Respiratory symptoms and dust exposure among dangote cement processing factory workers in Mtwara, Tanzania

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RESPIRATORY SYMPTOMS AND DUST EXPOSURE AMONG DANGOTE CEMENT PROCESSING FACTORY WORKERS IN MTWARA, TANZANIA

By

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A Dissertation Submitted in (Partial) Fulfillments of the Requirements for the Degree of Master of Science (Environmental and Occupational Health) of

Muhimbili University of Health and Allied Sciences
October, 2019

CERTIFICATION

The undersigned certify that, has read and recommends for acceptance by Muhimbili University of Health and Allied Science a dissertation titled: **‘‘Respiratory Symptoms and Dust Exposure Among Dangote Cement Processing Factory Workers in Mtwara, Tanzania’’,** in (partial) fulfillment of the requirements for the degree of Master of Science (Environmental and Occupational Health) of Muhimbili University of Health and Allied Sciences.

_____

Dr. Simon H. Mamuya

Supervisor

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Date

DECLARATION AND COPYRIGHT

I, **Epaphroditus Canute Sabuni,** declare that this **dissertation** is my original work and has not been presented in any university for the same or other degree awards.

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DEDICATION

This work is dedicated to my lovely brother, late Aphrodisius Canute Sabuni, My father, the late Canute Cyprian Sabuni and to my lovely mother Naomi Natalis Sabuni.

ABSTRACT

Background: Cement manufacturing is among the growing industry in Tanzania. It involves processes from blending, kiln burning, clinker, grinding and cement final production. All of these cement manufacturing processes generates cement dust which contain silica and other toxic materials where can potentially affect respiratory function of exposed workers.

Objective: The main objective of this study was to assess respiratory symptoms and dust exposure among Dangote cement processing factory workers in Mtwara, Tanzania.

Methodology: A cross sectional comparative study design was conducted at Dangote cement processing factory and Ndanda springs natural mineral water processing factory serving as a non exposed site, all of these factories are located in Mtwara region in Tanzania. A total of 398 workers were selected randomly from these two factories and interviewed using structured questionnaires on respiratory symptoms modified from British Medical Research Council questionnaire. Checklist for assessing workplace environment and workers' practices were also used for determinants dust exposure. Personal total dust samples were collected using Side Kick Casella (SKC) pumps. Lung function tests were performed by using a portable spirometer and lung function parameters such as FEV1, FVC and FVC/FEV1 were used to interpret the results.

Results: The Prevalence of respiratory symptoms was higher among workers in cement processing factory (45.6%) than in mineral water processing factory (34%), this was statistically significant. Workers in cement processing factory were exposed to higher levels of total dust with AM 14.1033 mg/m^3 (SD 4.357) than in mineral water processing factory AM 0.0867 mg/m3 (SD 0.035).

Conclusion and recommendation: Exposure to cement dust in a working environment causes the increase in work related respiratory symptoms and reduced lung function. This study recommends the use of control measures to decrease dust exposure level among cement workers, also periodic medical examination should be conducted to assess workers health.

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ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygiene
CDC	Center for Disease Control
COPD	Chronic Obstructive Pulmonary Diseases
COSHHR	Control of Substances Hazardous to Health Regulations
DALYS	Daily Adjusted Life Years
FEV1	Forced Expiratory Volume in one second
FVC	Forced Vital Capacity
MUHAS	Muhimbili University of Health and Allied Sciences
NIOSH	National Institute of Occupational Safety and Health
PEFR	Peak Expiratory Flow Rate
PPEs	Personal Protective Equipments
SCOEL	Scientific Committee on Occupational Exposure Limits
SEG	Similar exposure groups
SKC	Sidekick pump
SPSS	Statistical Package for Social Sciences
TLVs	Threshold Limit Values
WEL	Workplace Exposure Limit

OPERATIONAL DEFINITIONS

Respiratory symptoms:-

Refers to the occurrence when workers develop symptoms of cough, phlegm, wheeze, dyspnea, chest pain, chest tightness and chronic bronchitis.

Cough:-

Refers to the involvement of expel air from lungs suddenly with sharp, short noise usually In a series of efforts.

