory
(viii). Weaving section

4.4. Sample Size: the sample size was calculated with 95% confidence interval, assuming 45 % prevalence of byssinosis and other respiratory symptoms (34), and acceptable difference of 0.05. The formula used to calculate the sample size was (35):

$$n = \frac{p\,(1-p)\,Z_{1-\alpha/2}^{2}}{d^{2}}$$

Where: n= the required sample size

P= the prevalence of byssinosis and other respiratory symptoms (45%)

d= the margin of error or acceptable error (0.05)

$Z_{1-\alpha/2}$= Standard normal distribution curve value for the 95% CI (1.96)

Therefore, the sample size calculated was 380, which with 10% contingency for non-response came to 418. Fifty five percent of the production workers were involved in the study.

4.5. Sampling Procedure: the population was known to be having heterogeneity with regard to dust concentrations of the working sections and those factors were used for stratification. The population was divided into homogeneous, mutually exclusive groups called strata, and then independent samples (respondents) were selected from each stratum (working sections) according to the size of the working department as ascertained from rosters.

Exclusion Criteria: administrative workers and other workers outside the cotton mill house were not included because they were not considered exposed.

Inclusion Criteria: study subjects were those who have been working in the same textile factory for at least one year.

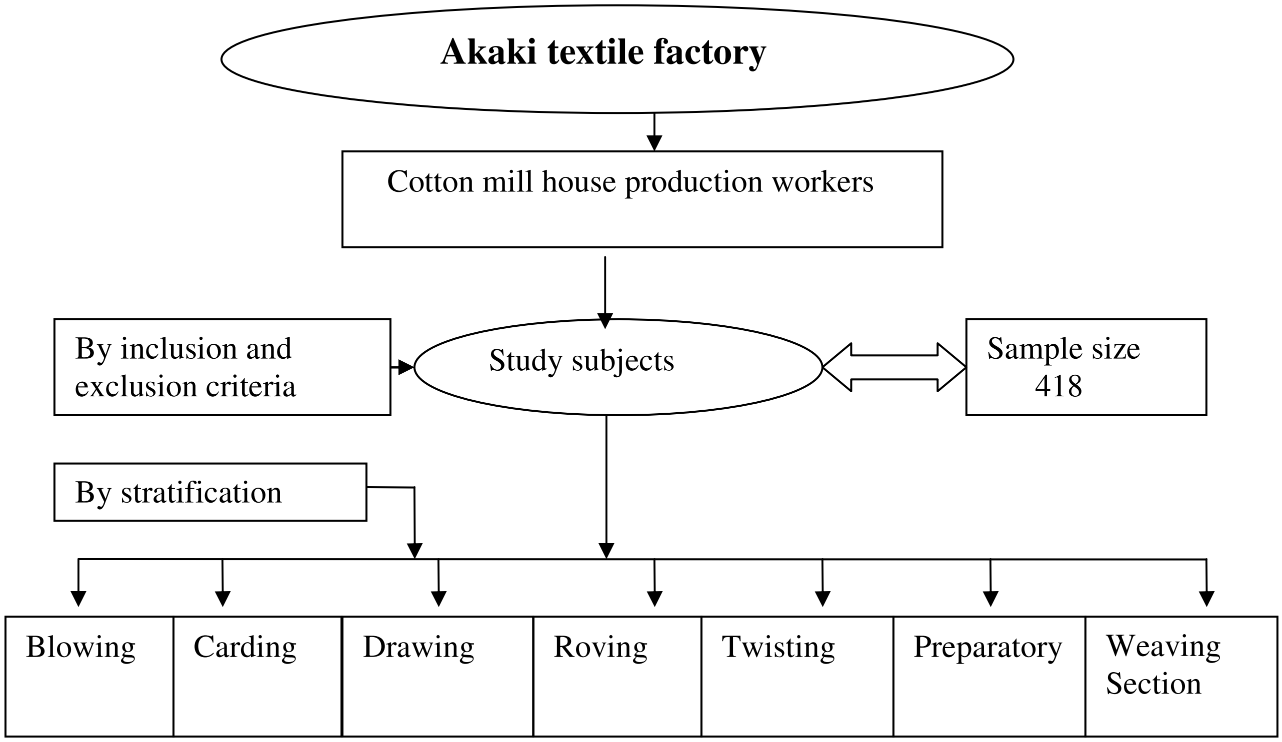

Fig .2. Sampling diagram

4.6. Data Collection Procedures:

4.6.1. Questionnaires: the questionnaire was modified from American Thoracic Society (ATS) questionnaire (32). A trained interviewer interviewed each worker during his or her Work time. The respiratory questionnaire was first translated from English to Amharic and then translated back to English by different translators to verify accuracy. The questionnaire was pre tested in a variety of different conditions and was shown to be accurate way of collecting such information. The questionnaires were administered face-to-face and consisted of five parts:

(i). Personal and work characteristics,

(ii). Use of personal protective device

(iii). Respiratory health symptoms, which included symptoms of dyspnea, cough, phlegm, chest tightness, and chronic bronchitis

(iv). Smoking habits

(V). Detailed occupational history.

4.6.2 Ventilatory Lung Function Test: pulmonary function tests were conducted by a trained technician. Forced expiratory spirograms were performed before work shifts on the first day back to work after two days' rest. Workers were asked to refrain from smoking for at least 1 hour before performing the test. The participants were 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 from a normal breathing pattern and then blow into the apparatus, without interruption, as hard, fast, and completely as possible.

The measurement was taken standing with the chin slightly elevated and the neck slightly extended. For each subject, forced vital capacity (FVC), forced expiratory volume in 1 sec (FEV1), forced expiratory volume in 1 sec to forced vital capacity (FEV1/ FVC), were obtained. The averages of three best results were calculated. The hand-held spirometer comes with tables that include predicted values to determine whether the study subjects measured values are normal. To calculate the measured values, the recorded numbers divided by the numbers that would be expected for someone of their height, weight, age and gender (the predicted values) determined for African population.

4.6.3. Environmental measurements:

4.6.3.1 Area Sample: dust concentrations in the work environment were measured using the MIE Data RAM 4(Data –logging Real Time Aerosol Monitor 4) designed to measure the concentration of air born particulate matter (liquid or solid) as well as mean particle size, air temperature and humidity, providing direct and continuous read out of respirable dust particles. The Data RAM 4 is a high sensitivity, two-wavelength nephlometric (i.e. photometric) monitor whose light scattering sensing configuration has been optimized for the measurement of the fine particle fraction of airborne dust and covers a wide measurement range: from 0.0001mg/m^3 to 400mg/m^3. The Data RAM 4 was placed and operated centrally about 1.5 meters above the floor of the breathing zone with in the area to be monitored, away from localized air currents due to fans, blowers, ventilation intakes, or exhausts.

A total of six dust samples were collected in the blowing, carding, drawing, and ring frame, preparatory and weaving sections in the mill house over the 8-h day work shift in those work areas. Dust concentrations are expressed as the average and maximum measurements, and the ranges are shown in milligrams per cubic meter. A factor of 1.00 was taken for calibration to indicate that the calibration slope was identical to that programmed at the factory.

The mass concentration in $\mu g/m^3$ was selected as the measurement unit. The particle size correction was arranged to measure mass concentration automatically took into account the volume, median particle diameter determined in real time from the ratio of the scattering irradiances at the two wave lengths of illumination of the Data RAM 4.

The relative humidity correction was arranged to correct for the particle growth effect due to a high humidity environment. This meant that the computed mass concentration was based on the original dry environment particle population. The air sampling flow rate of the Data RAM 4 was adjusted at 2 liters per minute (2 LPM) .What ever the selected flow rate, it was maintained at a constant volumetric rate during the measurement run regardless of changes in the system flow resistance, up to a maximum load.

4 .7 Study Variables:

Independent Variables	**Dependant Variables**
Age and Sex	Byssinosis
Educational status	other respiratory symptoms
Economical status	
Working sections	
Duration of exposure	
Cotton dust concentration	
Occupational history	
Smoking habits	
Protective equipment	

4.8. Data Analysis

4.8.1 Data Entry and Processing: questionnaires were checked for completeness and consistency by the principal investigator. The questionnaires were classified as unfilled, partially incomplete, item missed, and completed .Totally unfilled and partially filled formats were excluded from the analysis. Fully completed and completed with few missing items were coded. The investigator entered the coded questionnaire, cleaned the data and validated those using EPI Info version 6.04d statistical packages and exported to SPSS version 13.0 statistical packages for analysis. About 47 (10%) of the questionnaires were double entered to verify accuracy of data entry and no discrepancies were noted.

Data clean up was performed by running frequencies of each variable to check for accuracy, outliers, and inconsistencies and missed values. Prevalence, adjusted odds ratios (OR) were calculated, for each respiratory symptom and byssinosis, univariat for testing significance relationship of the dichotomous variables, and multivariate logistic regression analysis to study independent predictive factors for individual symptom categories 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 their prediction of FEV1 and FVC.

4.9. Data Quality Management: the principal investigator was the overall coordinator and supervisor of research activities on a daily basis. During the data collection, constant monitoring and supervision was carried out. All the activities and work quality of the interviewers, the expert for measuring lung function test and the expert of dust sampler was supervised regularly. On occasion, on the questionnaires, and formats filled in by interviewers, the principal investigator carried out counter checks and any deviations were corrected immediately.

The supervisor checked the correct use and completion of questionnaires and recording formats during the nighttime. Any mistakes or omissions were corrected as soon as possible. Any missed data were obtained within 24 to 48 hours. The questionnaire was tested by the pretest. The necessary readjustment was made based on the pretest result. The environmental measurement and the spirometr were calibrated as per their instruction manuals. The procedures for spirometeric measurements were explained carefully to the study subjects.

