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A Dissertation Submitted to the University of Zambia for the Partial Fulfilmnet of the Requirements of Master of Public Health

PREVALENCE AND FACTORS ASSOCIATED WITH ACUTE OCCUPATIONAL LUNG DISEASE AMONG COTTON GINNERY WORKERS IN KATETE DISTRICT

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MASTER OF PUBLIC HEALTH (MPH) – 2013

Declaration

I hereby declare that the work presented in this study for a Masters' Degree of Public Health is the product of my own work and that it has not been presented for any other degree. It has been prepared in accordance with the guidelines for Master of Public Health Dissertation of the University of Zambia. I further declare that, other peoples' work has been duly acknowledged and referenced thereto, to which I owe them.

Signed…………………………………………………….

Date………………………………………………………………

Candidate

Supervisors:

We the undersigned have read this dissertation and have approved it for examination.

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Approval of Admission of Dissertation

This dissertation by Dr Martha Sinzala is in partial fulfilment of the requirements for the award of the Master of Public Health Degree (MPH) by the University of Zambia, Lusaka.

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Dedication

I would like to affectionately dedicate this thesis to my youngest daughter, Kawela who despite being a small girl (5years) was able to remain and allow me to spend all the time on my books and come up with this work. I cannot wait to see her grow up into an adult and give a witness to this.

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List of Abbreviations

EFC	Expiratory Flow Capacity
FEV_1	Forced Expiratory Volume per second
FVC	Forced Vital Capacity
ILO	International Labour Organisation
MACO	Ministry of Agriculture and Cooperatives
MVV	Maximum Voluntary Ventilation
PEP	Peak Expiratory Flow Rate
UNZA	University Of Zambia
WHO	World Health Organisation

Abstract

The presence of byssinosis among workers in cotton ginneries has been well documented in studies from several countries.However, no studies had been performed among cotton workers in the Eastern Province of Zambia. In view of this, a cross sectional study design with 151 sample elements, drawn from Dunavant Ginnery in Katete, was employed. The main purpose of the study was to find out the prevalence of byssinosis among cotton ginnery workers. A survey questionnaire and lung function tests were conducted by a trained technician using a spirobank G spirometer.

At the time of the study, the workers were employed in five departments and just about half n= 77 (51.1%) were involved in carding with 48.1% involved in other jobs. The longest a worker had served the company was 180 months or fifteen years and the least was barely one month.Out of the 151 workers, only 50 workers (33.1%) did not experience any symptoms of byssinosis. A greater number suffered from chest tightness and/or shortness of breath on most of first days back at work and on the first and other days of the working week. However, 76 (50.6%) of the workers showed a reduction in one symptom over the weekends and an increase in another within the week. Using the generally accepted World Health Organisation (WHO) (1983) criteria, this study found evidence for byssinosis among cotton workers with the highest prevalence of among those who at the time of the study had been engaged in carding, blending, and cleaning processes. The prevalence of byssinosis among cotton workers was 67%. Lung functional tests showed a peculiar trend of decline from day one today four in this sample under study. Of the four lung function tests, Forced Expiratory Volume per second (FEVs) and Forced Vital Capacity (FVC) showed more consistent reduction changes. However, all lung function tests were not significantly associated with work induced byssinotic symptoms.

It can, therefore, be concluded on the basis of the study that byssinosis occurs in cotton workers particularly in those who are exposed to high concentrations of dust for a longer period especially in unmanaged and unprotected working environments.

The study recommends the provision of protective clothing, environmental hygiene and periodic medical examination at two yearly intervals to identify those who ultimately will have to leave the industry because of progressive symptoms.

CHAPTER ONE – INTRODUCTION

1.0 Background Information

Occupational health is simply public health applied to the work environment (WHO/ILO, 1950).Such an orientation requires serious efforts aimed at preventing and controlling occupational disease, even in the absence of definitive scientific knowledge. Failure to apply this fundamental approach to the hazards of the workplace has contributed to the continuing political, economic, and scientific controversies over byssinosis, a disabling lung disease of cotton mill or ginnery workers. Powerful economic interests, reinforced by medical and scientific uncertainty, have delayed and undermined effective measures for the prevention, control of, and compensation for this industrial disease. This, in turn, has resulted in placing the burdens of hazardous employment like the effects of cotton dust in the cotton industry on the party least able to bear the weight of public and corporate inaction-the sick worker (Jacobset al.,;1983; Li et al.,; 1995).The assumption made in this study is that the acute symptoms which these employees experience could be attributed to byssinosis.

Byssinosis is an acute occupational lung disease often observed among workers exposed to cotton dust (Cinkotai et al.,; 1998).The presence of byssinosis among workers in cotton ginneries has been well documented in studies from several countries. It has long been appreciated that exposures to organic dusts are potentially harmful to the respiratory tract. The hazards of grain dust exposure were described in the 5th century. Organic dusts are a diverse complex mixture containing material derived from vegetable and animal Sources (Schilling, 1981). The potential for such a dust to be hazardous to health is readily appreciable noting that cotton is emerging as a money spinner among peasant farmers and peri -urban mill or ginnery workers. Government, textile mills, ginneries and farms are the most important source of employment in the Eastern province and it has been estimated that nearly one thousand people work on the cotton farms and ginneries (MACO Annual Report, 2008).

Despite this and the fact that these ginneries have been the scene of several working class struggles, working conditions in most of the textile ginneries are known to be very bad. Dust, heat, noise, contact with dangerous chemicals and high frequency of accidents are the most common occupational hazardsAll these hazards result in the development of byssinosis,

Byssinosis is far from a mere workplace annoyance, however. Over the years, the discomfort of "Monday fever" often develops into a permanent condition that drains vitality and robs workers of years of life (Waren, 2003). The acute reversible symptoms gradually deteriorate to chronic irreversible dyspnoea which eventually persists even when the worker is away from the mill. In its later, disabling stage this disease is difficult to distinguish from chronic non-occupational lung diseases (Dogra, 1985; Karim and Ona, 1987). The problem of respiratory symptoms due to this disease seems to be high in industrialized countries. While the prevalence of byssinosis is decreasing in industrialized countries and persists at high levels in developing countries, this prevalence is unknown in developing countries and this includes Zambia, particularly in Katete district where cotton production has increased over the past two years. This has resulted in more cotton being processed.

1.1 Statement ofthe Problem

It has been shown that byssinosis is a problem in the West, Asia and some parts of Africa even when control measures have been in place to reduce the prevalence of this disease. This could be the case for Zambia too except that the severity and extent of the problem are not well studied. The Eastern Province of Zambia and particularly Katete are leading in cotton production and recruitment of persons working on cotton farms and cotton companies.Production of cotton has increased over the past two years in Katete district resulting in high levels of cotton being processed by the ginnery (DunavantReport, 2008) and more and more cotton dust being generated.

It has long been appreciated that exposures to organic dusts are potentially harmful to the respiratory tract (Schilling, 1981).Despite this, working conditions in most of the textile ginneries are known to be very bad which subjects workers to unhealthy working conditions .These include dust, storage of cotton for more than three months contrary to industry standard, lack of protective clothing and no periodic lung tests for workers as opposed to International Labour Organisation regulations (ILO, 2003).There are a number of notable problems and the following stand out.

KateteDistrict Hospital has over the years been recording higher numbers of respiratory complications some of which have unknown cause. According to hospital records there is an increasing trend in the number of respiratory related cases being reported. Forinstance, in 2008 there were 314 cases. This represents 15% increase in the cases being recorded compared to 2007. At the same time 17 were granted sick leave due to respiratory related conditions at the ginnery (Annual Report, 2008 Dunavant, Katete). While this is the case, at the moment, the district is unable to determine how many of these cases could be arising from cotton dust inhalation and the complications that have arisen.

To date, no attention has been paid to the effects of cotton dust on the respiratory systems of cotton workers**.** We are not in a position further, to ascertain whether or not workers in the cotton industry in Katete do have acute respiratory problems because no studies have been done so far.

It is important to measure the severity of the disease among cotton workers who are continuously exposed to the offending agent so that an intervention can be made before it worsens.

CHAPTER TWO - LITERATURE REVIEW

2.0 Introduction

This chapter will review the literature related to byssinosis. Since most studies in public health have not been done in Zambia, most of the literature discussed here is mainly based and informed by researches conducted in the West and some parts of Africa and Asia. Noting that it is difficult to get journals on occupational health and internal medicine and that the University of Zambia (UNZA) does not subscribe to most journals, this literature review has very few articles dating within the last five years. The bulk of the studies are from the 1970 to 1980 epochs.

An electronic search on keywords published only in peer reviewed articles in data bases where UNZA subscribes was performed to compile the main body of literature that has been reviewed. Other than these journal articles, an electronic multi-campus network of library holdings was used to identify books. Particular note was taken of references that were frequently cited in bibliographies and appeared to be classics. References were selected that reflected the models' original formulations and origins, and changes that have been made to the theories over time. In some instances, content within references was repetitive. When this occurred, the most comprehensive sources were selected for analysis.

2.1 Production of Cotton

The accumulation of knowledge concerning cotton dust exposure yielding byssinosis continues to be impeded by variations in the quality of cotton and the different methods for cotton harvesting. The main products of cotton seed mills are oil for human consumption, hulls for farm animals and lint as an industrial source for paper and cellulose. In the blow-room, where the cotton bales are opened and cleaned, the dust level is very high. Here the cotton is vigorously beaten several times to separate impurities. Then in the carding section, the laps of cotton are drawn on a machine so that dust, leaves, twigs, etc, can be separated. In the process a lot of cotton dust is released in the carding room. The next stage of work is in the spinning shed. Here also dust levels are high. The high dust level gives rise to respiratory problems and diseases. After treatment, cottonseeds are transported by pneumatic conveyors to machines where lint is separated from the surface of the seed by a process called ‘delinting’.