Phlegm:-

Refers to a thick viscous liquid secreted by the mucous membrane of the respiratory passage during disease and inflammation usually contain mucus with bacteria.

Wheeze:-

Refers to breathe with a whistling sound in the chest, as a result of obstruction in the air passages.

Chest tightness:-

Refers to constriction of the chest occurring at any time during the work shift and on work day.

Dyspnea:-

Refers to labored or difficult breathing which create fear and is associated with anxiety, fear, or depression.

Breathlessness: Refers to the sensation of difficulty in breathing.

Bronchitis: Refer to an inflammation of the bronchial tubes, the airways that carry air to your lungs.

Personal Protective Equipment: Refers to anything worn by a person to minimize risk to the person's health and include a wide range of clothing and safety equipment.

Exposure: Refers to the act of being subjected to a hazardous agent.

Dust: Refers to dispersed solid particles suspended in air.

Cement dust: Refers to a fine, grey powdery material, portions made of a mixture of calcined limestone and clay of which contain some reactive calcium oxide.

Occupational diseases: Refers to diseases arising out of the course of employment.

Occupational hazards: Refers to working condition that can lead to illness, injury or death.

CHAPTER ONE

1.1 Background Information

Cement factories represent one of the most important basic elements in the economic development of any country. Workers in this sector constitute an important productive aggregate in the community. Cement is one of the most important building materials in the world. More than 2,500,000 people worldwide work in Cement processing factories (1). Urbanization needs housing and infrastructure, workers need factories, offices and shops, and natural resources need to be extracted and transported to markets. Supporting all of these activities will require millions of tonnes of cement in the coming decades. Currently, Tanzania's annual cement production amounts to more than 2 Million tonnes, compared to only 900,000 tonnes in the year 2001 (2). Africa's leading cement producer, Dangote Cement notes that Tanzania's per capita cement consumption of around 50kg per annum is well below the global average and low even for Africa. Nonetheless, the improving performance of the economy has fueled strong growth in cement demand and the prospects remain favorable, given the linear relationship between economic growth and Cement consumption. About 18,000 workers are working in cement production factories in Tanzania (3). Construction industry chiefly depends on the cement. The constituents in the cement have various health effects in the exposed group (4). Cement factory workers are exposed to cement dust during various manufacturing and production processes. Manufacturing of cement can be divided into two major parts which are quarrying of the limestone and cement production. Characteristics of exposed hazards are different according to these manufacturing processes. During the mining and milling of limestone, workers are exposed to airborne limestone dust containing a variety of minerals, whereas during the kiln-to packing process, workers are exposed to cement dust containing Cr6 (5). Production, cleaning, and maintenance work are the job types with highest exposure to thoracic aerosol in cement production plants (6).

Cement is a mixture of Calcium oxide (CaO) (62–66%), Silicon oxide (SiO2) (19–22%), Aluminum tri-oxide (Al2O3) (4–8%), Ferric oxide (Fe2O3) (2–5%), Magnesium oxide (MgO) (1–2%) and small fraction of Selenium. The aerodynamic diameter of cement particles range from 0.05 to 5.0 μm. These particles are respirable in size, hence most of

brands of cement are as important as potential cause of occupational lung disease. A high prevalence of respiratory symptoms and varying degrees of airway obstruction in relation to cement dust exposure has been reported in many studies. A higher percentage of the exposed workers reported recurrent and prolonged cough, phlegm, wheeze, Dyspnea, bronchitis, sinusitis, shortness of breath and bronchial asthma (7).

Cement is produced typically through a series of processes that includes quarrying, crushing, raw milling, blending, kiln burning to form clinker and homogenous blend of limestone and clay, which is then adjusted to a suitable content of Calcium, Silicon, Aluminum and Iron in a kiln.

During its heating clinker is formed, the clinker contains Calcium Silicates, Calcium Aluminates and Calcium Ferrites. Clinker is subsequently ground with gypsum and other additives, resulting in a fine particulate powder called Cement. Substantial dust is emitted during these processes, exposing workers to cement dust. In contact with water, clinker partly dissolves and forms aqueous slurry of high alkalinity, giving clinker and cement strong irritant properties and cause respiratory symptoms and disease. Worker's exposure to total dust should not exceed 10mg/m^3 as TWA for eight-hour work day and 40-hr work week (8). Chronic exposure to cement dust has been reported to lead to greater prevalence of various clinical conditions which includes both respiratory and non-respiratory systems involvement (9).