4.10. Ethical Consideration: ethical approval was obtained from the ethical committee of the Faculty of Medicine through the Department of Community Health. Informed written and verbal consent or permission was obtained from the factory administrators. The freedom of the production workers to participate or not to participate in the study was explained to the study subjects. The importance of the study was explained to the participants. Data confidentiality was assured (i.e. access to data was limited to only the research team), and the study did not harm to the study subjects. Verbal consent from participants and oral and written consent were obtained from the labor union. Based on the findings advice on possible prevention and protection methods was given, including using appropriate protective device, work rotation, and controlling dust. Workers who had respiratory disease were referred for appropriate treatment.

4.11. **Dissemination of Results:** The results of this thesis finding will be disseminated to the Department of Community Health, AAU, and the Ministry of Health, Ministry of Social Affairs, Addis Ababa Social Affairs Bureau and Akaki textile factory and will be submitted for publication.

4.12. Operational Definitions:

Symptoms: are classified as lower respiratory tract symptoms (cough, phlegm, chest tightness, and shortness of breath) (LRTS) or upper respiratory tract symptoms (ocular and nasal irritation) (URTS).

Work related symptoms: defined as any symptom developing after first starting to work in the mill environment, which improves on days away from work or that are reported as being worse when working.

Smoking status: workers are classified as current smokers, ex-smokers, or non-smokers according to their baseline questionnaire. If the workers started smoking during the follow up period they are reclassified as current smokers.

Byssinosis: is defined by Schilling's grading.

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

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

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

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

Grade 3: means grade 2 symptoms accompanied by evidence of permanent impairment in capacity from reduced ventilatory defect (4).

Byssinosis (all grades): chest tightness or shortness of breath at work occurring in the first or other days of the work week according to the criteria of Schilling and colleagues.

Chest tightness: tightness or constriction of the chest occurring any time during the work shift and on any workday, without being worse specifically on the first day of the working week.

Chronic bronchitis: sputum production occurring on most 5 days a 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 a week for a minimum of three months a year for at least two consecutive years.

Dyspnoea (2+): having to walk slower than a person of the same age at an ordinary pace on level ground because of breathlessness.

Chronic cough or phlegm: cough and/or phlegm for a minimum of 3 months a year during the course of 1 year;

Chronic bronchitis: cough and phlegm for a minimum of 3 months a year and for not less than 2 successive years;

Dyspnea grades: *grade 3, shortness of breath when walking with other people at an ordinary pace on level ground; and grade 4, shortness of breath when walking at their own pace on level ground; and .*

Obstructive defects: are characterized by airway narrowing which increases the time it takes to empty your lungs. FEV1 and FVC are both reduced but FEV1 is reduced to a greater degree causing a reduction in the FEV1/FVC ratio.

FVC: forced volume capacity; the total volume that can be forcefully expired from a maximum inspiratory effort.

FEV_1: forced expiratory per second; volume of air forcefully expired from a maximum inspiratory effort in the first second.

5. RESULTS

5.1. Distribution of characteristics in study subjects

Altogether 418 production workers were included in the study with a response rate of 99.7% from two departments spinning and weaving. The size of the study population was 201 (48.2%) from the spinning and 216 (51.8%) from the weaving department. Study subjects were selected from six working sections in the spinning department (blowing 21 (10.44%), carding 13 (6.5%), drawing 18 (9.0%), roving 89 (44.3%), reeling 22 (10.9%) and ring frame 40 (19.9%)) and two working sections in the weaving department (preparatory 114 (53.2%) and weaving section 99 (48.8%).

Of the study population 226 (54.2%) were males and 191 (45.8%) were females. Most workers were aged greater than or equal to fifty, 161 (38.8%) and between forty and forty nine 141 (33.9%).The mean age of the study population was 46.7±7.5 years and ranged from 26 to 72 years. Most participants were married (80%); nearly half were literate (49%) and most were orthodox Christians (90%) (Table 2).

Table1. Study population characteristics in Akaki textile factory Addis Ababa, Ethiopia 2006/2007(n =417).

Variables	No of subjects	Percentage (%)
Sex:		
Male	226	54.2
Female	191	45.8
Age in years: Mean = 46.7±7.5, R=26-72		
<40	110	26.5
40-49	141	33.9
≥50	161	38.8
Marital Status:		
Single	15	3.6
Married	335	80
Divorced	35	8.4
Widowed	32	7.7
Educational status:		
Illiterate	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
Muslims	24	5.8
Protestant	10	2.4
Catholic	1	0.2
Others	3	0.7
Exposure status in years: Mean = 25.9±8.1, R=3- 45		
<20	124	29.7
20-29	150	35.9
> 30	143	34.3

The mean work exposure in cotton mill house was 25.94±8.1 years and ranged from 3 to 45 years. Most 386 (92.6%) did not use protective devices at work. The 31 individuals who did use a protective device did not use a recommended one. Of the work force, 11 (2.6%) were smokers and 23 (5.7%) were ex-smokers. The mean years of smoking were 16.1±16.1years and ranged from 1 to 42 years.

5.2. Prevalence of respiratory symptoms

The greatest proportion of workers with respiratory symptoms were among those in the spinning department, where 29.8% had cough, 24.4% phlegm , 23.4% chest tightness ,and 43.3% dyspnea. Dyspnea 159 (38.1%) was the most common highest respiratory symptom in the study population, and cough affected 91 (21.8%) (Table 3).

Table 2. Respiratory symptoms by working department of study subjects in Akaki textile factory, Addis Ababa, Ethiopia 2006/2007.

Department	Symptoms		Crud OR(95%CI)	
	Cough: Yes	No		
Spinning *	60	141	3.4	1.4 - 8.7
Weaving	31	185	1.00	
Total	91	326		
	Phlegm: Yes	No		
Spinning *	49	152	2.4	1.4 - 3.9
Weaving	26	190	1.00	
Total	75	342		
	Chest tightness: Yes	No		
Spinning *	15	154	4.08	2.1 - 8.2
Weaving	62	201	1.00	
Total	77	355		
	Dyspnea :Yes	No		
Spinning **	87	114	1.53	1.03-2.3
Weaving	72	144	1.00	
Total	159	258		

*Significance at p<0.001, ** significance at p<0.01

The over all prevalence of respiratory symptoms in the study subjects were cough (21%), phlegm (18 %), chest tightness (15.0%) and dyspnea (38.1%). Workers in the spinning department were more likely to have each of the respiratory symptoms (cough 3.4 times, phlegm 2.4 times, tightness 4.08 times and dyspnea 1.53 times) comparing with the weaving department and strongly significant at p< 0.001(Table 3).

Table 3. Respiratory symptoms and working sections of study subjects in Akaki textile factory, Addis Ababa, Ethiopia, 2007(n=417).

Sections	Respiratory Symptoms		Crude OR (95% CI)		Adjusted OR (95% CI)	
Cough :	Yes	No				
Blowing	5	16	0.59	0.10- 3.5	0.5	0.04- 4.6
Roving	21	67	3.75	0.64- 22.1	4.8	0.59-39.2
Ring frame	14	26	1.64	0.33-8.35	3.1	0.42-22.7
Preparatory	17	97	0.55	0.16-1.96	1.1	0.14-9.2
Weaving	14	85	1.00		1.00	
Phlegm:	Yes	No				
Blowing	6	15	3.2	1.03- 9.9	3.5	1.02-11.9
Carding	8	5	12.8	5.6- 46.1	12.9	3.32- 50*
Drawing	4	14	2.3	0.64- 4.2	2.3	0.58- 8.7
Roving	18	70	2.1	0.9 - 4.6	2.7	1.1- 6.7*
Reeling	2	20	0.9	0.18- 4.4	1.3	0.23-7.3
Ring frame	12	28	3.4	1.36- 8.6	4.4	1.53-12.8
Preparatory	14	100	1.11	0.48- 2.6	1.5	0.55-4.3*
Weaving	11	88	1.00		1.00	
Chest tightness:	Yes	No				
Blowing	3	18	1.89	0.46 -7.8	1.6	0.35- 7.1
Carding	6	7	9.75	2.64 -36.1	7.8	1.97- 30.8*
Drawing	5	13	4.38	1.24 -15.4	3.8	1.02-14.4*
Roving	22	66	3.74	1.57 - 8.9	3.3	1.26- 8.6*
Reeling	5	17	2.84	0.77 -10.6	2.9	0.65-12.5
Ring frame	6	34	2.01	0.65 - 6.2	10.9	0.58- 203
Preparatory	7	107	0.74	0.26 -2.1	2.1	0.21- 2.5
Weaving	8	91	1.00		1.00	
Dyspnea:	Yes	No				
Blowing	4	17	1.14	0.34 -3.8	6.9	1.91- 25.7*
Carding	8	5	7.72	2.25 -26.5	2.3	0.76- 7.1
Drawing	8	10	3.86	1.33 -11.2	2.5	1.19- 5.3*
Roving	38	50	3.59	1.839 -7.0	1.8	0.56- 5.9

Reeling	8	14	3.22	1.14 - 9.1	0.01	0.00 - 2.2E
Ring frame	22	18	5.89	2.61 -13.3	3.64	1.45- 9.1
Preparatory	54	60	4.27	2.6 -8.1	2.2	0.95- 4.9
Weaving	17	82	1.00		1.00	

* Significance at $p<0.05$

The highest proportions of respiratory symptoms (cough 77%, phlegm 62%, chest tightness 46%, and dyspnea 62%) were found in the carding section comparing with other sections. 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 the weaving section. Workers in the blowing section were seven times more likely to have dyspnea than those in other sections (Table 3).