2.2 Characteristics of The disease

Byssinosis is a chronic airway disease associated with the inhalation of cotton and other textile dusts (Niven and Pickering, 1996). It is recognized as a worldwide occupational lung disease and remains a problem in the United States despite federally mandated regulations (Schachter, 1994). Acute manifestations of the disease are tightness in the chest, broncho-spasm, and shortness of breath. These responses occur early in the workweek, following a weekend without exposure, in a pattern described as ‘Monday dyspnoea’ (grade 0.5 or 1 byssinosis in the Schilling classification). In many epidemiological surveys, byssinosis is graded by a classification of Schilling and others as follows:

a) Grade ½ The worker feels occasional or mild symptoms such as irritation of the respiratory tract, chest tightness or coughs on the first day of the working week.
b) Grade 1: Chest tightness is experienced on every first day of the work week.
c) Grade 2: The worker feels chest tightness on the first and other days of the working week.
d) Grade 3: The worker has grade 2 symptoms and shows evidence of permanent ventilatory impairment from diminished respiratory effort intolerance.

Schilling’s original classification of byssinosis was updated later by the World Health Organisation (WHO). The WHO experts proposed classification of byssinosis in 1983 which should be used henceforth (see Table 1). This classification respects respiratory symptoms, acute and chronic disorders in lung ventilation. It also enables the classification of nonspecific respiratory tract irritation by dust which can indicate byssinosis as well. The value of FEV1 can be declined also in workers not having byssinosis; on the contrary, byssinosis cannot even be excluded in persons in whom the decline is not expressed (WHO, 1983).

Clinically, the onset of a byssinotic response typically occurs after exposure to dust in the industry. This temporal pattern of symptoms distinguishes byssinosis from other occupational airway diseases. Findings of ‘Monday dyspnoea’ may progress to chronic bronchitis with permanent lung function changes and chronic, debilitating airflow obstruction (Glindmeyer et al.,; 1994; Niven et al.,; 1994) showing varying symptoms such as cough, wheeze, shortness of breath and acute or chronic lung function decline(Niven and Pickering, 1999). In cotton dust-exposed workers, acute and chronic pulmonary function changes have been demonstrated. Jones et al., (1977) showed that mean functional declines over the working shift were present on the first working day of the week and absent on the last day, indicating an acute broncho-constrictor response of the workers in cottonseed mills.

Based on airway challenge observations, McKerrow and others suggested in 1958 that cotton dust contains a pharmacological agent responsible for airway constriction. From subsequent studies, Bouhuys et al. (1960) confirmed that the acute byssinotic response was elicited by aerosol inhalation of an aqueous dust extract, mediated by a water-soluble agent or agents. This group further demonstrated that not only textile workers but also healthy non-workers were susceptible to the broncho-constrictor effects of cotton dust, and that these responses were of similar magnitude. Thus, the acute reaction is not dependent on prior exposure or presentation. The experimental application of cotton dust to lung tissue in vitro was found to induce the release of histamine and other mediators (Bouhuys et al.,; 1961). Nicholls and others (1966) systematically studied components of the cotton boll for the capacity to cause histamine release. Among the parts of the plant tested were pericarps (fruit capsules), bracts and fibers. Of these, only the bract extract had consistent histamine-releasing properties. Neither extract of the pericarps nor that of the cotton fiber itself induced airway constriction in studies in humans (Bouhuys and Nicholls, 1966). Cotton bracts are leaf-like structures surrounding the stem of the cotton boll. They are friable and cling to cotton fibers after ginning. Bract was found by Morey and others (1976) to be the major trash component in raw baled cotton, with a mean value of 43.2% of total trash by weight. Investigators have considered bract a possible source of agents capable of inducing airway obstruction in byssinosis because of its high content in cotton dust and its ability to induce symptoms in challenged subjects.

2.3 Critical Studies on the Prevalence of Byssinosis

Clinical studies in byssinosis have tended to focus on pulmonary function, symptomatology, immunopathology and pathogenesis. Others have focussed on the prevalence of the disorder. Below, are summaries of the most cited studies. Most of the studies have been cross sectional with a few being experimental.

2.3.1 Global Perspective

Among the few studies that have assessed pulmonary responses to cotton dust in the early stages of exposure, Sepulveda and colleagues observed a significant decrement in FEV1 after exposure to 1.02 mg/m3 of elutriated cotton dust in model card rooms for six hours in 226 healthy and non-asthmatic volunteers. The mean FEV_1 decline, however, was found to be significantly greater in atopic subjects, defined by skin prick tests, than in non-atopic subjects.

Another experimental study by Beryl and others(1974) reported significantly higher bronchial reactivity after exposure to cotton dust for five hours in 57 non-smoking and non-asthmatic volunteers, while atopic subjects (defined by questionnaire) had higher reactivity than non-atopics. These studies suggest that non-specific airway responsiveness and atopic status may be two potential markers related to the variability of the acute response to cotton dust. This study could be relied upon a great deal because it did make a follow-up and it provided additional information in understanding the adverse effects of cotton dust inhalation at the early stage of exposure. The follow up study was undertaken among a group of newly hired cotton textile workers. Because all the workers of the cohort were lifelong non-smokers, this population provided a unique opportunity to observe relatively pure effects of exposure to cotton dust. The aims of the current analysis were to determine the changes in lung function, nonspecific airway responsiveness, and respiratory symptoms caused by exposure to cotton dust, and to ascertain whether there is a difference in pulmonary responses between atopic and non-atopic persons.

Aglind and others (1981) conducted a prevalence study of byssinosis in Swedish cotton mills using the British Medical Research Council questionnaire for byssinosis among workers in bale opening areas, carding rooms, and spinning rooms in five cotton mills. Airborne dust and gram-negative bacteria were measured. Nineteen per cent of the interviewed workers reported symptoms of light byssinosis (grade 1/2). The prevalence of symptoms was not related to the duration of employment, and cases of byssinosis were found among people who had worked in cotton mills for only a few years. A significantly higher proportion of male than female workers reported symptoms. No difference in the extent of byssinosis was found between smokers and non-smokers, but the prevalence was significantly higher among those workers who had ceased smoking. The prevalence of byssinosis was related to the number of airborne viable Gram-negative bacteria as well as to the dust level in the different mills.

Altinand others (2000) in a prevalence study of byssinosis and respiratory symptoms among cotton mill workers in Turkey, determined dust exposure effects. In order to determine the effects of past cotton dust exposure on the respiratory tract, a total of 223 persons working in a cotton mill were recruited. A questionnaire was used to inquire about respiratory symptoms. Participants underwent several spirometric measurements, which were performed on the 1st, 3rd and 5th day of the working week. Cotton dust measurements were performed in different divisions of the factory. The study showed that the most common respiratory symptom was chest tightness (20.3%). The prevalence of byssinosis was 14.2% in cotton processing workers. Among these cases, 28.6% had symptoms on the 1st day of the week, and 71.4% had symptoms on all days of the week. An acute effect was seen in 53.6% of the workers with byssinosis. Mean respirable dust levels were between 0.095 and 0.413 mg/ m^3. Elwood (1965), in a study of byssinosis and other respiratory symptoms in 2,528 flax workers aged 35 years and over in Northern Ireland were interviewed based on the Questionnaire on Respiratory Symptoms (Medical Research Council, 1960) with additional questions relating to respiratory symptoms at work. Byssinosis was found in workers in all stages of the industry, though its prevalence was highest in flax preparers; wet spinners and wet polishers did not appear to be at serious risk of developing the condition. When the effects of other relevant factors had been allowed for, e.g., age, duration of employment, and smoking habits, differences between the prevalence in the two sexes were found to be very small. The associations between byssinosis and the age of workers and their durations of employment in flax-preparing occupations were complex, and it was thought that a selective discharge of affected workers before the study might, in part at least, explain the absence of marked associations between these variables. Marked associations were found between both chronic bronchitis and exertional dyspnoea and the type of occupation in the mill. Workers in the early preparing occupations had a considerably higher prevalence of these conditions than expected on a null hypothesis. There were also marked associations between byssinosis and bronchitis, and between byssinosis and dyspnoea. The possible importance of these associations with regard to the aetiology of byssinosis is discussed, and it is suggested that byssinosis represents an acute, specific effect of certain textile dusts on the respiratory system, superimposed on a non-specific chronic bronchitis process.

Jiang and others (1995) studied the prevalence of byssinosis and other respiratory abnormalities in workers exposed to cotton dust in Guangzhou China in two factories that processed purely cotton. All the 1320 workers exposed were included. The controls were 1306 workers with no history of occupational dust exposure. Total dust and inhalable dust were measured by Chinese Total Dust Sampler and American Vertical Elutriator respectively. A World Health Organisation questionnaire was used. Forced Vital Capacity (FVC) and forced expiratory volume in one second (FEV_1) were measured by a Vitalograph spirometer. The results showed that a median inhalable dust concentrations that ranged from 0.41 to 1.51 mg/m^3 and median total dust concentrations from 3.04 to 12.32 mg/m^3.The prevalence of respiratory abnormalities in the cotton workers were (a) typical Monday symptoms 9 0%; (b) FEV_1 fall by ≥ 5% after a shift 16-8%; (c) FEV_1 fall by ≥ 10% after a shift 4-2%; (d) FEV_1< 80% predicted 6-1%; (e) FEV/FVC < 75% 4-0%; (/) cough or phlegm 18-2%; (g) chronic bronchitis 10.9%; and (h) byssinosis, defined by (a) plus (b) 1.7%. With the exception of (d), most of the prevalences increased with increasing age, duration of exposure, and cumulative inhalable dust exposure. No increasing trends of respiratory abnormalities were found for current total dust, inhalable dust, and cumulative total dust concentrations. Compared with controls, after adjustment for sex and smoking, with the exception of (d), all the pooled relative risks of respiratory abnormalities were raised for cotton exposure. Conclusions-It is concluded that cumulative inhalable cotton is likely to be the cause of byssinotic symptoms, acute lung function decrements, cough, or phlegm, and chronic bronchitis.