No organ is more vital and no organ is more vulnerable than the lungs. Being unable to breathe is one of the most distressing feelings one can have. The lungs are the largest internal organ in the body and the only internal organ that is exposed constantly to the external environment. Everyone who breathes is vulnerable to the infectious and toxic agents in the air. While respiratory disease causes death in all regions of the globe and in all social classes, certain people are more vulnerable to environmental exposures than others (10). The impairment of lungs usually depends on direct or indirect exposure of cement dust particles. However, some of the factors also need to consider the level of awareness and knowledge. Those factors may or may not influence the respiratory health level and lung function impairment (11). The health risks posed by inhaled dust particles are influenced by the deposition pattern of the particles in the various regions of the

respiratory tract and by the biological responses exerted by the deposited dust particles (12). Dust with aero diameter of less 100μm is inhalable. Inhalation is the primary route of dust exposure where by these agents gain access to respiratory system and can potentially affect exposed workers causing respiratory problems (13). The main route of entry of cement dust particles in the body is the respiratory tract and or the gastrointestinal tract by inhalation or swallowing respectively. Both routes, especially the respiratory tract are exposed to numerous potentially harmful substances in the cement environment. The personal exposure to respirable cement dust increases the risk of lung impairment by highly developing respiratory health symptoms, reducing lung function level and increasing the higher level of airway inflammation among highly exposed workers (11). Cement dust contains limestone, clay, calcium, silica quartz, aluminum and iron. Some of those are irritants and can cause acute or chronic respiratory tract inflammation and fibrosis leading to scarring lung tissue, overproduction of mucus, cough, dyspnea and others respiratory symptoms. Quartz (the common form of free crystalline silica) is highly insoluble compound, the toxicity of which is completely dependent on its penetration to the alveolar portion of the lungs that reach alveoli when enough small in size but most of time it deposited in the nose, throat, bronchi, or larger bronchiole to cause respiratory symptoms and disease. Occupational lung diseases are preceded by different symptoms such as shortness of breath, cough, sputum, dyspnea, and wheeze. The existence of respiratory symptoms could indicate that there is a mild cold or a life threatening condition and show the chronic respiratory disorders (14).

Globally occupational respiratory diseases are huge which account for up to 17% of all registered work-related diseases and the burden is highly affecting developing countries. Africa contributes about 11.8% to the global work related mortality, and it is estimated that 2.78 million deaths occurring annually across the countries being attributed to work (15). Respiratory health infections primarily contribute to respiratory diseases burden and they are leading cause of death in developing countries where by over two billion people are regularly exposed to the toxic effects of indoor and outdoor air pollution globally, which accounts for 3.5 million premature deaths annually (16). Respiratory diseases, circulatory diseases and cancer contribute to more than three-quarter of the total work-related mortality (17).

Respiratory diseases are ranked as the greatest single contributor to the overall burden of diseases globally and the big five respiratory conditions which account for a great burden to society are Chronic Obstructive Pulmonary Diseases, asthma, acute respiratory infections, TB and lung cancer (18). COPD affect more than 200 million people and is the fourth leading cause of death in the world (19) whereby COPD and asthma kill more than four million people in the world. One of the most important risk factors for the disease are inhaled occupational exposures through various occupations including manufacturing, mining, farming, construction and transportation (20). Breathing unhealthy air is a cause or contributor to most respiratory conditions. Common sources of unhealthy air are occupational exposures to lung toxins (unhealthy air in the workplace),air pollution from traffic and industrial sources, tobacco and household air pollution (21).

Occupational respiratory diseases account for up to 30 % of all registered work related diseases and 10 - 20 % of deaths are caused by respiratory problems. Occupational respiratory diseases account for up to 50 % prevalence among workers in high risk sectors such as mining, construction, and dust generating works (15).