5.3. Prevalence of byssinosis

Table4. Prevalence of byssinosis and chronic bronchitis by working department Akaki textile factory, Addis Ababa, Ethiopia 2006/2007.

Department	Grade of byssinosis		Crude OR (95%CI)	
Byssinosis ½ :	yes	No		
Spinning *	18	183	10.5	2.4 - 45
Weaving	2	214	1.00	
Total	20	397		
Byssinosis I:	yes	No		
Spinning *	82	119	5.5	3.3-9.2
Weaving	24	192	1.00	
Total	106	311		
Byssinosis II:	yes	No		
Spinning*	23	178	3.4	1.5 - 7.7
Weaving	8	208	1.00	
Total	31	386		
Overall byssinosis :	yes	No		
Spinning*	123	78	8.44	5.18 -13.8
Weaving	34	182	1.00	
Total	157	260		

*Significance at $p<0.001$

The prevalence of byssinosis was higher among workers in the spinning department (61.2%) than the weaving department (15.7%). This pattern was the same at each grade of byssinosis. Of those who had byssinosis in the study population, 20 (5.0%) had grade ½ byssinosis, 106 (25.4%) had grade I byssinosis and 31 (7.4%) had grade II byssinosis. The over all prevalence of byssinosis in the study population was 38.0%. Those who had worked in the spinning department were ten times, six times and three times more likely to have grade ½, I and II byssinosis, respectively, compared to worker in the weaving department (Table 4).

Table5. Prevalence of byssinosis by working section in Akaki textile factory, Addis Ababa, Ethiopia 2006/2007.

Sections*	Grade of byssinosis		Crude OR	95% CI	Adjusted OR	95% CI
Grade ½:	Yes	No				
Blowing**	2	19	5.1	0.68 – 38.5	12.8	1.21-135.8
Carding **	3	10	14.6	2.2 – 97.7	27.3	2.81-265.7
Drawing	2	16	0.1	0.00–1.4	0.001	0.00-3.9
Roving **	4	36	4.8	0.99 – 23.2	11.84	1.68-83.4
Twisting **	3	19	8.6	1.3 – 55.1	24.77	1.87-327.8
Ring frame	2	38	0.01	0.01 – 6.7	0.000	0.000-2.7
Preparatory	2	112	2.5	3.5 – 18.8	8.3	0.8-95.9
Weaving	2	97	1.00		1.00	
Grade I :	Yes	No				
Blowing***	5	16	4.1	1.2 -14.5	4.8	1.25-18.8
Carding ***	6	7	11.3	2.9 - 42.8	12.3	3.0-50.4
Drawing ***	8	10	10.5	3.1 – 35.1	12.4	3.3-45.7
Roving ***	32	8	7.4	3.1 – 17.8	9.6	3.48-26.3
Twisting***	10	12	13.1	4.1 – 42.2	21.6	5.56-83.6
Ring frame***	18	22	10.8	3.9 – 28.9	16.2	5 .20-50.5
Preparatory **	7	107	2.4	0.97– 6.0	3.5	1.2- 10.8
Weaving	18	81	1.00		1.00	
Grade II:	Yes	No				
Blowing	2	19	2.5	0.43 – 14.6	1.96	0.29 -13.1
Carding	2	11	4.3	0.71 – 26.3	3.33	0.01 -21.9
Drawing	3	15	4.7	0.96 – 23.4	3.86	0.71 -21.1
Roving	10	30	3.0	0.91 – 10.0	2.05	0.55 -7.7
Twisting	1	21	1.3	0.13 – 11.8	0.76	0.07 -8.6
Ring frame	5	35	3.4	0.86 – 13.4	2.44	0.53 -11.3
Preparatory	4	110	0.9	0.21 – 3.5	0.57	0.11-3.1

Weaving	4	95	1.00	1.00

* Variables adjusted for sex, age, smoking status, occupational history and work exposure.
** Significance at p<0.05, *** significance at p<0.001.

The highest prevalence of byssinosis was found in the carding (84.6%), drawing (72.2%) and ring frame sections (63.0%).The lowest prevalence of byssinosis was found in the preparatory (11.4%) and weaving (24.2%) sections. The highest prevalence of grade I byssinosis was found high in the twisting (50%), carding (46.2%) and drawing (44.4%) sections. High prevalence of grade II byssinosis was found in carding sections (15.4%). After controlling for age, sex, smoking status, occupational history and use of protective devices, those who had worked in 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 the reference sections (p < 0.001)(Table 5). Those in the carding section were 27 times more likely to have graded ½ byssinosis.

Table 6. Prevalence of byssinosis by smoking status in Akaki textile factory, Addis Ababa, Ethiopia 2006/2007.

Variables*	Grade of	byssinosis	Crud OR	(95%CI)	Adjusted OR	95% CI
	Grade ½: Yes	No				
Smokers ***	3	8	1.7	0.5 – 5.9	11.1	1.5-81.9
Nonsmokers	17	387	1.00		1.00	
Total	20	395				
	Grade I: Yes	No				
Smokers	4	7	1.3	0.2 - 10.1	2.5	0.59-10.5
Non-smokers	102	302	1.00		1.00	
Total	106	109				
	Grade II: Yes	No				
Smokers	1	10	8.6	2.1 - 35.3	1.9	0.22-17. 1
Non-smokers	30	374	1.00		1.00	
Total	31	384				
Over all byssinosis:	Yes	No				
Smokers	8	3	4.56	1.08 - 22		
Non- smokers**	149	255				
Total	157	258				

* Variable adjusted for sex, age, working sections, occupational history and work exposure.
** Reference 1.00, *** significance at P<0.01.

Of those who had byssinosis 36.8% were non-smokers and eight smokers of eleven had byssinosis. No significance difference was found in the prevalence of byssinosis between smokers and non-smokers (Table 6).

Table7. Prevalence of byssinosis by ages in Akaki textile factory, Addis Ababa, Ethiopia 2006/2007.

Age in years*	Grade of byssinosis		Crude OR 95% CI		Adjusted OR 95% CI	
Grade ½:	Yes	No				
<40	2	108	1.00		1.00	
40-49	8	132	3.2	0.67 - 15.5	0.22	0.03-1.75
≥50	10	155	3.5	0.75 -16.2	0.17	0.02-1.53
Total	20	397				
Grade I:	Yes	No				
<40	20	90	1.00		1.00	
40-49	38	104	1.64	0.89- 3.0	1.47	0.64-3.41
≥50	48	117	1.9	1.02- 3.3	1.42	0.55-3.63
Total	106	311				
Grade II:	Yes	No				
<40	5	105	1.00		1.00	
40-49	11	131	1.76	0.59 -5.2	2.02	0.48-8.56
≥50	15	150	2.1	0.74 - 5.95	2.34	0.5 -11.1
Total	31	386				

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

Although the prevalence of byssinosis appeared to increase with age the increase was not statistically significant.

Table 8. Prevalence of byssinosis by duration of exposure in Akaki textile factory, Addis Ababa, Ethiopia 2006/2007.

Exposure in years*	Grade of byssinosis		Crude OR (95% CI)		Adjusted OR 95% CI	
	Grade ½: Yes	No				
<20	-	124	1.00		1.00	
20-29	11	139	1.64	0.89-3.03	8548	0.0 - 7.7
>30	9	134	1.85	1.02-3.33	6320	0.04e+33
Total	20					
	Grade I: Yes	No				
<20	26	98	1.00		1.00	
20-29	40	110	1.37	0.78 - 2.41	1.4	0.61 - 3.14
>30	40	103	1.46	0.83 – 2.3	0.9	0.35 - 2.2
Total	106	311				
	Grade II: Yes	No				
<20	7	114	1.00		1.00	
20-29	12	138	1.45	0.55 – 3.81	1.3	0.34 - 4.64
>30	12	131	1.5	0.58 – 4.02	0.94	0.23 - 3.9
Total	31	386				
	Overall byssinosis:		Chi square for		Odds Ratio	
	Yes	No	Linear trend		OR	
<20	33	91			1.00	
20-29	63	87	6.934		2.00	
>30	61	82	6.934		2.05	
Total	157	260				

* Exposure years adjusted with sex, working section, smoking status, occupational history

There was no significant association between years of exposures and grade of byssinosis. However; there was linear trend increase of byssinosis with years of exposure increased (Table 8).

5.4. Prevalence of chronic bronchitis

The prevalence of chronic bronchitis was highest in the carding section (69.2%) and lowest was found 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 the reference sections (p < 0.001).

Table 9. Prevalence of chronic bronchitis in Akaki textile factory Addis Ababa, Ethiopia 2006/2007 (n = 417).

Factors	Chronic bronchitis Yes	No	Crud OR	95% CI	Adjusted OR	95% CI
Sections:						
Blowing	3	18	0.9	0.2 – 3.3	0.9	0.2-3.8
Carding	9	4	11.7	3.2 – 42.6	13.4	3.4-52.6*
Drawing	6	12	2.6	0.9 – 7.9	2.7	0.8- 8.8
Roving	23	65	1.8	0.9 – 3.8	2.3	1.0 -5.2
Reeling	4	18	1.3	0.4 – 4.4	1.2	0.8 - 5.4
Ring frame	14	26	0.1	0.0 – 38.6	1.4	9.8 - 9.8
Preparatory	21	93	2.8	1.2 – 6.5	1.5	0.6 - 3.8
Weaving sec.	16	83	1.00			
Exposure :						
<20 years	19	97	1.00		1.00	
20-29 years	45	113	2.4	1.3 – 4.3	2.5	1.1 - 5.6*
>30 years	32	111	1.6	0.9 -3.3	1.5	0.6 - 3.9
Age in years:						
<40	18	92	1.00		1.00	
40-49	39	102	1.9	1.05 – 3.7	1.2	0.5-2.8
>50	39	125	1.6	0.9 – 2.9	0.9	0.3 - 2.2
Smoke:						
Non-smokers	92	312	1.00		1.00	
Smokers	4	7	1.9	0.6 – 6.8	2.1	0.6 - 7.6

* Significance at p<0.05

The prevalence of chronic bronchitis higher in the spinning department compared to the weaving department (29.4% vs. 17.0%). Of a total of 96 (23%) workers who had chronic bronchitis 96% were non smokers while only 4.2% were smokers (Table 9).