2.3.2 Regional Perspective

Mustafai et al.,;(1978) set to study Byssinosis and other respiratory symptoms focusing on acute and chronic changes in FVC and $FEV_{1.}$ 77 workers were investigated in sisal spinning industry and 83 workers in sisal brushing departments in six Tanzanian sisal factories. Although the prevalence of byssinosis in spinning departments was found to be low (5.2 %), it was very high in brushing departments (48.2 %). Workers in brushing were exposed to sisal dust for a significantly longer period (11.77 ± 7.3 years) compared to workers exposed to sisal in spinning (2.85 ± 2.56 years). Although the number of smokers in brushing (42 %) was similar to that in spinning (37 %), smokers were more prone to byssinosis than were non- or ex-smokers after standardisation for duration of exposure. They were unable to measure dust levels in this study, but dust levels in spinning and brushing are cited from previous studies. These confirm our impression that the dust level in spinning is higher than that in an average cotton carding department and far higher in brushing than in spinning. Acute falls in FVC and $FEV_{1.0}$ were found during the work shift. The extent of the fall in $FEV_{1.0}$ correlated well with the severity of byssinosis; 75 % of the workers with grade II byssinosis and 33 % of those with grade ½+ I were found to have acute falls in $FEV_{1.0}$ greater than 0-2 litres. However in some workers, 10% in spinning and 33 % in brushing, who denied symptoms of byssinosis, were also found to have acute falls in $FEV_{1.0.}$ Some workers had slight or severe chronic ventilatory impairment from dust ($FEV_{1.0}$ less than 80 %, or less than 60 % of the respective predicted values), and these workers were mostly from the brushing department. The prevalence of chronic cough and chronic bronchitis was found to be negligible in workers in the spinning and in the brushing departments: 9.6% had a chronic cough and 12% had chronic bronchitis. It is concluded that a high prevalence of byssinosis associated with chronic and acute changes in FVC and $FEV_{1.0}$ occurs in the brushing departments of sisal factories, and that this is related to lengthy exposure, high dust level and smoking.

Fishwick et al.,;(2001) in a study of Respiratory Symptoms, Lung Function and Cell Surface Markers in a Group of Hemp Fiber Processors, using a Questionnaire data, lung function, serial FEV1 and blood, (64%) of the workers complained of at least one respiratory symptom (one with byssinosis). The mean percentage predicted FEV_1 was 91.5, FVC 97.7, PEF 92.1, and FE_{25-75} 79.5. Serial FEV_1 measurements in the two workers with work related respiratory symptoms revealed a mean change in FEV_1 on the first working day of -12.9%. This contrasted with +6.25% on the last working day. Respective values for the two workers without work-related symptoms were -1.4 and +3.2%. Based on these findings, it was concluded that lung function changes and abnormalities in a profile of cell surface activation markers and antibodies were related to the presence of work-related respiratory symptoms, not seen in the control group.

Takam and Nemery (1988) designed a study to assess the risk of byssinosis in a cotton textile factory in Cameroon. A preliminary study was conducted on a random sample of 125 men from production areas and 68 men from nonproduction areas. Symptoms were assessed by a questionnaire, which also included questions regarding sleep; peak expiratory flow rate (PEF) was measured with a miniature peak flow meter at the end of a working day and total dust concentrations were assessed by static and personal sampling with Casella dust samplers giving values of 6-4 ± 2-6 mg/m^3 (m ± SD) in production areas and 1.7 ± 0.7 mg/m^3 in control areas. Exposed subjects had significantly more symptoms (particularly in smokers) and lower PEF values than controls (408 ± 961/min *v* 468 ± 70 1/min, $\boldsymbol{\rho}$< 0-00 1). Twenty three exposed subjects (18%) reported chest tightness on returning to work after the weekly break (compared with one control, $\boldsymbol{\rho}$< 0.01). Subjects with byssinosis had lower PEF values than those without chest tightness (356 ± 50 1/min v 426 ± 95 1/min, $\boldsymbol{\rho}$< 00 1), more chronic bronchitis (52% v 6%, $\boldsymbol{\rho}$< 0.001), they were more often smokers (61% *v* 31%, $\rho < 0\ 05$), and came generally, though not exclusively, from the opening carding spinning department with the highest concentrations of total dust (8 ± 2 mg/m^3) and an estimated prevalence of byssinosis of 28%. There were no significant differences in sleep related symptoms between the exposed and controls, though the 23 subjects with byssinosis tended to report more snoring (48%), early morning headache (48%), and sleep improvement over the working week (44%) than all the other subjects (28%, 24%, and 24% respectively, $\rho < 0.1$).

2.3.3 Local Perspective (Zambia)

In Zambia three pioneering studies on byssinosis have been done. Siziya and Munalula (2001) did a prevalence study on respiratory diseases associated with cotton dust on workers in a cotton spinning mill. A total of 297 employees took part in the study of whom 274 (92.3%) were males. Wheezing was recorded in 4.4% of the workers, chest tightness (14.5%), cough (19.9%), phlegm (11.4%) and breathlessness (5.7%). They observed a generally low rate of respiratory conditions which may have been partly due to under reporting by the workers themselves and partly due to sampling bias as the sample was selected by the management from all work-areas.

2.4 Summary

The review has shown that byssinosis occurs in different countries of the world. The data about its prevalence are very different. For example in the West where cotton processing has the longest tradition, the prevalence has been falling whereas in Less Developing Countries it has been increasing. The prevalence of byssinotic signs varies within an industry with workers involved in carding, thrashing, and blending being the dusty parts suffering the most. Changes in lung function are objective findings supporting influence of textile dust on respiratory system in exposed workers.

CHAPTER THREE – RESEARCH QUESTIONS AND STUDY OBJECTIVES

3.0 Research Question

1. Whatis the prevalence of acute occupational lung disease (cotton dust byssinosis) among cotton mill or ginnery workers?
2. What factors are associated with acute occupational lung disease among cotton mill or ginnery workers?

3.1 General Objective

To investigate the prevalence and factors associated with acute occupational lung disease (cotton dust byssinosis) among cotton ginnery workers in Katete district.

3.2 Specific objectives

1. To determine, based on WHO (1983) clinical grades, the proportion of workers experiencing byssinotic symptoms at the ginnery.
2. To determine the severity of respiratory symptoms at the beginning and end of the work week.
3. To determine factors that are associated with acute occupational lung disease
4. To profile abnormal signs using WHO clinical grades

CHAPTER FOUR – METHODOLOGY

4.0 Study variables

Dependant variable

- Occupational respiratory abnormalities (see the WHO grading of byssynosis)

Independent variables as factors

- Age
- Sex
- Type of work done
- Employment status
- Protective clothing
- Workplace environment

4.1 Research Design

This was a cross-sectional study design. In this type of research design we were interested in collecting information about subjective symptoms of respiratory pathology and relating these with pulmonary function tests to see what was going on at only one point in time. In this cross-sectional study the researcher was attempting to determine whether there was a relationship between symptoms of respiratory pathology and pulmonary function tests.

4.2 Research Setting

The area selected for this study was Katete in the Eastern province of Zambia, at Dunavant Ginnery. The District lies on the Great East Road, about 90km southwest of the provincial capital, Chipata and 470km east of Lusaka, the capital city of Zambia. Katete Cotton Ginnery currently engages 700 casual workers. It has an annual processing capacity of 22 000 metric tonnes (Annual Report, Dunavant, Katete).

4.3 Sample Size

Workers were sampled using stratified random sampling. This sample was drawn from a population of 570 workers and sample elements included workers from various sections of the factory. Sample size was calculated using Epi-info; version 3.4.3.The sample size was 196.

4.4 Inclusion Criteria

The inclusion criterion for participation in this study was workers in various sections of the factory who gave consent.

4.5 Exclusion criteria

The workers with chronic medical illnesses like asthma and cardio vascular disease or other respiratory disease as well as those who did not give consent were excluded from the study. Workers from the managerial offices were also excluded from the study.

4.6 Data Collection Tool

4.6.1 Questionnaire

A general demographic and respiratory questionnaire was administered to all the workers who were involved in the study. The questionnaire was administered by trained Research Assistants, who interviewed the workers in English as well as using their local language, Chichewa. This recorded the presence of work-related and non-work related symptoms including cough, phlegm production, wheeze, chest tightness, and shortness of breath. The main studies on the workers were made from Monday to Thursday in one week. It took about 10 minutes for a respondent to complete the whole questionnaire.

4.6.2 Spirometry

Spirometric measurements were conducted by a trained clinical technician from the Department of Community Medicine, University of Zambia School of Medicine, using a Spiro-bank G Spirometer. This technician was particularly chosen because he was trained and had done several spirometric measurements before. Each measurement took about 5 to 10 minutes per participant. This ideally measured forced vital capacity (FVC), forced expiratory volume per second (FEV_1), expiratory flow capacity (EFC), forced vital capacity (FVC), and maximum voluntary ventilation (MVV). The initial lung tests were done after being away for at least two days, after a weekend and then on the first day of return to work after at least six hours of exposure. The tests were done in a quiet room within the factory premises.

4.7 Data Analysis

Analysis of the data was done using the statistical package for social scientists (SPSS). Descriptive statistics were performed relying as much on exploratory analysis, association tests using Chi-square and Fisher's Exact test noting that in most instances the sample units were small. Differences were considered statistically significant at the $\rho < 0.05$ level.

CHAPTER FIVE - ETHICAL CONSIDERATIONS

Informed Consent

Permission was sought from the University of Zambia Biomedical Research Ethics Committee before commencement of the study. Consent to participate in this study was guaranteed to the workers as a right so that the person involved had legal capacity to give consent and exercise free power of choice, without the use of any element of force, fraud, deceit, duress, over-reaching, or other form of constraint or coercion. All participants were availed with sufficient knowledge and comprehension of the elements of the subject matter involved as to enable them to make an understanding and enlightened decision. This latter element required that before acceptance of an affirmative decision by the participants, it was made known to them the nature, duration, purpose of the research, the method and means by which it was conducted. Participants were also free to withdraw from the study at any point.