In developed nations like Great Britain there are currently about 12,000 deaths each year due to occupational respiratory diseases, about 2/3 of which were due to dust related diseases (16). In developing countries like India, the second cement producing country, respiratory disease accounted for 17% of the 11 million occupational diseases and chronic obstructive pulmonary diseases are responsible for 87 % of work related respiratory disease mortality (17). In low income countries, especially Sub-Sahara African countries, respiratory problems are the sixth cause of death and most of these problems are due to dust exposure associated with increasing cement factories. Cement factory workers seem to be at high risk of developing chronic respiratory symptoms and COPD probably caused by cumulative high total cement dust exposure independent of smoking habits (22).

In Tanzania, respiratory diseases are among the top ten causes of deaths in the country, where by COPD and lower respiratory infections accounts for 6 % and 5% of mortality respectively (23). The burden of COPD is high, as it has been reported to be prevalence of 17.5% with higher prevalence of 21.7% in men than in female with prevalence of 12.9% (24). Various studies have been done in Tanzania and found that problems with lung

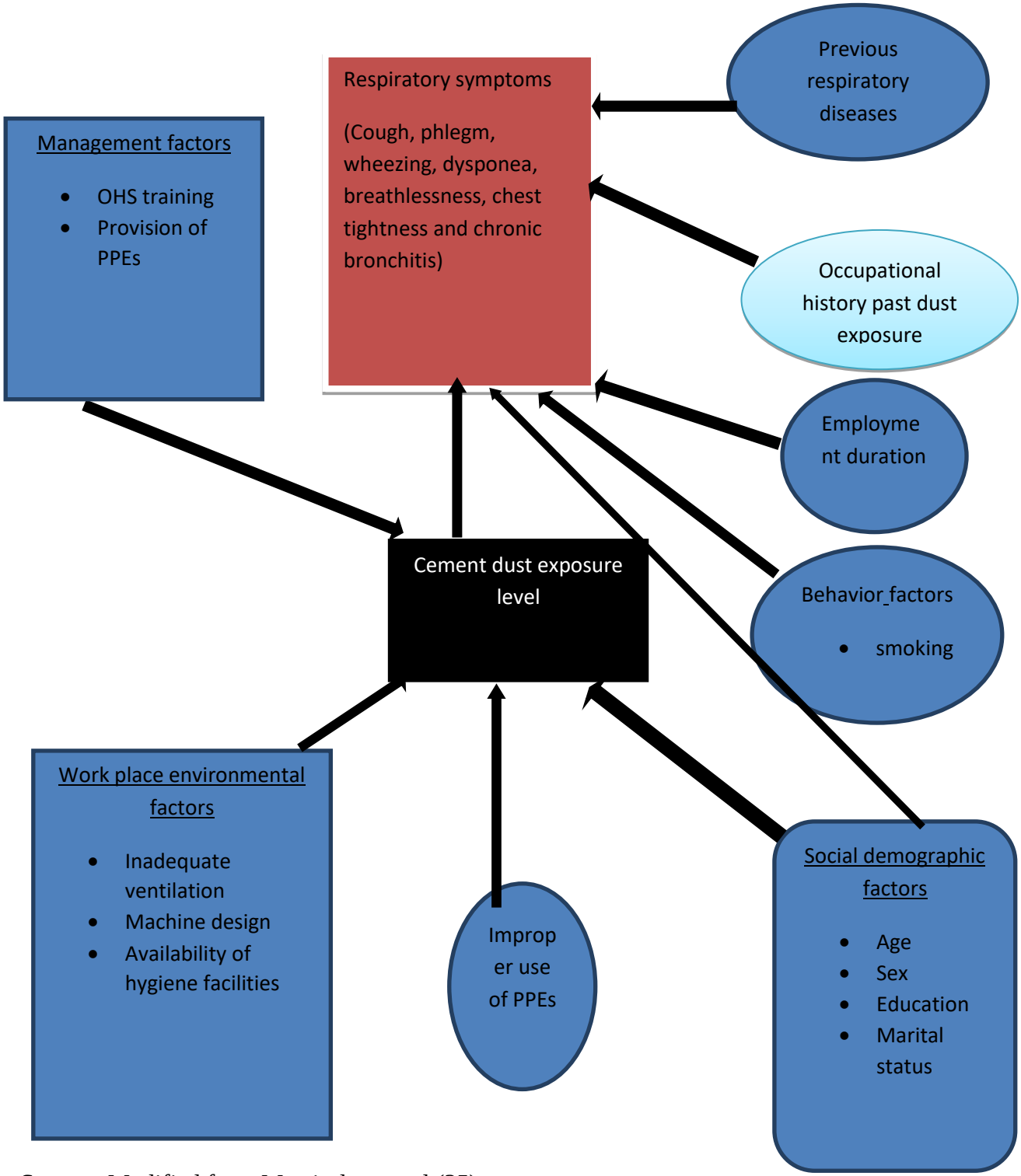
function and respiratory health among workers exposed to dust in various dusty works including Coal miners (25) whereby exposed workers to coal dust has been associated with airflow limitation, Mererani mine workers (26) where exposed workers to crystalline silica dust has been associated with silicosis, cement industry workers (27) whereby exposure to cement dust has been associated with chronic respiratory symptoms.