5.5. Distribution of cotton dusts in the work area

The level of cotton dust in each work section was measured by area sampling. The cotton dust levels and distribution are shown in Table 10. Workers in all working areas (blowing, carding, drawing, ring frame, preparatory and weaving section) were exposed to the highest level of cotton dust with mean dust level of 32.2 mg/m3, 8.0 mg/m3, 5.6 mg/m3, 3.3 mg/m3, 2.0 mg/m3 and 2.0 mg/m3 respectively. The cotton dust particle diameter was found to be about 4µm aerodynamic diameter.

Table 10. Cotton dust concentrations in working areas of Akaki textile factory, Addis Ababa, Ethiopia 2006/2007.

Sections	Mass in mg/ m3				Diameter in µm	
	Maximum	Mean	Range	Median	Maximum	Mean
Blowing	61.44	32.20	5.75	34.78	4.10	4.07
Carding	21.03	8.00	1.94	8.88	4.13	3.90
Drawing	7.43	5.62	6.19	5.99	4.13	3.96
Ring frame	4.81	3.30	4.08	3.24	4.13	3.99
Preparatory	2.42	2.00	2.02	1.75	4.13	3.91
Weaving section	3.20	2.00	2.65	1.50	4.13	3.98

Workers in the blowing and carding areas were exposed to the highest levels of cotton dust with mean dust levels of 32.2 mg/ m3 and 8.0 mg/ m3 respectively. The concentrations of cotton dust in working sections were not normally distributed (skewed to one direction).

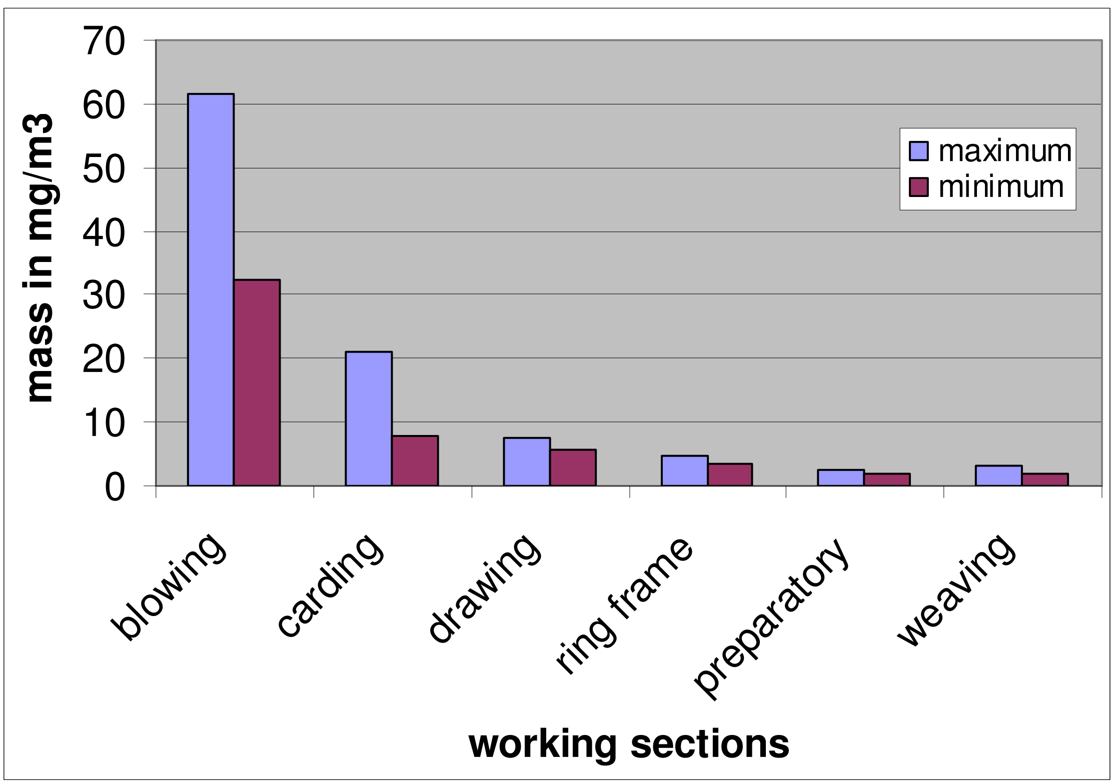

Fig 3. Maximum and minimum cotton dust concentration by working sections.

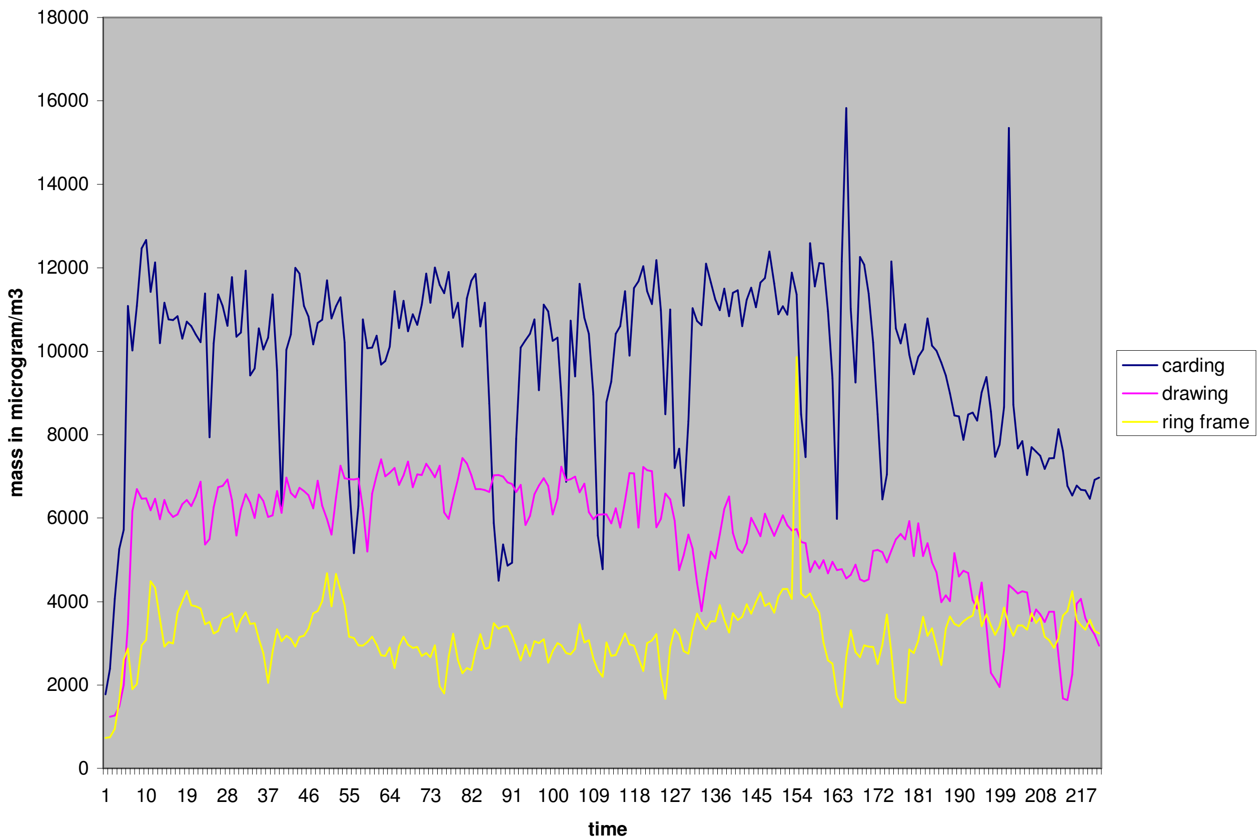

Fig.4 Variation of cotton dust concentration in the carding, drawing and ring frame sections.