5.1 Permission

Permission to conduct study was sought from Ministry Of Health,KateteDunavant Administration as well as the Provincial and District Health Offices.

5.2 Benefits

The respondents were informed that there were no direct benefits accruing to them by participating in the study but that they were able to know their respiratory health status. However it was explained to them that there were institutional benefits later on should the institutions take on board the results and recommendations of the study outcomes. They were assured that the study would make considerable contribution in occupation health.

5.3 Risks

There were no risks or harm that was associated with the study. Respondents were informed of what would be done and how they would be involved in the study. The time to be spent with the participants varied from a few minutes to about twenty minutes.

5.4 Confidentiality

The participation in this study conferred confidentiality to the extent permitted by law. All information provided by the participants was considered confidential. However health status was revealed to them after undergoing spirometric measurements and if need be some were referred to a government hospital for treatment.

CHAPTER SIX – RESEARCH FINDINGS

6.0 Introduction

A total of 196 workers were eligible for the study. Out of these, 5 declined to be part of the study leaving a potential sample for study N = 191. Within this sample, 40 workers were excluded from the study after preliminary screening. Three had a cardiac problem, 13 had chronic bronchitis complicated by smoking and 24 were chronic smokers. One of the smokers had asthma also. Of the 3 who had a heart problem, one of them actually was a smoker. The remaining 151 workers constituted the study sample.

6.1 Demographic characteristics

All workers were Zambians. The mean age was 30.5 years (SD± 7.4) and, based on the age distribution, the workers were rather youths with the youngest being 17years. Two of the workers were over the retirement age. (See Table 6.1). A test of normality in exploratory analysis using Kolmogorov-Smirnov test shows that age was normally distributed and highly significant (*$p<0.001$)*

Table 6.1 Age Stem-and-Leaf Plot

Frequency	Stem & Leaf
1.00	7
2.00	99
5.00	00111
10.00	2222223333
15.00	444444555555555
26.00	66666666666666777777777777
20.00	88888888888899999999
18.00	000000000000000111
13.00	2222222223333
10.00	4444555555
10.00	6677777777
6.00	899999
6.00	001111
1.00	3
1.00	4
7.00 Extremes	(>=49)

Stem width: 10.00

The production and working conditions of these employees was rather unstable for most of them. Every 12 months or eighteen months some of these workers are rotated as a routine. The mean stay in one place of work was 13 months (SD+ 15) with the median and modal employment duration being 8 and 24 months, respectively. However, there were times when others were not rotated. The mean employment duration was 33 months (SD+ 30) with the median and modal employment duration being 24 years in either case. The longest a worker had served the company was 180 months or fifteen years and the least was barely one month.

At the time of the study, the workers were employed in five main departments which are carding, blending, cleaning, blowing and drawing. Just about half n= 77 (51.1%) were involved in carding with 48.1% involved in other jobs (Table 6.2)

Table 6.2 - Current job

Job	Frequency	Percent
Carding	77	51.0
Blending	26	17.2
Ginning	1	.7
Drawing	5	3.3
Cleaning	22	14.6
Spinning	2	1.3
Thrashing	3	2.0
Blowing	15	9.9
Total	**151**	**100.0**

6.2 Symptoms of Byssinosis during the workweek

Out of 151 workers, only 50 workers (33.1%) did not experience any symptoms of byssinosis. A greater number suffered fromchest tightness and/or shortness of breath on most of first days back at work and on the first and other days of the working week. The commonest combinations of symptoms were on the first and other days of the working week, the workers showed a reduction in one symptom over the weekends and an increase in another within the week so that all combinations of change occurred, making formal analysis unprofitable because of the small numbers involved in each category.

Table 6.2.1 Symptoms of byssinosis

Symptoms	Frequency	
	N	%
I have been experiencing chest tightness on most of first days when I get back at work	101	66.9
I have been experiencing shortness of breath on most of first days when I get back at work	66	43.7
I have been experiencing chest tightness on the first and other days of the working week	101	66.9
I have been experiencing shortness of breath on the first and other days of the working week	65	43.0
I experience shortness of breath on the first day and other days of the week	67	44.4
I experience cough associated with dust exposure	63	41
I produce sputum (that is on most days during three months of the year) initiated or worsened by exposure to work	88	58.3
I have been producing sputum that is started or made worse by exposure to work or either with chest illness	54	35.8
I have been producing sputum for 2 years	91	60.3

Out of the sample n = 101 that had at least one symptom of byssinosis, n = 51 (33.8%) were receiving medications for chest problem.

Table 6.2.2 Treatment for Chest Pain Related To Byssinosis

Receiving Any Treatment	Frequency	Percent
Yes	51	33.8
No	100	66.2
Total	**151**	**100.0**

Using the generally accepted WHO (1983) criteria, this survey found evidence for byssinosis among cotton workers with the highest prevalence among those who at the time of the study had been engaged in carding, blending, and cleaning processes (Table 6.2.3).

Table 6.2.3 Prevalence of Byssinosis in Current Job

		I have been experiencing chest tightness on most of first days when I get back at work		
		Yes	No	Total
What is your current job?	Carding	48	29	77
	Blending	17	9	26
	Ginning	1	0	1
	Drawing	3	2	5
	Cleaning	18	4	22
	Spinning	1	1	2
	Thrashing	2	1	3
	Blowing	11	4	15
Total		101	50	151

6.3 Prevalence of Byssinosis Based on Abnormal signs in WHO (1983) clinical grades

From table 6.2.1 WHO (1983), the percentage abnormal signs of byssinosis was derived as follows:

Table 6.3.1 Symptoms of byssinosis

Classification	Symptoms	Frequency	
		n	%
Grade 0 Byssynosis	No symptoms	50	33.1
Grade B1 Byssynosis	Chest tightness and/or shortness of breath on most of first days back at work	101	66.9
Grade B2 Byssynosis	Chest tightness and/or shortness of breath on the first and other days of the working week	101	66.9
Respiratory tract irritation: Grade RTI 1 Byssynosis	Cough associated with dust exposure	54	35.8
Grade RTI 2 Byssynosis	Persistent phlegm (i.e. on most days during 3 months of the year) initiated or exacerbated by dust exposure	91	60.3
Grade RTI 3 Byssynosis	Persistent phlegm initiated or made worse by dust exposure either with exacerbations of chest illness or persisting for 2 years or more	67[1]	44.4

6.4 Levels of lung function and dysfunction

Below in tables 6.4.1 and 6.4.2, we show cumulated profiles of lung function tests that demonstrated reduced lung function over the four days of the survey.

Table 6.4.1 State of Reduction of Lung Function - Serial Measurements

Lung function test	***Frequency***		***Association with Byssinotic symptoms***	
	N	***%***		***p value***
FEV			Cough associated with dust exposure	0.318 Fisher's
No reduction	64	42.4	Shortness of breath on the first and other days of the working week	0.248 Fisher's
Reduced	87	57.6	Chest tightness on the first and other days of the working week	0.323 Fisher's
			Producing sputum or made worse by exposure to dust at work	0.980 Fisher's
Total	**151**	**100.0**		
FCV			Cough associated with dust exposure	0.409 Fisher's
No reduction	62	41.1	Shortness of breath on the first and other days of the working week	0.143 Fisher's
Reduced	89	58.9	Chest tightness on the first and other days of the working week	0.244 Fisher's
			Producing sputum or made worse by exposure to dust at work	0.158 Fisher's
Total	**151**	**100.0**		
FEVp			Cough associated with dust exposure	0.182 Fisher's
No reduction	53	35.1	Shortness of breath on the first and other days of the working week	0.280 Fisher's
Reduced	98	64.9	Chest tightness on the first and other days of the working week	0.354 Fisher's
			Producing sputum or made worse by exposure to dust at work	0.499 Fisher's
Total	***151***	***100.0***		
PER			Cough associated with dust exposure	0.144 Fisher's
No reduction	15	9.9	Shortness of breath on the first and other days of the working week	0.303 Fisher's
Reduced	136	90.1	Chest tightness on the first and other days of the working week	0.404 Fisher's
			Producing sputum or made worse by exposure to dust at work	0.470 Fisher's
Total	***151***	***100.0***		

Table 6.4.2 Lung function serial measurements from Monday to Thursday

	Minimum	Maximum	Mean	Std. Deviation
Forced vital capacity day one	0.65	7.31	3.0318	1.37013
Forced vital capacity day two	0.04	6.06	2.9625	1.28831
Forced vital capacity day three	0.47	6.28	2.9571	1.13273
Forced vital capacity day four	0.90	5.80	2.6987	.93672
Forced expiratory volume per second day one	0.65	5.71	2.3438	1.21690
Forced expiratory volume per second day two	0.40	5.37	2.2434	1.04985
Forced expiratory volume per second day three	0.47	5.10	2.2663	0.92805
Forced expiratory volume per second day four	0.48	5.12	2.1693	0.86976
Forced expiratory volume percent day one	4.59	100.00	78.7761	20.33431
Forced expiratory volume percent day two	20.60	100.00	78.8075	20.83354
Forced expiratory volume percent day three	32.20	100.00	73.8307	18.07184
Forced expiratory volume percent day four	28.20	99.50	68.4044	17.99819
Peak expiratory flow rate day one	0.92	8.26	3.2924	1.65927
Peak expiratory flow rate day two	0.72	9.41	3.1118	1.55371
Peak expiratory flow rate day three	0.89	8.76	3.1841	1.52023
Peak expiratory flow rate day four	0.51	7.94	2.4323	1.18315

We advise to focus more on FEV to track changes because it has an advantage of being the most repeatable lung function parameter and one that measures changes in both obstructive and restrictive types of lung disease. From another angle, we also show lung function changes over time, box-and-whisker diagram or plot was used to graphically depict groups of numerical data through their five-number summaries: the smallest observation (sample minimum), lower quartile (Q1), median (Q2), upper quartile (Q3), and largest observation (sample maximum) top most bar. The bottom and top of the box are the 25^{th} and 75^{th} percentile (the lower and upper quartiles, respectively), and the band near the middle of the box is the 50^{th} percentile (the median). But the ends of the whiskers represent possible alternative values, among them:

- The minimum and maximum of all the data
- The lowest datum still within 1.5 IQR of the lower quartile, and the highest datum still within 1.5 IQR of the upper quartile.