1.2 Statement of the problem

Cement dust is generated during processing of raw material, manufacturing and packing of cement in cement processing factories, and is a tiny particles spread in the air and affect respiratory health. The aerodynamic diameter of cement particles range from 0.05 to 5.0 µm where by this size is within the size of respirable particles and make the tracheobronchial respiratory zone the primary target of cement deposition, hence cement dust is important as a potential cause of respiratory illiness. Exposure to cement dust has been reported to lead to a greater prevalence of chronic respiratory symptoms and a reduction of ventilatory capacity (28).

Dangote cement processing factory in Mtwara is a new and large cement processing factory in Tanzania which has employed many factory workers, about 1,800 employees. This cement processing factory has a multi production where by its production capacity is likely to be a combination of all other cement processing factories in Tanzania hence dust exposure in such a factory needed to be explored and documented. The respiratory symptoms were also elicited in relation to the dust exposure.

1.3 Conceptual Framework



Source: Modified from Mwaiselage et al (35)

Figure 1.1: Conceptual framework on factors that contribute to respiratory symptoms among workers exposed to Cement dust.

The conceptual framework explains relationship between variables and it gives the picture of two scenarios, one being the respiratory symptoms as an outcome variable which is dependent to various factors. The predictors are the independent variables which are dust concentrations, work duration, history of respiratory disease, past dust exposures and smoking habit which aggravates the prevalence of respiratory symptoms.

Workers exposure to higher concentration of cement dust more than 10 mg/m^3 for total cement dust TWA for eight hours work day and 40 hours work week as per ACGIH and 5 mg/m^3 for respirable cement dust as per NIOSH is the main contributor to the development of respiratory symptoms. However other factors such as worker's previous exposure history (past dust jobs), previous history of respiratory disease and behaviors such as cigarette smoking may aggregate the respiratory symptoms to develop compared to healthy worker with no history of respiratory diseases and non smokers.

Second scenario is the determinants of cement dust exposure which increase or reduce cement dust exposure and they are independent variables to the outcome variable which is cement dust. The independent variables here which are determinants of cement dust exposure are behavior or individual factors and institutional factors.

Individual and behavior factors

They include factors such as age, education level and use of personal protective equipments that may influence respiratory symptoms and exposure to cement dust. For example elderly people are more prone to acquire respiratory symptoms than young adult as with increasing age, there is high chance of decreased immunity hence susceptible to infections. Workers with low level of education are more at risk to get exposure due to lack of knowledge and bad practices unknowingly such as not using respiratory protection even if they might be provided, poor hygiene as individual behavior may increase exposure. Proper use of PPEs such as full face respirators may reduce cement dust exposure among workers in high cement dust emissions work areas while improper PPEs use may increase cement dust exposure levels to workers in cement dusty areas.

Institutional factors

These factors include both administrative (management) issues and work place environmental factors that influence worker's health. They include conditions such as occupational health services policy and enforcement which may directly or indirectly protect workers' health or predispose workers to hazards. Work place conditions such as engineering design done by management to provide favorable working environment.

Management factors that can predispose worker into danger while at work and therefore affect worker's health can be due to failure in administration to provide health and safety training to employees and special induction to newly employed workers, lack of pre-medical examination to newly employed workers, inadequate regular health checks among workers and working duration. It also involves provision of PPEs and ensures availability of hand wash facilities.