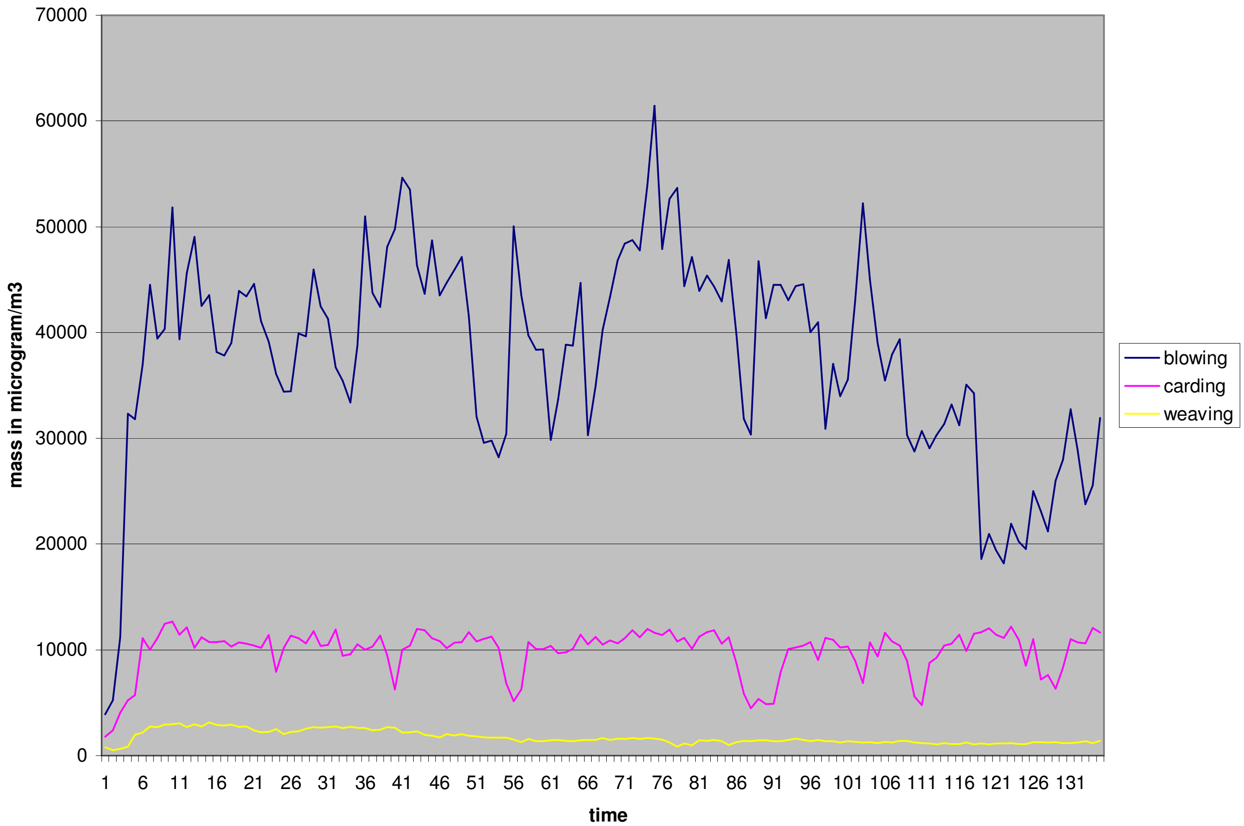

Fig.5. Cotton dust concentration difference among the three sections

5.6. Lung function measurements

Table 11. Observed and predicted FEV1 and FVC of mean ± SD among production workers in Akaki textile, cotton mill house, Addis Ababa, Ethiopia 2006/2007.

Sections	No. subjects	Observed		Predicted	
		FEV1*	FVC**	FEV1***	FVC***
Blowing	11	2.6±0.76	2.98±0.54	3.2±0.73	3.75±0.54
Carding	8	2.2±0.71	2.76±0.29	3.48±0.32	4.27±0.67
Drawing	10	2.25±0.79	2.76±048	2.94±0.61	3.57±0.78
Roving	58	2.25±0.78	2.85±0.55	2.88±0.74	3.45±0.58
Reeling	15	2.07±0.38	2.36±0.57	2.52±0.38	2.92±0.44
Ring frame	24	2.27±0.68	2.61±0.77	2.83±0.63	3.37±0.82
Preparatory	55	2.23±0.52	2.38±0.60	2.68±0.48	3.11±0.62
Weaving section	23	2.54±0.67	2.66±0.69	3.34±0.55	4.13±0.78

* Significance at $p<0.05$, ** significance at $p<0.01$ and *** significance at $p<0.001$

Table 11 depicts the comparison of mean and standard deviation of the observed FEV1, FVC, pred. FEV1 and pred. FVC test results in textile, cotton mill house according to working sections. The ANOVA statistics tells us that there was mean difference of FEV1 and FVC between groups and statistically significant at $p<0.05$ and $p<0.01$ respectively. Similarly, the mean difference of pred.FEV1 and pred.FVC between groups were statistically significant at $p<0.0001$. The mean of twisting, carding, preparatory, roving and drawing sections were slower than the other sections.

Table 12. Chronic changes in FEV1 by years of exposure in among production workers in Akaki textile factory Addis Ababa, Ethiopia 2006/2007.

Grade of Byssinos	No. subjects	FEV1 Chronic changes		
		Normal > 80% of pred. FEV1	Moderate 60-80%of pred.FEV1	Sever <60% pred. FEV1
Grade 1/2	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 (10.9%)

Table 12 presents the chronic changes in ventilatory functions. According to WHO classifications workers with FEV1 greater than 80% of the predicted value are considered to have no chronic ventilatory impairment, those with FEV1 60 to 80% have slight to moderate and those with FEV1 less than 60% to have moderate to severe impairment. About 11.0% of byssinotics developed FEV1 severe chronic changes. Of the byssinotic workers 32% to 45% showed slight to moderate chronic impairment and 52.0% to 54.8% had no chronic impairment.

6. DISCUSSION

The relationships between occupation and occupational pulmonary contaminants and respiratory symptoms have been studied since the late 1970s (21). In this investigation the authors tried to make a study on 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, where 29.8% had cough, 24.4% Phlegm, 23.4% chest tightness, and 43.3% dyspnea comparing with the weaving department. Workers in the spinning department were three times, two and half times, two times and one and half times likely to have cough, phlegm, chest tightness and dyspnea respectively compared to the weaving department. There were similar findings which showed a high degree ($p < 0.001$) of respiratory-related illness symptoms present among the workers in the blow/card rooms and the workers in the spinning section (15) and having respiratory symptoms in the spinning department was about twice that of the weaving department and the difference was statistically significant ($p<0.05$)(16).

The highest prevalence of respiratory symptoms (cough 77%, phlegm 62%, chest tightness 46% and dyspnea 62%) were found in the carding section comparing with other sections and workers in this sections were more likely to contract phlegm 13 times and tightness 8 times higher compared to others sections. Workers in blowing sections were seven times more likely to have dyspnea than the other sections. This study showed that the higher prevalence of respiratory symptoms were found compared to other studies done in China frequent cough 2.23 %, 95% CI 1.05-4.75, frequent phlegm 3.24%, 95% CI 1.54-6.84), shortness of breath 4.54%, 95% CI 1.40-14.72, Bangladesh 4.3 % experienced chest tightness or breathlessness and India cough or phlegm 18.2% (15,18,19).

The study done by Mehdi G. et al in South Tehran, Iran, found a significantly higher prevalence of respiratory symptoms related to textile industrial workers such as cough 30.8%, phlegm 53.8% and dyspnea 65 % and by using logistic regression the risk of respiratory disorders for dyspnea was highest 12.86 times, cough 3.43 times phlegm 2.08 times and tightness 0.22 times (1).

This study revealed that the over all prevalence of chronic bronchitis was 23.0% and the highest found in carding sections 69.2%. Prevalence of chronic bronchitis increased with increasing years of exposure (twenty to twenty nine 30.0% and forty to forty-nine 27.7%). Workers in carding sections were 13 times more likely to have chronic bronchitis comparing with the other sections and strongly significant at $p < 0.001$. There were similarity findings that the prevalence of chronic bronchitis increased with increasing age and duration of exposure. However; in these studies the prevalence of chronic bronchitis found small 5.7% and 10.9% compared to this finding (12,15).

Byssinosis is a world wide and popular occupational disease. Schilling and his colleagues under took the first epidemiologic studies in 1950's. 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 presented over all prevalence of byssinosis among cotton mill workers in this study was 38.0% and relatively lower than the study conducted in Bahir Dar textile by Wolyohanis et al 43% and Yekoye et al ,1995, 45% at different time and the study in Khartoum, Sudan 46% (32,33,34).

This investigation revealed the high prevalence of byssinosis reported in the carding (84.6%), drawing (72.2%) and ring frame (63.0%) sections compared to the report in Bahir Dar 57.9 % in the carding section and 57.1% in the ring frame section and the study in Sudan-Khartoum revealed that the prevalence of byssinosis was 67% among blowers, 40% in carders and draw-frame workers (32, 33, and 34). The high prevalence of byssinosis in these sections may be due to the fact that those sections were not segregated from the card room. This may also explain the closeness of dust levels in these sections. Cotton processing is known to produce a respiratory disease known as byssinosis particularly in the early processes of cotton spinning (9). The lowest prevalence of byssinosis in this study was in 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 difficult on Monday (grade I byssinosis) was found higher in the reeling (50%), carding (46.2%) and drawing (44.4%) sections. Similarly, chest tightness or breathing difficult on Monday and other days (grade II byssinosis) were higher in carding sections (15.4%). Production workers had been worked in reeling, 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 the other sections ($p < 0.001$). It has noticed that prevalence of byssinosis is common particularly those who exposed to high concentration of dusts for a longer time than other factors (27).

This study revealed that of those who had byssinosis 36.8% were non-smokers and eight smokers of eleven had byssinosis. No significance difference was found in the prevalence of byssinosis between smokers and non-smokers .The numbers of smokers were small in number in this study. However, the result generally tells us that smokers were more likely to have byssinosis. This is strengthened by the study conduced in Taiwan, revealed that smoking potentiated the effect of cotton dust exposure on respiratory symptoms and byssinosis and the prevalence of impaired lung function in smokers was also significantly higher than that in non-smokers (20).

The prevalence of byssinosis was increasing with age’s increased and the ages forty to forty nine was one and half times and ages greater or equal to fifty was nearly two times likely to have byssinosis comparing with the reference age < 40. This investigation showed that a significance increase in the prevalence of byssinosis with increasing years of exposure. All byssinosis grade steadily increased by duration. This finding was supported by many studies that the progression in the degree of the disease was related to the duration of exposure (23, 26).