Any data not included between the whiskers is plotted as an outlier with a dot, small circle. The following are figures of box plots obtained for lung function tests of those who suffered symptoms (yes the right box and no the left box).

Figure 6.4.1 is about shortness of breath on the first and other days of the working week relating with FVCon Day 4. The box plot tells us that these two variables are not very well behaved because sample 32 is an outlier.

Figure 6.4.1 Shortness of Breath on the First and Other Days of the Working Week and FVC on Day 4

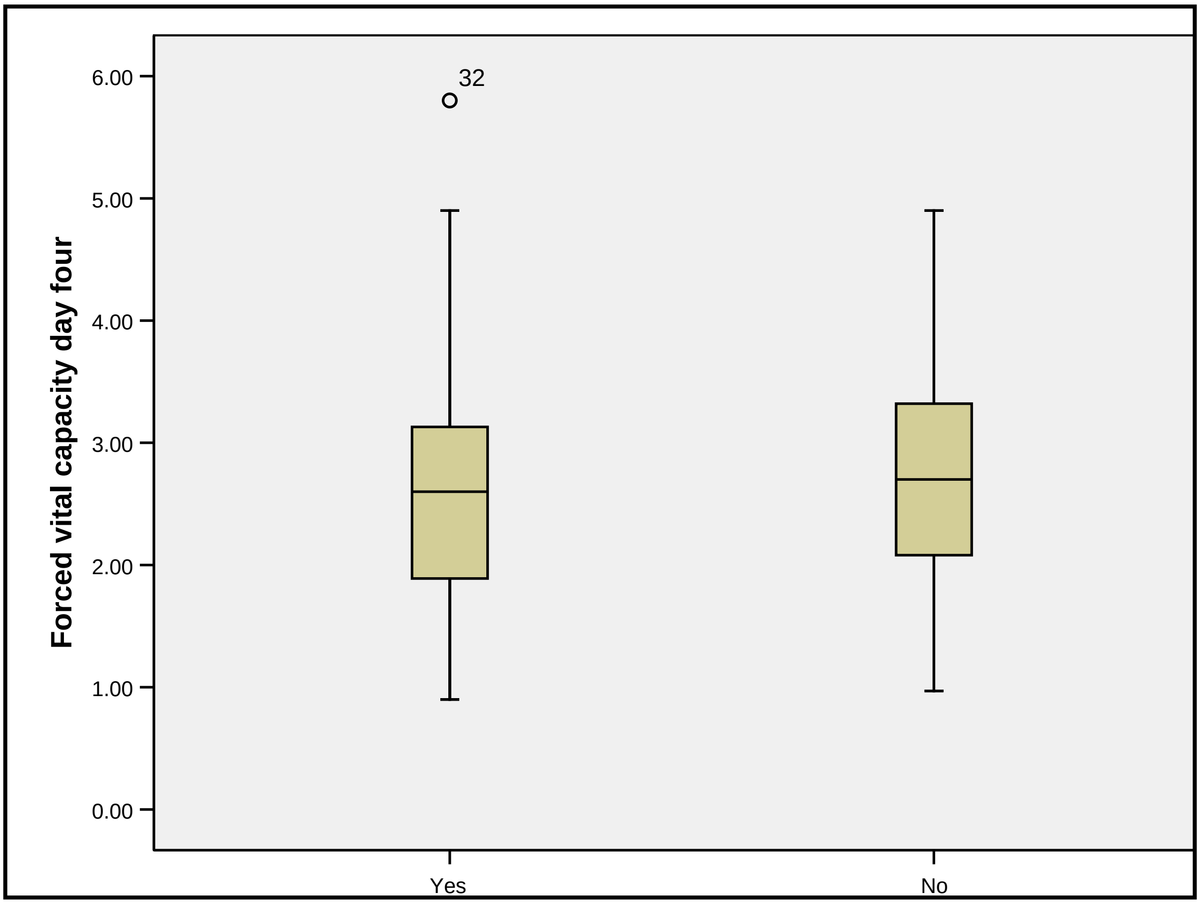


Figure 6.4.2 is about shortness of breath on the first and other days of the working week relating with FVC/son Day 4. The box plot tells us that these two variables are very well behaved because no single sample is considered to lie extremely far from the median.

Figure 6.4.2 shortness of breath on the first and other days of the working week and FEV/s on day 4

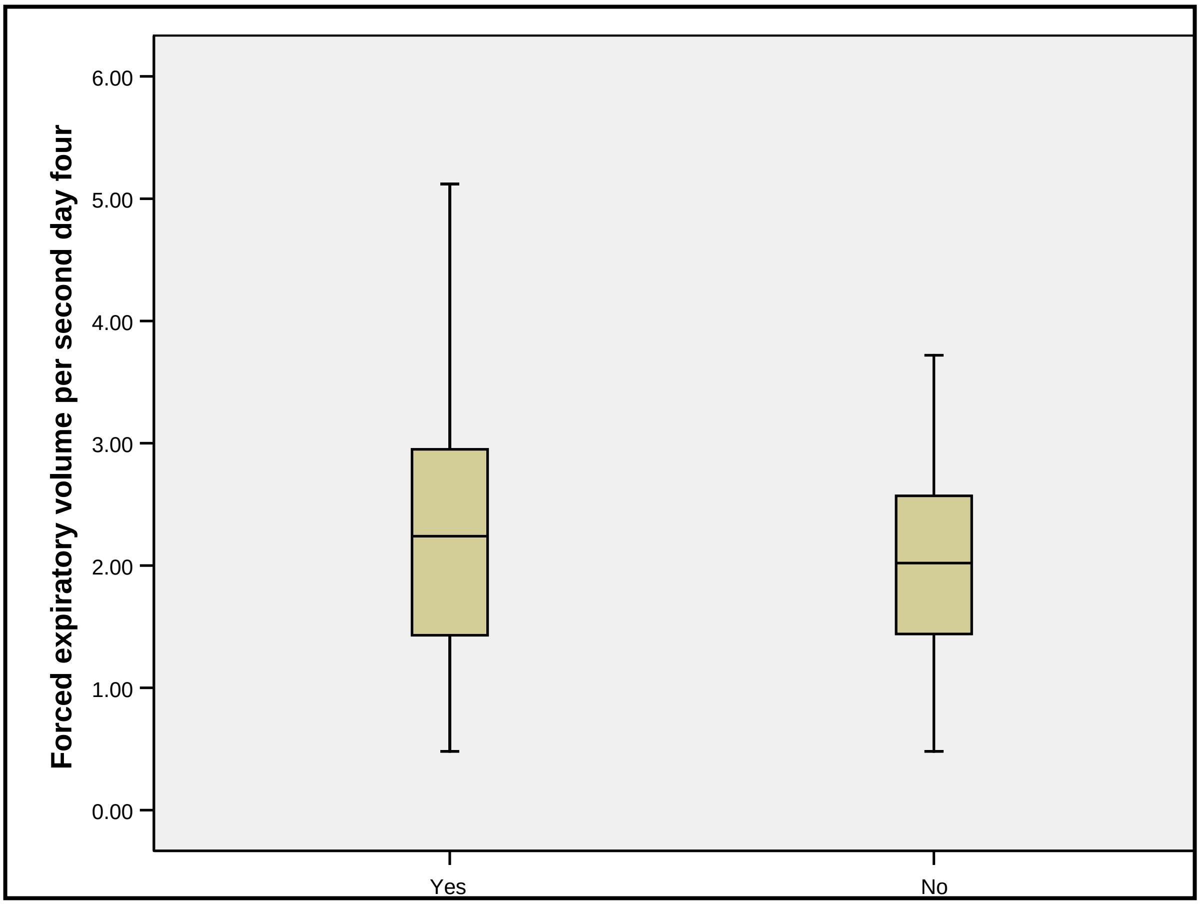
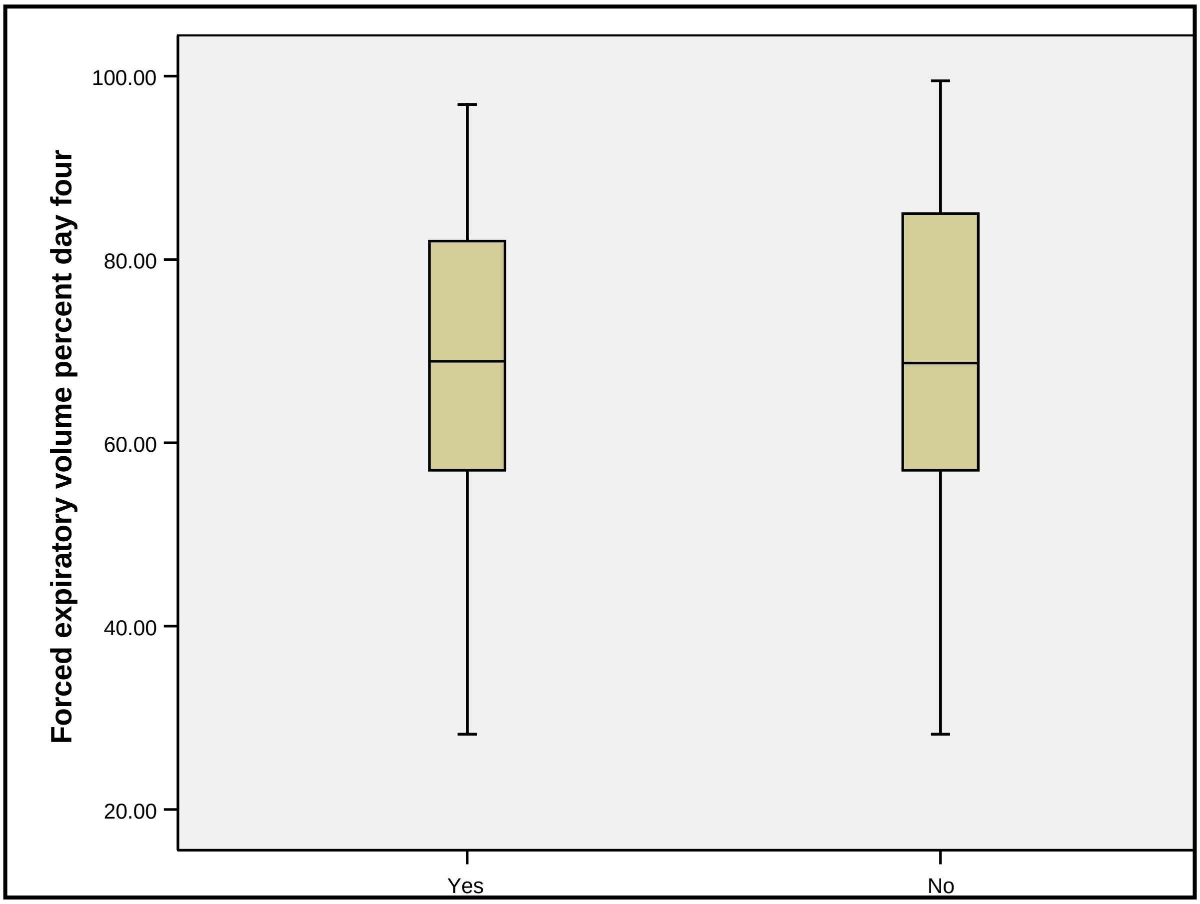