Work place environmental factors- They address aspect of the working environment that may affect worker's health by predisposing worker into dangerous working environment. They can be poor working condition due to number of reasons such as inadequate ventilation, work station and equipment design, machine and building type.

1.4 Rationale of the study

The justification for this study emanated from studies done in other countries, which has reported high prevalence of respiratory symptoms as a result of cement dust exposure above the recommended limits (29, 30, 31, 32). Safe and health working environment is a key aspect in ensuring health of workers which has an international and national concern. Sustainable development goal number 8 aims at protecting workers' rights and promoting safe and secure working environment for all workers, Also the goals of National health policy of 2017 are to ensure sustainable health and safety at work place. Among the challenges in Occupational health and safety (OHS) stipulated by OSHA is inadequate information. This study is very important at the material time as cement dust exposure at Dangote cement processing factory in Mtwara, Tanzania was not yet known hence findings from this study will help the management of Dangote and other owners of cement factories to improve the control of cement dust exposure at working places. Health policy of 2007 requires workers to comply with safety and health aspects, as a matter of fact this study will be useful in establishing the magnitude of the problem and enables the nation to make effort to reduce the burden of respiratory symptoms and hence align with sustainable development goal number 8 which is to protect workers' rights by promoting safe and securing decent working environment for all workers.

1.5 Main Research Question

What is the prevalence of respiratory symptoms and lung function among Dangote cement processing factory workers in Mtwara, Tanzania?

1.6 Specific research questions

1. What is the prevalence of respiratory symptoms among Dangote cement processing factory workers in Mtwara, Tanzania?
2. What level of cement total dust concentration does Dangote cement processing factory workers, in Mtwara, Tanzania exposed to?
3. Are the use of personal protective equipment and gears in their working environments at Dangote cement processing factory in Mtwara, Tanzania well implemented?
4. Is the lung function of Dangote cement processing factory workers in Mtwara, Tanzania in normal condition?

1.7 Objectives

1.7.1 Main study objective

To assess respiratory symptoms and dust exposure among Dangote cement processing factory workers in Mtwara, Tanzania.

1.7.2 Specific study objectives

1. To determine prevalence of respiratory symptoms among Dangote cement processing factory workers in Mtwara, Tanzania.
2. To determine the personal total cement dust concentration among Dangote cement processing factory workers in Mtwara, Tanzania.
3. To assess the use of personal protective equipment and gears in the working environments among Dangote cement processing factory workers in Mtwara, Tanzania.
4. To determine lung function among Dangote cement processing factory workers, in Mtwara, Tanzania.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Respiratory symptoms among cement processing factory workers

A study done in Saudi Arabia shows that cement dust contains various types of metal oxides including calcium oxide, silicon oxide, aluminum trioxide, ferric oxide, magnesium oxide, sand and other impurities. According to this study workers who are directly exposed to the cement dust for longer durations, suffer from more shortness of breath, as compared to the workers who take precautionary measures. In this scenario, the study was performed, based on the distributed questionnaire and the collected sputum from the concerned cement dust exposed workers to evaluate the chronic respiratory complications or changes in lung function. Results of the study concluded that most of the subjects suffered from inflammation of the respiratory epithelial cells and other respiratory related complications including an asthma and productive cough (29).

A study done in United Arab Emirates shows that cement is manufactured through a series of processes that include the mining, crushing and grinding of the raw materials, blending and kiln burning to form clinker, cement milling and packing. Dust is emitted during these processes exposing workers to dust. According to this study chronic occupational exposure to dust in cement factories leads to a greater prevalence of chronic respiratory symptoms and signs such as coughing, sputum, wheezing and dyspnea as well as altering the pulmonary function indices (30).

The similar study shows that in developed nations like Great Britain there are currently about 12,000 deaths each year due to occupational respiratory diseases, about 2/3 of which were due to dust related diseases. In developing countries like India, the second cement producing country, respiratory disease accounted for 17% of the 11 million occupational diseases and chronic obstructive pulmonary diseases are responsible for 87 % of work related respiratory disease mortality. In low income countries, especially sub-sahara African countries, respiratory symptoms are the sixth cause of death and most of these problems are due to dust exposure associated with increasing cement factories (30).