Workers in all working areas (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 sections 2.0 mg/m3) were exposed to the high level of cotton dust less than 4 μm diameter 4 to 64 times above the permissible threshold limit value (TLV). Likewise, the prevalence of byssinisis 38.0% and other respiratory symptoms (cough 77.0%, phlegm 62.0%, chest tightness 57.0%, dyspnea 62.0% and chronic bronchitis 23.0%) were higher in these areas where high level of dust concentration presented.

Health and safety guidelines in the United Kingdom described the recommended procedures and set the permissible exposure level at 0.5 mg/m3 (27). Committee of Hygiene standards in 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 down to less than 0.5 mg/m3, as measured by the work area sampling technique. In the United States, cotton dust standard was 0.2 mg/m3 for the areas of packing, carding and spinning, and 0.75 mg/m3 for the slashing and weaving area (24).

Technical prevention is very important, which the situation in the USA proves. The technical and technological improvements have practically brought to reduction and finally to disappearance of the prevalence of byssinosis. There are different highest admitted concentrations of textile dust in different countries. In the USA the National Institute for Occupational Safety and Health (NIOSH) recommends time-weighted averages (TWA) for cotton dust bellow 0.2 mg/m3. Occupational Safety and Health Administration (OISHA) recommends TWA from 0.1 to 1 mg/m3 according to performed operation, personal exposure limits (PEL) 1 mg/m3. In Germany TWA makes 1.5 mg/m3, in Sweden and the UK it is 0.5 mg/m3, in Switzerland 0.3 mg/m3(23).

The ANOVA statistics tells us that there was mean difference of FEV1 and FVC between groups that is statistically significant at $p<0.05$ and $p<0.01$ respectively. Similarly, there was also the mean difference of pred.FEV1 and pred. FVC between groups that was statistically significant at $p<0.0001$. 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 the mean measured values of ventilatory capacity (FEV1 and FVC) were significant extent reduced in the exposed groups compared with controls ($P<0.01$)(33).

The chronic changes in ventilatory functions, according to WHO classifications workers with FEV1 greater than 80% of the predicted value were considered to have no chronic ventilatory impairment, those with FEV1 60 to 80% slight to moderate and those with FEV1 less than 60% to have moderate to severe impairment. About 11.0% of byssinotics developed FEV1 severe chronic changes. Of the byssinotic workers, 32% to 45% showed slight to moderate chronic impairment and 52.0% to 54.8% had no chronic impairment.

7. STRENGTH AND LIMITATION

Cross-sectional study, like all epidemiological study design option has unique strength and limitation that needed to be considered so as to yield a valid result.

7.1 STRENGTH

- It can be the baseline information for further epidemiological studies.
- It used dust measurements and lung function tests along with the standard respiratory questionnaires.
- It determined the magnitude of respiratory health problem in textile.
- It used cotton dust measurement and lung function measurement.

7.2 LIMITATION

- Control groups were not included
- Work shift lung function measurement was not done to identify the acute changes of FEV1 of workers.
- Personal samplings for dust concentration measurements were not undertaken.

8. CONCLUSION

In view of the above discussion points, the following conclusions are being to drawn.

- ✓ The prevalence of byssinosis and other respiratory symptoms were higher.
- ✓ The prevalence of byssinosis was increased with increasing years of exposure and ages got increased.
- ✓ Inhaling cotton dust was identified as a source of byssinosis and other respiratory disease for textile workers.
- ✓ The byssinosis occurs more in cotton mill house particularly in those who exposed to high concentrations of dust for a long period.
- ✓ Workers who had cotton dust exposure in spinning department were more likely to have byssinosis and other respiratory symptoms.
- ✓ In spinning mill, the extent of cotton dust contamination varies from section to section, as it was worst in the blow room, carding and drawing and minimum at the ring frame section.
- ✓ The concentrations of cotton dust in the working environment of all sections were found above the permissible thresh hold limits value (TLV).
- ✓ Long duration of exposure to cotton dust caused the chronic ventilatory impairment.
- ✓ Preventive measures are supreme importance in minimizing the prevalence of byssinosis and other respiratory disorders. Controlling dust, using face masks, and other measures can reduce the risk.

9. RECOMMENDATION

Based on the study findings the following important recommendations are forwarded which could help to reduce the prevalence of byssinosis and other respiratory symptoms and to create healthy and conducive working environment. Textile management should proceed in the following sequence to control the cotton dust exposure to workers:

1 **Engineering controls to reduce the emission**: the cotton dust levels of the occupational environment are above PEL, and then management should explore ways and means to reduce its level. Local exhaust ventilation systems should be installed at machines or areas with high dust levels like blowing, carding and drawing sections which capture dust particles and to avoid their dispersal to nearby areas of the same production floor and dilution ventilation could be sufficient for other sections.

2. **Monitoring of cotton dust concentration in the occupational environment**: the managements should monitor the cotton dust concentration in the occupational environment.

3. **Training and education of workers:** an organization should provide a training program for all employees exposed to cotton dust and should assure that each employee is informed of the following:

- ❖ The acute and long term health hazards associated with exposure to cotton dust
- ❖ The names and description of jobs and processes that could result in exposure to cotton dust at or above the PEL.
- ❖ The measures including work practices necessary to protect the employee from exposure in excess of the permissible exposure limit.
- ❖ The purpose and proper use for respiratory protection.
- ❖ The purpose for and a description of the medical surveillance program required by and other information that will aid exposed employees in understanding the hazards of cotton dust exposure.

4. **Use of dust masks**: workers should be provided with appropriate dust masks which can cover their noses and mouth and prevent the inhalation of dusts into workers breathing systems. Their utilize should be explained and enforced in the blowing, carding, drawing, roving and ring frame Sections.

5. **Provide medical surveillance to the cotton dust exposed workers:** it is recommended for the employer to provide medical surveillance of those employees exposed to cotton dust. Employees exposed to cotton dust are generally checked for forced expiratory volume in one second (FEV1) and forced vital capacity (FVC). For new employees, this examination shall be provided prior to initial assignment.

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ANNEX

I.WHO grading system for byssinosis

CLASSIFICATION	SYMPTOMS
Byssinosis:	
Grade 0	No symptoms
Grade B_1	Chest tightness and/or shortness of breath on most of first days back at work
Grade B_2	Chest tightness and/or shortness of breath on the first and other days of the working week
Respiratory Irritation:	
Grade RTI1	Cough associated with dust exposure
Grade RTI2	Persistent phlegm(i.e. on most days during 3 months of the year)initiated or exacerbated by dust exposure
Grade RTI3	Persistent phlegm initiated or made worse by dust exposure either with exacerbation of chest illness or persisting for 2 years or more
Acute changes	
No effect	A consistent decline in FEV1 of less than 5% or increase in FEV1

	during the working shift
Mild effect	A consistent decline 5-10% in FEV1 during the working shift
Moderate effect	A consistent decline 10-20% in FEV1 during the working shift
Sever effect	A decline of 20% or more in FEV1 during the working shift
Chronic changes	
No effect	FEV1 80% of predicted value
Mild to moderate effect	FEV1 60-79% of predicted value
Sever effect	FEV1 less than 60 % of predicted value

II. WRITTEN CONSENT FORM

Addis Ababa University Faculty of Medicine Department of Community Health

<u>Questionnaire for assessment prevalence of byssinosis and other respiratory symptoms among production workers in Aday Ababa textile cotton mill house Addis Ababa.</u>

Questionnaire identification number-----------------------

Identification

Name of industry---------------------

Final product-------------------------

Address: kebele--------------- sub city-------------------

<u>Verbal consent form before conducting interview</u>

Greeting

How are you, I am---------------------. I am working in the research team of Addis Ababa University Medical Faculty Department of Community Health. I would like to ask you a few questions about your personal characteristics, the use of personal protective equipment, occupational history and duration of exposure for cotton dust. This will help us to improve occupational health safety and wok environment management provided to you base on your answers to our questions. Your name will not be written in this form and will never be used in connection with any information you tell us. All information given by you will be kept strictly confidential. Your participation is voluntary and you are not obligate to answer any question you do not wish to answer. If you feel discomfort with the interview, please feel free to drop it any time you want. This interview will take about 30 minutes. Could I have your permission to continue?