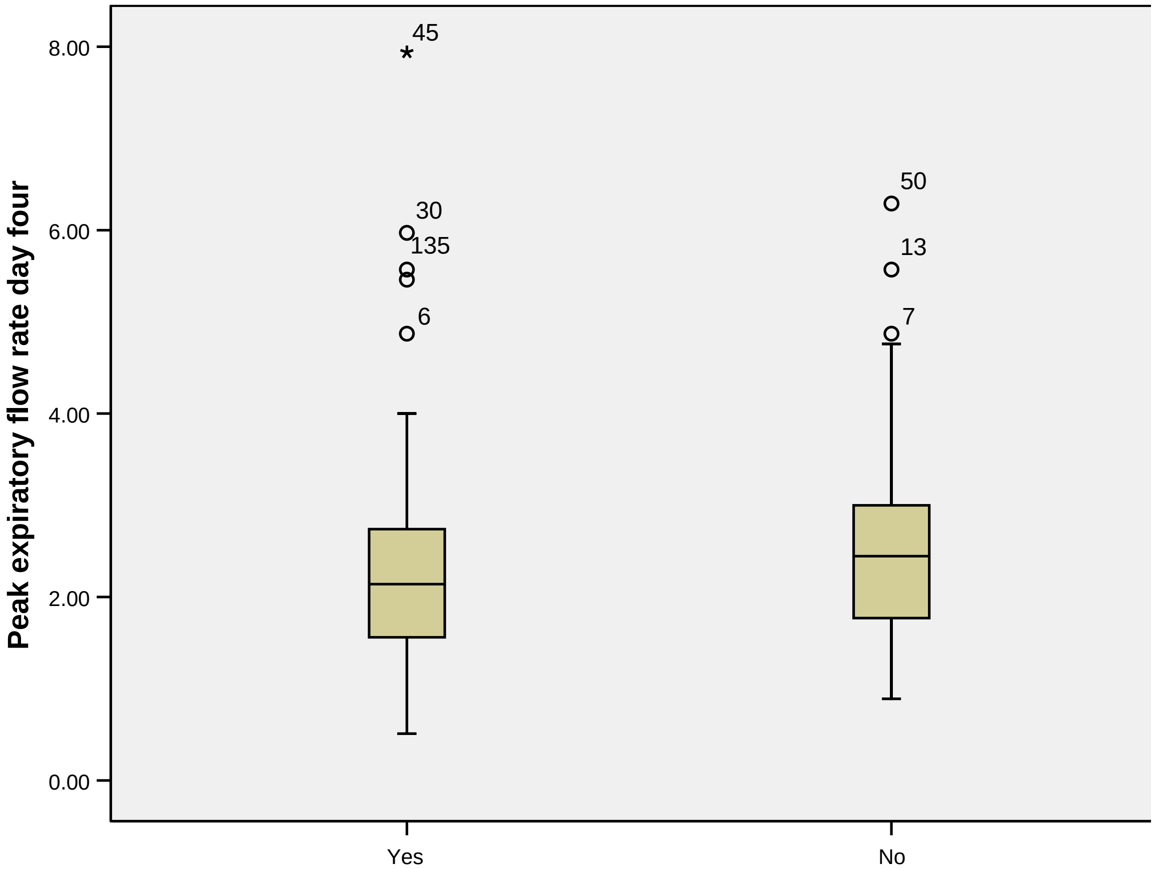
Figure 6.4.3 is about experiencing chest tightness on most of first days when the workers get back at work in relation with FVC day one. The box plot tells us that these two variables are very well behaved because no single sample is considered extreme.

Figure 6.4.3 shortness of breath on the first and other days of the working week and FEV% on day 4



In Figure 6.4.4 we see a very different picture. There are now extreme sample values for both categories (yes and no. We see in the figure a distinction which is made between close extreme values and is a far away extreme from the median which is element 45 shown by the * symbol.

Figure 6.4.4 shortness of breath on the first and other days of the working week and PER on day 4



In this study, lung function tests tend to drop on the first and other days of the week in response to chronic and daily cotton dust exposure. There is a trend to have acute drops in lung function tests in both sexes. Lung function tests on day four were significantly lower than the baseline values if we take day one.

The WHO (1983) criterion presented below could not be used to show manifestations of byssinosis according to lung function tests as initially planned because the study design did not allow the collection of data during or just after the shift end (Appendix)

6.5 Possible Associations and Differences of Key Variables

Though every 12 months or 18 months some of these workers are rotated as a routine, we wanted to profile the association at the time of byssinotic symptoms across key variables. We desired to see the pattern by job or department, age, sex, and lung function test. An examination of the job profile, age, sex and symptoms of byssinosis across all these variables shows no significant associations (See tables 6.5.1- 6.5.5).

Table 6.5.1 Symptoms of Byssinosis and Current Job

Associated variables	Observed value	df	Asymp.Sig. (2sided)	Decision
Job and experiencing cough due to dust exposure	8.366(a)	7	0.301	Not significant and therefore , no association at all
Job and shortness of breath on the first day and other days of the week	9.954(a)	7	0.191	Not significant and therefore , no association at all
Job and shortness of breath on the first and other days of the working week	3.294(a)	7	0.857	Not significant and therefore , no association at all
Job and chest tightness on the first and other days of the working week	4.102(a)	7	0.768	Not significant and therefore , no association at all
Job and shortness of breath on most of first days when I get back at work	3.351(a)	7	0.851	Not significant and therefore , no association at all
Job and chest tightness on most of first days when I get back at work	4.102(a)	7	0.768	Not significant and therefore , no association at all

Table 6.5.2 Age and Symptoms of Byssinosis

Associated variables	**Observed value**	**Df**	**Asymp.Sig. (2sided)**	**Decision**
Age and experiencing cough due to dust exposure	8.366(a)	7	0.301	Not significant and therefore , no association at all
Age and shortness of breath on the first day and other days of the week	9.954(a)	7	0.191	Not significant and therefore , no association at all
Age and shortness of breath on the first and other days of the working week	3.294(a)	7	0.857	Not significant and therefore , no association at all
Age and chest tightness on the first and other days of the working week	4.102(a)	7	0.768	Not significant and therefore , no association at all
Age and shortness of breath on most of first days when I get back at work	3.351(a)	7	0.851	Not significant and therefore , no association at all
Age and chest tightness on most of first days when I get back at work	4.102(a)	7	0.768	Not significant and therefore , no association at all

Table 6.5.3 Sex and Symptoms of Byssinosis

Associated variables	Observed value	Df	Asymp.Sig. (2sided)	Decision
Job and experiencing cough due to dust exposure	8.366(a)	7	0.301	Not significant and therefore , no association at all
Job and shortness of breath on the first day and other days of the week	9.954(a)	7	0.191	Not significant and therefore , no association at all
Job and shortness of breath on the first and other days of the working week	3.294(a)	7	0.857	Not significant and therefore , no association at all
Job and chest tightness on the first and other days of the working week	4.102(a)	7	0.768	Not significant and therefore , no association at all
Job and shortness of breath on most of first days when I get back at work	3.351(a)	7	0.851	Not significant and therefore , no association at all
chest tightness on most of first days when I get back at work	4.102(a)	7	0.768	Not significant and therefore , no association at all

Table 6.5.4 Age and Lung Function Tests

Associated variables	Observed value	Df	Asymp.Sig. (2sided)	Decision
FCV over the serial measurements	7.279(b)	1	.407	Not significant and therefore , no association at all
FEV over the serial measurements	5.479(a)	3	.140	Not significant and therefore , no association at all
FEVp over the serial measurements	3.173(a)	3	.366	Not significant and therefore , no association at all
PER over the serial measurements	2.313(a)	3	.510	Not significant and therefore , no association at all

Table 6.5.5 Sex and Lung Function Tests

Associated variables	**Observed value**	**Df**	**Asymp.Sig. (2sided)**	**Decision**
FCV over the serial measurements	7.279(b)	1	0.407	Not significant and therefore , no association at all
FEV over the serial measurements	0.885(b)	1	0.347	Not significant and therefore , no association at all
FEVp over the serial measurements	0.061(b)	1	0.804	Not significant and therefore , no association at all
PER over the serial measurements	1.423(b)	1	0.233	Not significant and therefore , no association at all

CHAPTER SEVEN - DISCUSSIONS AND CONCLUSIONS

7.0 Introduction

This investigation is, as far as is known, one of the first in Zambia to show definitely that the symptoms of classical byssinosis occur among cotton workers. Sixty seven percent of the workers had symptoms of byssinosis. The present study confirms the continued presence of byssinosis in coarse and medium cotton plants. The study suggests that airway obstruction in the sample could have been the cause of reduction in lung function. Looking at the symptoms, airflow obstruction may be secondary to bronchospasm, airway inflammation, and loss of lung elastic recoil, increased secretions in the airway or any combination of these causes.