A study done in Pakistan showed that aerodynamic diameter of cement dust particles is within the respirable extent, consequently occupational exposure to cement dust can cause numerous health hazards including the onset of acute or chronic respiratory diseases and respiratory function deficits (31).

A study done in Tanzania shows that worldwide community, especially the people in developing countries, are facing increasing risks of respiratory diseases due to production of smoke and dust in different occupational and industrial sectors. The health risks posed by inhaled dust particles are influenced by the duration of exposure and the biological responses exerted by the particles. Cement industry is one of the largest manufacturing industries and its workers are exposed to dust at various manufacturing and production processes. It is very well known that Portland cement dust is a mixture of calcium oxide, silicon oxide, aluminum tri oxide, ferric oxide, magnesium oxide, sand and other impurities (32).

Study done in Tanzania shows that interviews on respiratory symptoms were performed using a modified British Medical Research Council (BMRC) questionnaire. Participants were considered to have respiratory symptoms if they answered ‘yes’ to at least one of the questions in a symptom category (cough with or without sputum, dysponea, work related shortness of breath and wheeze). The prevalence of each symptom category was defined as the proportion of participants having at least one of the respiratory symptoms in each main symptom category (32).

2.2 Personal total cement dust concentration among cement processing factory workers

A study done in United Arab Emirates showed that personal total dust samples were collected on 37 mm cellulose acetate filters with pore size 0.8 μm placed in closed faced Millipore cassettes situated in the breathing zone of the selected workers. The cassettes were attached to pumps (SKC Side Kick) at a flow rate of 2 l/min. The air flow was checked before and at the end of the sampling period using a rotameter. In 2009, the mean sampling time of total dust for the cleaners was 308 minutes (range: 122- 442 minutes), and for production workers, it was 333 minutes (180-450 minutes) during the eight hour morning shift. Due to very high exposure levels in 2009, the sampling time in 2010 was

reduced to 49 minutes (range: 22- 100 minutes) for the cleaners, and 197 minutes (100-315 minutes) for production workers during the morning shift.

A study done in Shiraz, Iran showed that assessment to the extent to which workers had been exposed to cement dust, personal dust monitoring for airborne inhalable particle size > 5um and respiratory fractions particle size < 5 um was carried out at different dusty work sites. Dusty work site included five major areas and those are quarrying, blending and grinding of raw materials, grinding of a mixture of clinker and gypsum and screening and storing of cement in silos and packing. For estimation of the atmosphere dust in these units a personal dust sampler (Casella, London ltd), calibrated by digital automatic calibrator connected to a filter holder equipped with a 25mm membrane filter (pore size 0.45 um) through which air was pumped by a battery powder motor at a constant flow rate of 2 l/mm was used. Based on a few preliminary dusts, the optimum sampling time, to avoid overloading of the filters, was evaluated to be 120 minutes (33).

A study done in Tanzania shows that total dust samples were collected on pre weighed 37 mm cellulose acetate filters with a pore size of 0.8 mm in a closed faced three-piece Millipore cassette connected to a Sidekick Casella (SKC) pump (SKC Limited, Blandford Forum, UK) with a flow rate of 2.0 l/min. The cassettes were placed in the breathing zone of each study participant. The SKC pumps were calibrated daily using a rotameter before the sampling started and were checked at the end of the sampling time. The mean sampling time was 373 min (range: 145–538 min) among exposed and 348 min (range: 240–461 min) among controls (34).

A study done in Tanzania has demonstrated that exposure to cement dust in the factory has considerable variability. The a priori grouping by eight OGs representing the work area was found to be an efficient grouping scheme with regard to high contrast in exposure level between the work areas, minimal attenuation of exposure–response slope and small SE of the slope. Workers in the crane, packing and crusher were highly overexposed to total cement dust relative to OEL, irrespective of the mixed-model applied (35).

2.3 The use of personal protective equipment and gears in working environment

A study done in the United Arab Emirates shows that despite the availability of respiratory protective equipment for the workers Sharjah factory, only 19.5% of them used protective equipment during working hours. Similar and high percentages were reported by others. In this similar study cement workers who reported using masks all the time had lower prevalence rates of respiratory symptoms than those not using them during working hours. This findings justifies the use of appropriate respiratory protective devices during working hours to protect workers from developing respiratory symptoms (30).