1. If yes, continue the interview.
2. If no, skip to the next participant by writing reasons for his/her refusal.

Informed consent Certified by

Interviewer: Code-----------------Name-------------------------------signature-------------------

Date of interview-----------------Time started---------------------- Time completed------------

Result of interview: 1. Completed 2. Respondent not available 3. Refused 4. Partially completed

Checked by: Supervisor--------------------------------

III. Questionnaire

Identification No___________________

I.PERSONAL CHARACTERS TICS

Ser.no	Question	Response	Code	Skip to
101	Working section	____________________		
102	Sex	1.male 2. female		
103.	Age	_____years		
104	Marital status	1.single 2.married 3.divorced 4.widowed		
105	Religion	1.orthodox 2.muslem 3.protestant		
106	Ethnicity	1.oromo 2.amhara 3.tigre		

		4.other		
107	Monthly income	_______birr		
108	Working Department	1.spinning 2.weaving		
109	Working section	1.blowing 2.carding 3.drawing 4.roving 5. ring frame 6. reeling 7. preparatory 8. weaving section		
9.	Period of employment	______to____E.C		
II. PROTECTIVE DEVICE				
201	Have you ever used protective device?	1. Yes 2. No		
202	**If yes**, what type of personal protective device do you use?	1. respirators 2. 2.face shields 3. gloves 4. ear plug 5. helmets 6. others, specify_________		
203	If no, what are your reasons for not using personal protective device?	1.lack of protective device 2.lack of safety and health education 3.the device is not comfortable 4.the device decrease work performance		
III.RESPIRATORY SYMPTOMS				
Cough				
301	Do you usually cough first thing in the morning? (On			

	getting up)*(Count a cough with first smoke or on "first going out of doors". Exclude clearing throat or a single cough.)	1. Yes 2. No		
302	Do you usually cough during the day or at night? (Ignore an occasional cough.)	1. Yes 2. No		
303	**If YES to either 1 or 2:** 3. Do you cough like this on days for as much as Three months a year?	1. Yes 2. No 9. not applicable		
304	4. Do you cough on any particular day of the week?	1. Yes 2. No		
305	**If YES**: Which day?	1. Mon____ 2. Tue_____ 3 .Wed_____ 4 .Thur_____ 5. Fri______ 6. Sat______ 7 .Sun _____		
	If YES;	1.in dusty environment 2.in cold environment 3.in hot environment 4.othr, specify_________ 9.not applicable		

PHLEGM				
306	Do you usually bring up any phlegm from your chest first thing in the morning? (On getting up)(Count phlegm with the first smoke or on "first going out of doors." Exclude phlegm from the nose. Count swallowed phlegm.	1. Yes 2. No		
307	Do you usually bring up any phlegm from your chest during the day or at night? (Accept twice or more.)	1. Yes 2. No		
308	If YES to either question 6 or Do you bring up phlegm like this on most days for as much this on most days for as much as three months each year?	1. Yes 2. No		
309	If YES to question 3 or 8: How long have you had this phlegm? (cough) (Write in number of years)	(1).2 years or less (2). More than 2-9years (3) 10-19years (4). 20+years		
Chest illness				
310.	In the past three years, have cough and phlegm	(1) No lasting for 3 weeks or more? (2) Yes, only one period (3) Yes, two or more periods		
For subjects who usually have phlegm:				

311.	During the past 3 years have you had any chest illness, which has kept you off work, indoors at home or in bed? (For as long as one week, flu?)	1. Yes 2. No		
312.	**If YES to 11:** Did you bring up (more) phlegm than usual in any of these illnesses? If YES to 12: During the past three years have you had:	1. Yes 2. No		
313.	Only one such illness with increased phlegm?	1. Yes 2. No		
314.	More than one such illness:	1. Yes 2. No		
	TIGHTNESS			
315.	. Does your chest ever feel tight or your breathing become difficult	1. Yes 2. No		
316.	Is your chest tight or your breathing difficult on any particular day of the week? (after a week or 10 days away from the mill)	1. Yes 2. No		
317.	If `Yes': Which day?	1.Mon---------- 2.Tues---------- 3. Wed. --------- 4. Thur. --------- 5. Fri.------------		

		6. Sat.----------- 7. Sun------------. 1.Sometimes 2.Always		
318.	**If YES Monday**: At what time on Monday does your chest feel tight or your breathing difficult?	1.Before entering the mill 2.After entering the mill		
Ask only if no to question15				
319.	In the past, has your chest ever been tight or you breathing difficult on any particular day of the week?	1. Yes 2. No		
320.	If `Yes': Which day?	1) Mon. 2) Tues. 3) Wed. 4) Thur. 5) Fri. 6) Sat. 7) Sun. 1.Sometimes 2.Always		
Breathelness				
321.	If disabled from walking by any condition other than heart or lung diseases put "X" in the space and leave questions (22-30) unasked.			
322.	Are you ever troubled by shortness of breath, when hurrying on the level or	1. Yes 2. No		

	walking up a slight hill?			
If NO, grade is 1. If YES, proceed to next question				
323.	Do you get short of breath walking with other people at an ordinary pace on the level?	1. Yes 2. No		
If NO, grade is 2. If YES, proceed to next question				
324.	Do you have to stop for breath when walking at your own pace on the level?	1. Yes 2. No		
If NO, grade is 3. If YES, proceed to next question.				
325.	Are you short of breath on washing or dressing?	1. Yes 2. No		
If NO, grade is 4, If YES, grade is 5. 326. Dyspnea Grd.				
	ON MONDAY			
327.	Are you ever troubled by shortness of breath, when hurrying on the level or walking up a slight hill?	1. Yes 2. No		
If NO, grade is 1, If YES, proceed to next question				
328.	Do you get short of breath walking with other people at an ordinary pace on the level?	1. Yes 2. No		
If NO, grade is 2, If YES, proceed to next question.				
329.	Do you have to stop for your own pace on the level?	1. Yes		

		2. No		
If NO, grade is 3, If YES, proceed to next question				
330.	Are you short of breath on washing or dressing?	1. Yes 2. No		
	If NO, grade is 4, If YES, grade is 5. B. Grd.			
THEIR ILLNESSES AND ALLERGY HISTORY				
332	Do you have a heart condition for which you are under a doctor's care?	1. Yes 2. No		
333.	Have you ever had asthma?	1. Yes 2. No		
	If yes, did it begin:	(1) Before age 30 ______ (2) After age 30 ______		
334.	If yes before 30: did you have asthma before ever going to work in a textile mill?	1. Yes 2. No		
335.	Have you ever had hay fever mill? than above)?	1. Yes 2. No		
IV. TOBACCO SMOKING				
401	Do you smoke? Record Yes if regular smoker up to one month ago.	1. Yes 2. No		
402	If NO to (36). Have you ever smoked? (Cigarettes, cigars, pipe) Record NO if subject has never smoked as much as one cigarette a day, or 1 oz. of tobacco a month, for as long as one year	1. Yes 2. No		

If YES to (36) or (37)				
	What have you smoked for how many years? (Write in specific number of years			
403.	Cigarettes	1.< 5 Years 2.5-9 Years 3.10-14 Years 4.15-19 Years 5.20-24 Years 6.25-29 Years		
404.	If cigarettes, how many packs per day? Write in number of cigarettes	1.Less than 1/2 pack 2.1/2 pack, but less than1pack 3.1 pack, but less than 4.1 1/2 packs 5.1-1/2 packs or more		
405.	If an ex-smoker (Cigarettes, cigar or pipe), how long Since you stopped? (Write in number of years.)	1.0-1yr 2.1-4 yrs 3.5-9 yrs 4.10+yrs		
V.OCCUPATIONAL HISTORY				
501.	**Have you ever worked in:** A foundry? (As long as one year)	1. Yes 2. No		
502	Stone or mineral mining, Quarrying or processing? (As long as one year	1. Yes 2 .No		
503.	Asbestos milling or Processing? (Ever)	1. Yes---- 2. No---		
504	Cotton or cotton blends mill? (For controls only)	1. Yes---- 2. No----		
505.	Other dusts, fumes or			

	Smoke? If yes, specify. ▪ Type of exposure ▪ Length of exposure	1. Yes----- 2. No----		

IV. **Amharic version Questionnaire on byssinosis and other respiratory symptoms among production workers in Aday Ababa textile cotton mill house Addis Ababa, Ethiopia.**

SKÁ IØ`----------------

I.**PERSONAL CHARACTERSTICS**

}^.l	ØÁo	SMe	¢É
101.	ï	1.-"É 2.c?ƒ	1 2
102.	°ÉS- e"ƒ '¬;		
103.	¾Òw‰ G<'@	1.ÁLÑv 2.vKƒÇ` 3.¾ð(‹) 4.V„w—M	1 2 3 4
104.	HÃT•ƒ	1.*`„Ê¡e }ªlÊ 2.eMU" 3.ýa+e"ƒ 4.Ÿ„K=¡ 5.K?L ŸK ÃÖke-------------------------------------	1 2 3 4 9
105.	wN?[cw	1.*aV 2.›T^ 3.ƒÓ_ 4.Ñ<^Ñ@ 5.K?L ŸK ÃÖke-------------------------------------	1 2 3 4 9
106.	¾ƒUl`ƒ Å[Í	1.T"uw " S×õ ¾TÃ>‹M 2. T"uw " S×õ ¾T>>‹M 3.¾SËS]Á Å[Í ƒUl`ƒ ÁÖ"kk(‹) 4.G<K}— Å[Í ƒUl`ƒ ÁÖ"kk(‹) 5.Ç=ýKAT ÁK¬(Lƒ) 6.¾SËSÁ Ç=Ó] ÁK¬(Lƒ) 7.K?L ŸK¬ ÃÖke--------------------	1 2 3 4 5 6 9
107.	¾¨` Ñu=- e"ƒ '¬;		

		w`	
108.	e^-” ¾T>c\uƒ ¡õM ¾ƒ ’¬;	----------------------------	
109	e^-” ¾T>c\uƒ c?¡Y”¾ƒ ’¬;	1. 2. 3. 4.	
110.	u²=l ¾e^ ¡õM ¬eØ U” ÁlM Ñ>²? c\;		

II.PROTECTIVE DEVICE

201.	ue^- KÃ dK< SŸLŸÁ }ÖpS¬ Á¬nK<;	1.›- 2.›ÃÅKU-----ÅØÁo203	**1** **2**
202.	U” ›Ã’ƒ SŸLŸÁ ’¬ ¾T>ÖkS<ƒ;	----------------------------------	
203.	KU”É” ’¬ SŸLŸÁ ¾TÃÖkS<ƒ;	1.SŸLŸÁ eKK?K 2.Ø**p**S<” eKTL¬p 3.UŒƒ eKK?K¬ 4.¾e^ õØ’ƒ” eKT>k”e 5.K?L ŸK ÃÖke------------	**1** **2** **3** **4** **5**