Although the prevalence of byssinosis was not matched appropriately in the departments on account of the short periodic rotation, the disease occurs appreciably in all departments. Though this was a cross sectional finding, we cannot attribute the prevalence of byssinosis to current job because most of the workers have worked in other departments before. Appreciably, the job profiles in the various departments showed that the dust level in the work environment was higher than that in an average cotton plant (Table 6.2).

It is also important to note that the prevalence of the disease increased with exposure to cotton dust and in this study the mean duration of working in this company, 33 months (SD ± 30), was just sufficient to cause byssinosis. There was however no relationship between symptoms of byssinosis or byssinosis with age and sex.

The very high prevalence of byssinosis beginning on Monday among some workers or worsened on Monday by others, (chest-tightness) is consistent with research done in other parts of the world (Boren et al.,; 1966; Morris et al.,; 1971). While there has been spirometric evidence of airway obstruction during the first work shift of the week, the prevalence of byssinosis (that is, self-reported chest tightness, cough induced by dust and difficulty to breathe) have also been critical. Other studies (Barnes and Simpson 1976; Field and Owen, 1979) unlike this one found only two and three employees with the typical 'byssinosis' response-profile to the standard questionnaire. A Fall in FEV and FCV across the four days for instance and manifesting on Monday was observed amongst cotton workers both with and without the symptoms of byssinosis in previous findings like those of Gandevia and Milne, 1979) and two studies of earlier findings (Rylander et al.,; 1979; Zenlin and Zhou,1992; Chattopadhyay et al.,; 1993).

Noting that there were workers who had chronic forms of respiratory disease and those who did not have but had acute manifestations of byssinosis which they experienced when they returned to work, there were also others who showed a reduction in symptoms over the weekends. This scenario gave us varying combinations of clinical disease beyond the WHO criterion.

The high prevalence of byssinosis might be related to unsafe working conditions though it is not confirmed by dust monitoring. The duration of exposure of the workforce to cotton dust resembled those reported in the mills of other countries.

Some or all of the signs and symptoms of byssinosis found in the group may also have been related to other inducers other than cotton dust. Kamat et al.,; (1981) suggested that symptoms such as work related cough should be included in the diagnosis as variants of byssinosis. This, however, is not within the accepted definition of the disease.

Lung functional tests showed a peculiar trend of decline from day one today four in this sample under study. Of the four lung function tests, FEV and FVC showed more consistent reduction changes (Table 6.1.1). Reduction in the amount of air exhaled forcefully in the first second of the forced exhalation (FEV_1) reflected reduction in the maximum inflation of the lungs.

A trend of change in lung function with time was seen more distinctly in those who had chronic effects of byssinosis and these were cotton workers who had a cough associated with dust exposure, persistent phlegm (i.e. on most days during 3 months of the year) and persistent phlegm initiated or made worse by dust exposure either with exacerbations of chest illness or persisting for 2 years or more. However, all lung function tests were not significantly associated with work induced byssinotic symptoms. This is evident from the observed ***ρ*** values in table 6.4.1 Caution is advanced during the interpretation of lung function values because lung volumes are related to body size, and standing height is the most important correlating variable

7.1 Limitations and Strength of the Study

This study has research design mediated limitations and as such, our results need to be interpreted with caution in light of these.

1. Evaluation of an individual's change in lung function over a prolonged time is often more clinically valuable than a few lasting a week and this is because, it is not easy to determine whether a measured change in this short period reflects a true change in pulmonary status or is only a result of test variability. All lung function measurements tend to be more variable when made weeks to months apart than when repeated at the same test session or even daily, as observed by Burrows et al.,; (1986) and Degroodt et al.,;(1986).Researchers in byssinosis studies like Schwartz et al.,; (1991); Schilling (1981) and Mc Niven et al.,; (1990) have argued that when there are cross sectional evaluations of lung function available to evaluate change, the large variability necessitates relatively large changes to be confident that a significant change has in fact occurred. Thus, in subjects with relatively ''normal'' lung function (the 51 in this study), year-to-year changes in FEV1 over 1 yr should exceed 15% before confidence can be given to the opinion that a clinically meaningful change has occurred (American Thoracic Society, 1951).
2. Like most studies in byssinosis, we were unable to measure falls in FVC and FEV during the work shift. This resulted in failure to profile on spot cotton dust exposure related effects.

In spite of these limitations, this study has notable strengths and the following are worth pointing out.

1. The first strength of this study is the measurement. We had a relatively good sample size that was used to measure both lung function tests and clinical presentation of byssinosis which most studies in Africa have not done.
2. To the current authors' knowledge, this is one of the most rigorous exploratory studies in pulmonology in Zambia, to date, and involving cotton textile workers.
3. The relatively good sample size and low attrition of the original cohort enhanced the study power to detect some chronic respiratory effects due to exposure to cotton dust.

7.2 Conclusion

In summary, our findings show that exposure to cotton dust was associated with acute and longitudinal changes in lung function and increasing airway responsiveness among cotton workers. Unmanaged working environments and unprotected work may be important risk factors for an acute drop in lung function and chronic lung changes induced by cotton dust. It is concluded on the basis of the study that byssinosis occurs in cotton workers particularly in those who are exposed to high concentrations of dust for a longer period. The exposure to cotton dust leads to fall in lung function on Monday (first working day of the week) and this fall may occur in these workers in the absence of symptoms of byssinosis.

We found no significant association between byssinosis and age, sex and the current undertaking.

Recommendations

Noting the limitations inherent of the research design, we are recommending the following:

a) Further studies are needed to confirm these results, and longitudinal studies could help to clarify whether these failed associations are true.
b) This study is re emphasizing the hypothesis that long-term exposure may lead to chronic respiratory disease and excessive loss of lung. Due to a scarcity of longitudinally collected data in Africa, some important questions remain unresolved. For instance, what is the magnitude of the chronic air flow obstruction in cotton dust-exposed populations? Are adverse chronic effects reversible if the exposure ceases entirely? Is there a connection between byssinosis and long-term loss in lung function? What are the determinants of cotton dust related obstructive lung disease? Given these questions, a longitudinal cohort study ought to be designed to address these questions.
c) We recommending that the company provides a full kit of protective clothing to the workers and this includes gumboots, overalls, dustcoats and facemasks.
d) We are recommending the provision of other good working conditions such as environmental hygiene and periodic medical examination at two-yearly intervals as sufficient value to identify those who ultimately will have to leave the industry because of progressive symptoms.

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APPENDIX I- STRUCTURED BYSSINOSIS QUESTIONNAIRE

INSTITUTION: THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF PUBLIC HEALTH

TOPIC : PREVALENCE OF OCCUPATIONAL LUNG DISEASE AMONG COTTON GINNERY WORKERS IN KATETE DISTRICT

DATE :

SERIAL No :..

INSTRUCTIONS FOR THE INTERVIEWER

1. Do not write name of respondent on the interview schedule

2. Indicate the most appropriate response to the question in the spaces provided

3. Request the respondent to sign consent form before you start the interview

4. All the information provided by the respondent should be kept in the strict confidence

5. Respondents should not be forced to be interviewed

You have been selected by chance with other people to help us know what may relate to your health and your work. Please read /listen to each item carefully and decide to what extent it is characteristic of you. Give each item a rating that applies to you by using a scale that is given for each question. Please remember to respond to all items. There is indeed no right or wrong answers. Your answers will be kept by me in the envelope that I have given you in the strictest confidence for only six months which time I shall have examined all the responses. There after I shall destroy them. There will be no identification mark that relates to you on the questionnaire. I am sure that you will be open in responding to these statements.

1 Sex

	Sex	Tick only one
1	Male	
2	Female	

Age--------

2 Age range:

1. Sixteen to twenty five--------
2. Twenty six to thirty five………
3. Thirty six to forty five ……….
4. Over forty six………

3 For how long have you worked in this company................

1. One month
2. One to six months
3. Six months to one year
4. More than one year

4 How far have you gone in school?

Level of Education	Never	Primary	Lower Secondary	Upper secondary	College /University
Tick	1	2	3	4	5

5	I have asthma 1. Yes............. 2. No..................	☐
6	I have a heart problem 1. Yes............. 2. No..................	☐
7	I have chronic bronchitis. 1. Yes............. 2. No..................	☐
8	I smoke 1. Yes............. 2. No..................	☐
9	What is your current job? (Tick only one)	☐

1.Carding	
2.Drawing	
3.Cleaning	
4.Roving	
5.Spinning	
6.Twisting	

7.Bobbing	
8.Thrashing	
9.Blowing	
10.Weaving	
11.Blending,	
12.Stripping	

10 If you have worked in any of the departments below, please indicate how long this has been

	Worked in this area before (Tick if yes)	Worked for (years or months)
1.Carding		
2.Drawing		
3.Cleaning		
4.Roving		
5.Spinning		
6.Twisting		
7.Bobbing		
8.Thrashing		
9.Blowing		
10.Weaving		
11.Blending,		
12.Stripping		

11 Please indicate what your current state of health is like? Tick if yes or no

Occurrence of symptoms	**Yes**	**No**
1.Chest tightness on most of first days back at work		
2.Shortness of breath on most of first days back at work		
3.Chest tightness on the first and other days of the working week		
4.Shortness of breath on the first and other days of the working week		
5.Cough associated with dust exposure		
6.Production of sputum (i.e. on most days during 3 months of the year) initiated or worsened by exposure to work		
7.Production of sputum started or made worse by exposure to work or either with chest illness		
8.Production of sputum for 2 years or more		

12 Since I started work, my employers have never organised a medical screening by a doctor

1. Yes
2. No

13 For the health problem in my chest, my employers have never organised a medical screening by a doctor

1. Yes
2. No

14 I am receiving medications and for my chest problem

1. Yes
2. No

15 How often do you use protective clothing?

1. Never use
2. Once in a while
3. All the time

APPENDIX 2: INFORMATION SHEET

TOPIC: Prevalence and factors associated with acute occupational lung disease among cotton ginnery workers in katete district

Introduction

Martha Sinzala,a student at the department of community medicine in the University of Zambia. I would like to request you to participate in my research study.