III.RESPIRATORY SYMPTOMS

	cough		
301	Öªƒ ŸS˜- c=’c< G<MÑ>²? ÁeK-M;	1.›- 2.›ÃÅKU	**1** **2**
302.	G<MÑ>²? k” ¨ÃU T LÃ ÁeK-M;(›Mö›Kö ŸJ’ ÃKõ)	1.›- 2.›ÃÅKU	**1** **2**
303.	ØÁo 301“ 302 SMe ›- ŸJ’ u¯Sƒ u=u³ eŸ feƒ ¨` k” LÃ ÁeK-M;	1.›- 2.›ÃÅKU	**1** **2**
304.	udU”ƒ vK<ƒ k“ƒ ¬eØ ¾}K¾ k” LÃ ÁeK-M;	1.›- 2.›ÃÅKU---¨Å ØÁo 207	**1** **2**
305.	u¾ƒ—¬ k”;	1.c™ 2.T¡c™ 3.[u<° 4.NS<e 5.¯`w 6.pÇT> 7.G<É	**1** **2** **3** **4** **5** **6** **7**
306.	u¾ƒ—¬ G<’@ ’¬ ¾T>ÁeK-ƒ;	1.›v^ c=u³	

		2.c=k²p´ 3.Vnƒ c=J” 4.K?L ŸK ÃÖke----	
	phlegm		
307.	G<MÑ>²= Öªƒ ŸS˜-ƒ c=’c< ŸÅ[ƒ-ƒ LÃ ›¡ ’Ñ` ¾e}ó-M;	1.›- 2.›ÃÅKU	**1** **2**
308.	G<MÑ>²? ›¡ ScM ’Ñ` ŸÅ[ƒ-ƒ LÃ k” ¨ÃU T LÃÁe}ó-M(G<Kƒ Ñ>²? ¨ÃU Ÿ²=Á uLÃ)	1.›- 2.›ÃÅKU	**1** **2**
309.	ÃI ›¡ u›w³—¬ k“ƒ u=u³ Kfeƒ ¨` u¾¯S~ Áe}ó-M;	1.›- 2.›ÃÅKU	**1** **2**
310.	Ke”ƒ Ñ²?= ’¬ ÃI ›¡ ¨ÃU dM ¾’u[¬ƒ;	☐☐ ¯Sƒ	
	chest illness		
311.	LKñƒ feƒ ¯Sƒ dM ¨ÃU ›¡ ’u[-ƒ;	1.›ÃÅKU 2.›- K›”É cV” w‰ 3.›- G<KƒdU”ƒ “ “ Ÿ²=Á uKÃ	1 2 3
	›¡ LL†¬ w‰		
312.	LKñƒ 3 ¯Sƒ ¾Å[ƒ ¬Òƒ(ISU)Ÿe^¬ƒ ›ek`„-ƒ u?ƒ ¬eØ ›MÒ KÃ ¬K¬ Á¬nK<;(K›”É dU”ƒ Ñ>²?)	1.›- 2.›ÃÅKU	1 2
313.	KØÁo 311 SMe ›- ŸJ’&Ÿ}KSÅ¬ ¬ß uw³ƒ ›¡ u²=I ISU Ñ>²= ’u[-ƒ;	1.›- 2.›ÃÅKU	1 2
314.	KØÁo 312 SMe ›- ŸJ’ &vKñƒ feƒ ¯Sƒ K›”É Ñ>²? w‰ ’¬ u²=I ISU ›¡ uw³ƒ ¾’u[-ƒ;	1.›- 2.›ÃÅKU	1 2
315.	&Ÿ›”É Ñ>²= uLÃ ’¬ ÁSS-ƒ;	1.›- 2.›ÃÅKU ¨Å ØÁo 321	1 2
	tightness		
316	Å[}-ƒ ¾¬Òƒ eT@ƒ ¨ÃU ¾S}”ðe ‹Ó` ’u[u-ƒ;	1.›- 2.›ÃÅKU	1 2
317.	udU”ƒ vK<ƒ k“ƒ u}K¾ SMŸ< u›”Æ k” Å[}-ƒ ¾¬Òƒ eT@>ƒ ¨ÃU ¾S}”ðe ‹Ó` ’u[u-ƒ;	1.›- 2.›ÃÅKU----¨Å ØÁo 322	1 2
318.	u¾ƒ—¬ k”;	1.c™ 2.T¡c™ 3.[u<°	1 2 3

		4.NS<e 5.¯`w 6.pÇT> 7.G<É	4 5 6 7
319.	Ç=ÓÓVi	1.›”Ç”É Ñ>²= 2.G<MÑ>²=	1 2
320.	KØÁq 318 c™ ŸJ’ SMc< U” c›ƒ LÃ ’¬ Å[ƒ-ƒ ¾¬Òƒ eT@>ƒ ¨ÃU ¾S}”ðe ‹Ó` ¾T>cT-ƒ;	1.¨Å e^ ŸSÓv+ uòƒ 2.e^ ŸÑvG< uL	1 2
321.	KØÁo 315 SMe ›ÃÅKU ŸJ’&vKð¬ Å[ƒ- ¾¬Òƒ(¾ISU) ¨ÃU ¾S}”ðe ‹Ó` udU”ƒ u›”Æ k” u}K¾ SMŸ< ’u[w-ƒ;	1.›- 2.›ÃÅKU	1 2
322.	u¾ƒ—¬ k”;	1.c™ 2.T¡c™ 3.[u<° 4.NS<e 5.¯`w 6.pÇT> 7.G<É	1 2 3 4 5 6 7
323.	ÉÓÓVg<e;	1.›”Ç”É Ñ>²= 2.G<MÑ>²=	1 2
	breathlessness		
324.	**ŸMw ¨ÃU Ÿd”v ISU ¬ß uK?L ‹Ó` U¡”Áƒ ¾S^SÉ‹Ó` ›Ku-ƒ;**	1.›- 2.›ÃÅKU----¨Å ØÁo 401	1 2
325.	ðÖ” wK¬ ¨ÃU ›kuƒ LÃ c=H@>Æ ƒ”ói TÖ` ‹Ó` ›ÒØV-ƒ Á¬nM;	1.›- 2.›ÃÅKU	1 2
326.	u}KSÅ¬ G<’@ Ÿc-‹ Ò` c=%@Æ ƒ”ói ÁØ[-M;	1.›- 2.›ÃÅKU	1 2
327.	uKSÆƒ ›[TSÉ c=Ñ>²< ¾ƒ”ói TqU ‹Ó` ’u[u-ƒ;	1.›- 2.›ÃÅKU	1 2
328.	c=Öu< ¨ÃU Mwc-” c=Kwc< ƒ”ói ÁØ[-M;	1.›- 2.›ÃÅKU	1 2
329.	c™ °Kƒ ðÖ” wK¬ ¨ÃU ›kuƒ KÃ c=Ñ>²< ¾ƒ”ói TÖ` ÁÒØS-M;	1.›- 2.›ÃÅKU	1 2

Iv. **Their Illness And Allergy History**

401.	NŸ=U ¡ƒƒM ¾T>ÁÅ`ÓK-ƒ ¾Mw ‹Ñ` ›Kw-ƒ;	1.›- 2.›ÃÅKU	1 2
402	¾›eU ‹Ó` ’u[w-ƒ;	1.›- 2.›ÃÅKU	1 2

403.	KØÁo 402 SMe ›- ŸJ’&Sˆ ’¬ ¾ËS[-ƒ;	1. 30¯Sƒ dÃVL˜ 2. 30¯Sƒ ŸVL˜ uH>L	1 2
404.	KØÁo 403 SMe ›- ŸJ’&²=I Ú`nÚ`p ŸSe^ƒ-ƒ uòƒ ›eU ’u[w-ƒ;	1.›- 2.›ÃÅKU	1 2
405.	H@Ã ƒŸ<dƒ e^ c=c\ •aƒ Á¬nM;	1.›- 2.›ÃÅKU	1 2

v. Tobacco Smoking

501.	c=Ò^ ÁÖ?dK<;(eŸ ›"É ¨` uòƒ SÅu— ›Ýi Ÿ'u\)	1.›- 2.›ÃÅKU	1 2
502.	›G<" ¾TÁÖ?c< ŸJ' c=Ò^ ›Ö=c¬ Á¬nK<;(uk" ›"É c=Ò^ ŸLÖ?c< ›ÃÅKU }wKA ÃS´Ñw)	1.›- 2.›ÃÅKU	1 2
503.	Ke"ƒ ¯Sƒ ›Ö?c<;	¯Sƒ	
504.	e"ƒ ûŸ=ƒ c=Ò^ ÁÖ?dK;<	ûŸ?=ƒ	
505.	Éa ›Ö=c¬ ›G<" ¾UÁÖ?c< ŸJ' c=Ò^ TÖ?e ŸqS< e"ƒ Ñ>²= J'-ƒ;	¯Sƒ	

Vi. Occupational History

601.	ó¬"É] LÃ K›"É ¯Sƒ c`}¬ Á¬nK<;	1.›- 2.›ÃÅKU	1 2
602.	É"ÒÃ ¨ÃU S°É" lóa ¨ÃU Ÿv c`}¬ Á¬nK<;	1.›- 2.›ÃÅKU	1 2
603.	›eu?e„e ów]" c`}¬ Á¬nK<;	1.›- 2.›ÃÅKU	1 2
604.	K?L ›v^ ¨ÃU ße ÁKuƒ e^ c`}¬ Á¬nK<;	1.›- 2.›ÃÅKU	1 2