Purpose of the study

You are being asked to take part in a study which is aimed at determining the prevalence of breathing problems at this factory among the workers exposed to cotton dust .After agreeing to take part, you be asked to have your lungs examined by blowing air through a machine which will take 5 to 10 minutes and finally you be requested to complete a questionnaire for another 10 minutes.

Voluntary participation

Your participation in this study is purely voluntary. This means that you are free to decline to participate in the study without consequences.Furthurmore, if you wish to discontinue the discussion during the interviews, you are free to do so without facing any penalties.

Risks and Discomforts

The study does not involve any risks to you.

Benefits

There are no monetary benefits for participating in this study. You will benefit by knowing whether you have breathing problems or not. The study is not able to provide treatment because it does not have enough funds. However, you will be referred to a government clinic or hospitalfor your medical attention should you have them.

Confidentiality

I would like to reassure you that your personal information that you will entrust me with will not be disclosed to any other third party unless legally required to do so and with your consent. Your identity will be kept anonymous.

Information and clarity

Please be informed that if you at any time need some clarifications over the research study, direct your questions to:

MARTHA SINZALA
UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE
DEPARTMENT OF PUBLIC HEALTH
P.O. BOX 50110
LUSAKA
PHONE: 0977997261

OR
THE CHAIRPERSON
UNIVERSITY OF ZAMBIA
BIOMEDICAL RESEARCH ETHICS COMMITTEE
P.O BOX 50110
LUSAKA
PHONE: 01 256067

APPENDIX 3: CONSENT FORM

I agree that the purpose of the study has been explained to me .The risks and benefits have been clarified to me and I understand that participation or not will not affect my job security or health care that may be needed for me. I freely and voluntarily choose to participate. I also understand that my rights and privacy will be maintained.

I... (Names)

hereby agree to take part in the study “Prevalence and factors associated with acute occupational lung disease among cotton ginnery workers in Katete district cotton dust”

Signed/Thumb print.......................................Date.................................. (Participant)

Signed:...Date.................................. (Witness)

Signed..Date..................................(Researcher)

APPENDIX 4: BUDGET

The total budget for the research is K34, 207,000.00.

ITEM	QUANTITY	UNIT COST (ZMK)	TOTAL COST(ZMK)
1.STATIONARY			
Bond paper	5 reams	25 000	125 000
Printer Toner	1	800 000	800 000
Flash Disk	1	150 000	150 000
Binding Trans.	20	2 500	50 000
Binding Spiral	20	2 000	40 000
Binding Cover	20	1 000	20 000
Pens	10	500	5 000
Pencil	10	200	2 000
Erasers	10	2 000	20 000
Stapler	1	10 000	10 000
Staples	1 box	10 000	10 000
Perforator	1	10 000	10 000
Note book	5	10 000	50 000
Folders	5	12 000	60 000
Questionnaire Bags	5	50 000	250 000
CD	2	15 000	30 000
Printer ribbons	2	1 000 000	2 000 000
Scientific calculator	1	100 000	10 000
Tippex	1	10 000	10 000
SUBTOTAL			**3 ,652, 000**
ITEM	**QUANTITY**	**UNIT COST**	**TOTAL**
2.SERVICES			
Ethics committee	1	500 000	500 000
Data entry	1	750 000	750 000
Data analysis	1	1 000 000	1 000 000
Research proposal typing and printing	7x60pages	2 000	120 000
Research proposal	7	10 000	70 000

binding			
Photocopying Questionnaire	400x 10pages	200	800 000
		2 000	200 000
Research report typing	1x100pages	200	120 000
Research report photocopying	6x100pages	10 000	70 000
Research report binding	7		**3,630,000**
SUBTOTAL			
FIELD WORK			
-Training research assistants	5	50 000	250 000
-Principal Researcher	30days	295 000	8 850 000
Sub allowance	4trips	100 000	400 000
Transport costs:	5days	275 000	1 375 000
-Suballowance technician	2trips	100 000	200 000
Transport costs	5x30 days	50 000	7 500 000
Research assistants:	30days	30 000	900 000
-Lunch allowance			
Lung function tests	260 mouth pieces	20 000	5 200 000
SUBTOTAL			**24,675,000**
Communication services	25 Zain air time	10 000	250 000
SUBTOTAL			**250 000**
TOTAL			**32 207,000.00**
CONTINGENCY			**2,000,000.00**
GRAND TOTAL			**34,207,000.00**

Table 6.4.3 Manifestations of byssinosis according to Lung function Tests

Classification	Symptoms	Frequency	
		n	%
Lung function: Acute changes No effect	A consistent decline in FEV1 of less than 5% or increase in FEV1 during the work shift	Not assessed	0%
Mild effect	A consistent decline of 5-10% in FEV1 during the work shift	Not assessed	0%
Moderate effect	A consistent decline of 10-20% in FEV1 during the work shift	Not assessed	0%
Severe effect	A decline of 20% or more in FEV1 during the work shift	Not assessed	0%
Chronic changes No effect	FEV_1[b] 80% of predicted value[c]	Not assessed	0%
Mild to moderate effect	FEV_1[b] 60-79% of predicted value[c]	Not assessed	0%
Severe effect	FEV_1[b] less than 60% of predicted value[c]	Not assessed	0%

APPENDIX 5: APPROVAL LETTER FROM BOARD OF GRADUATE STUDIES

THE UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE

Telephone: 252641
Telegram: UNZA, Lusaka
Telex: UNZALU ZA 44370
Email: kbowa@yahoo.com

P.O. Box 50110
Lusaka, Zambia

==

30th March, 2010

Dr. Martha Sinzala
Department of Community Medicine
LUSAKA

Dear Dr. Sinzala,

RE: GRADUATES PROPOSAL PRESENTATION FORUM (GPPF)

Having assessed your dissertation entitled **"Prevalence of Acute Occupational Lung Disease Among Cotton Ginnery in Katete District".** We are satisfied that all the corrections to your research proposal have been done. The proposal meets the standard as laid down by the Board of Graduate Studies.

You can proceed and present to the Research Ethics.

Yours faithfully,

Mr. K. Bowa, MSc, M.Med, FRCS, FACS, FCS (Urol)
ASSISTANT DEAN, POSTGRADUATE

CC: Head of Department – Community Medicine

APPENDIX 6: APPROVAL LETTER FROM BIOMEDICAL RESEARCH ETHICS COMMITTEE

THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: unzarec@unza.zm
Assurance No. FWA00000338
IRB00001131 of IORG0000774

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

3 June, 2010
Ref.: 010-05-10

Ms Martha Sinzala
Department of Community Medicine
School of Medicine
P.O. Box 50110
LUSAKA

Dear Ms Sinzala,

RE: SUBMITTED RESEARCH PROPOSAL: **"PREVALENCE OF ACUTE OCCUPATIONAL LUNG DISEASE AMONG COTTON GINNERY WORKERS IN KATETE DISTRICT IN ZAMBIA"**

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 1 April, 2010 where changes/clarifications were recommended. We would like to acknowledge receipt of the corrected version with clarifications. The proposal is now approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat).
- **Ensure that a final copy of the results is submitted to this Committee.**

Yours sincerely,

Dr James Munthali
A/CHAIRPERSON

Date of approval: 3 June, 2010 **Date of expiry:** 2 June, 2011

APPENDIX 7: PERMISSION FROM MINISTRY OF HEALTH

Telephone: 260 (6) 221513

in Reply Please Quote

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH

Fax: 260 (6) 221219....

PROVINCIAL HEALTH OFFICE
EASTERN PROVINCE
P.O. BOX 510023
CHIPATA

19th July 2010

Dr Martha Sinzala
District Veterinary Office
Chipata

Dear Dr Sinzala

RE: REQUEST TO CONDUCT A RESEARCH ENTITLED PREVELANCE AND FACTORS ASSOCIATED WITH ACUTE OCCUPATIONAL LUNG DISEASE AMONG COTTON GINNERY WORKERS IN KATETE DISTRICT.

Reference is made to the above subject.

I write to inform you that following the clearance by the Research Ethics Committee, my office has no objection to your request to conduct the research.

By copy of this letter Katete District Medical Officer is hereby requested to facilitate.

Dr. Kennedy Malama
PROVINCIAL MEDICAL OFFICER
EASTERN PROVINCE

CC: The District Community Medical Officer -Katete District

APPENDIX 8: PERMISSION FROM DUNAVANT KATETE

-

DUNAVANT
ZAMBIA LIMITED

Plot 842 Mozambique Road, P. O. Box 550141, Katete Tel: +260 216 252295, email: katetegin@dunavant.co.zm

2nd July 2010

The Assistant Dean, Postgraduate
University of Zambia
School of Medicine
Department of Community Medicine
Lusaka

Attention: Dr Martha Sinzala

REF: PERMISSION TO UNDERTAKE A STUDY-PREVALENCE AND FACTORS ASSOCIATED WITH ACUTE OCCUPATIONAL LUNG DISEASE AMONG COTTON GINNERY WORKERS IN KATETE DISTRICT, ZAMBIA

Reference is made to the above subject matter.

Following your request to undertake a study at our institution, we write to acknowledge receipt of your summary proposal and wish to inform you that you can go ahead with your study at our workplace. It is our hope that the results obtained will be beneficial to our staff as well as the company as a whole.

Yours Sincerely,

Eng. Alibandila Siwiwaliondo
Ginnery and Administration Manager - Eastern