A study done in South Africa showed that workers encounter risks of throat cancer, reddish eyes, skin problems and breathe problems which was attributed to inadequate provision of PPE by the management and the contractors that directly employed these workers. The study recommended that safety performance should be improved by the stakeholders in the cement industry through effective monitoring visit by the department labor to cement factory and provision of PPE (36).

A study done in Tanzania showed that a total of 21 (41.2%) of the high exposed workers reported using disposable personal respiratory filter masks during their particular 8-h work shift. These facemasks were of poor quality and were used repeatedly (37).

2.4 Lung function among cement processing factory workers

A study done in Chilanga, Zambia showed that lung function testing was performed using the Easy One ultrasonic flow sensing spirometer. Before taking measurements, the procedure was explained and demonstrated to each participant at the beginning and during each data collection period until the participant was comfortable to perform the maneuver on their own without any assistance. Standard methods were used to determine the validity and reproducibility of the blows. Lung function was measured as FEV1, FVC and FEV1/FVC ratio. For daily session, performed between 07:30 a.m. and 09:30 a.m., the participant had to blow into the Easy One spirometer. The maneuver involved the participants inspiring fully, seal the nose with one hand and place the mouth around the mouthpiece of the spirometer, followed by breathing out as fast as they could until the lungs were empty. The measurements were carried out according to guidelines and techniques for performing spirometry according to American Thoracic Society (ATS) standards (38).

A study done in Greece showed that all participants participated in that particular study underwent spirometry by using a portable spirometer. Spirometries were performed according to ERS guidelines. Three satisfactory maximal forced exhalation were recorded and the best forced expiratory volume in one second (FEV1), forced vital capacity (FVC), and the ratio FEV1/FVC were taken into account for analysis (39).

A study done in Ethiopia showed that a digital Spirare spirometer (SPS310) was used to measure the ventilatory function of the study subjects according to the American Thoracic Society (ATS) recommendations. The procedures for the ventilatory function test were explained individually to the workers. Spirometry was performed before the morning shift, while the workers were in a seated position. The pulmonary function profile included tests for FEV1, FVC, with a percentage ratio of FEV1/FVC. Spirometry was performed by the first author. The standing height and weight of the subjects were measured before the work shift in normal working clothes (40).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

A cross sectional comparative study was undertaken to assess respiratory symptoms and dust exposure among Dangote cement processing factory workers in Mtwara, Tanzania.

3.2 Study Area

The study was conducted at Dangote Cement processing factory in Mtwara District Council at Hiyari village in Mayanga ward. Mtwara District Council is one of the 8 District Councils which form Mtwara region. Mtwara District council is lying between 39 0" and 40 27" longitudes east of Greenwich and 10 0" and 10 07" latitudes south of the Equator. On the East, Mtwara District Council is bordered by Indian Ocean, On North is bordered by Lindi region and on west is bordered by Nanyamba town council. It has an area of 2,159 kilometer square and according to 2012 census Mtwara District Council had total population of 228,000 inhabitant ants. Dangote cement processing factory in Mtwara has a capacity of producing 3 million tons of cement per annum and provides direct employment to more than 3000 people in Mtwara. Dangote cement processing factory Mtwara operates a 300 Million tons and is the largest cement factory in Tanzania with about 500 Million tons of limestone reserves enough for 149 years, the plant is capable of producing large amount of high quality 32.5 and 42.5 grade cements to meet local market needs at competitive price as well as surrounding export market by sea.

The study was conducted also at Ndanda springs natural mineral water processing factory which comprised the study participants of unexposed group (Controls). Ndanda springs natural mineral water processing factory is found at Ndanda village which is about 35 kilometers from Mtwara District council. Ndanda springs natural mineral water processing plant has a capacity of producing 2,800,000 liters of mineral water per annum which meet the demand of mineral processed water for Mtwara as well as neighboring regions. Ndanda springs natural mineral water processing factory has a total number of 108 employees and has three Departments which are Production with a total number of 88 workers, Laboratory with a total number of 10 workers as well as Administration department which has 10

workers. There is only one working shift at Ndanda springs natural mineral water processing factory which is from 7:30 Am to 3:30 Pm.

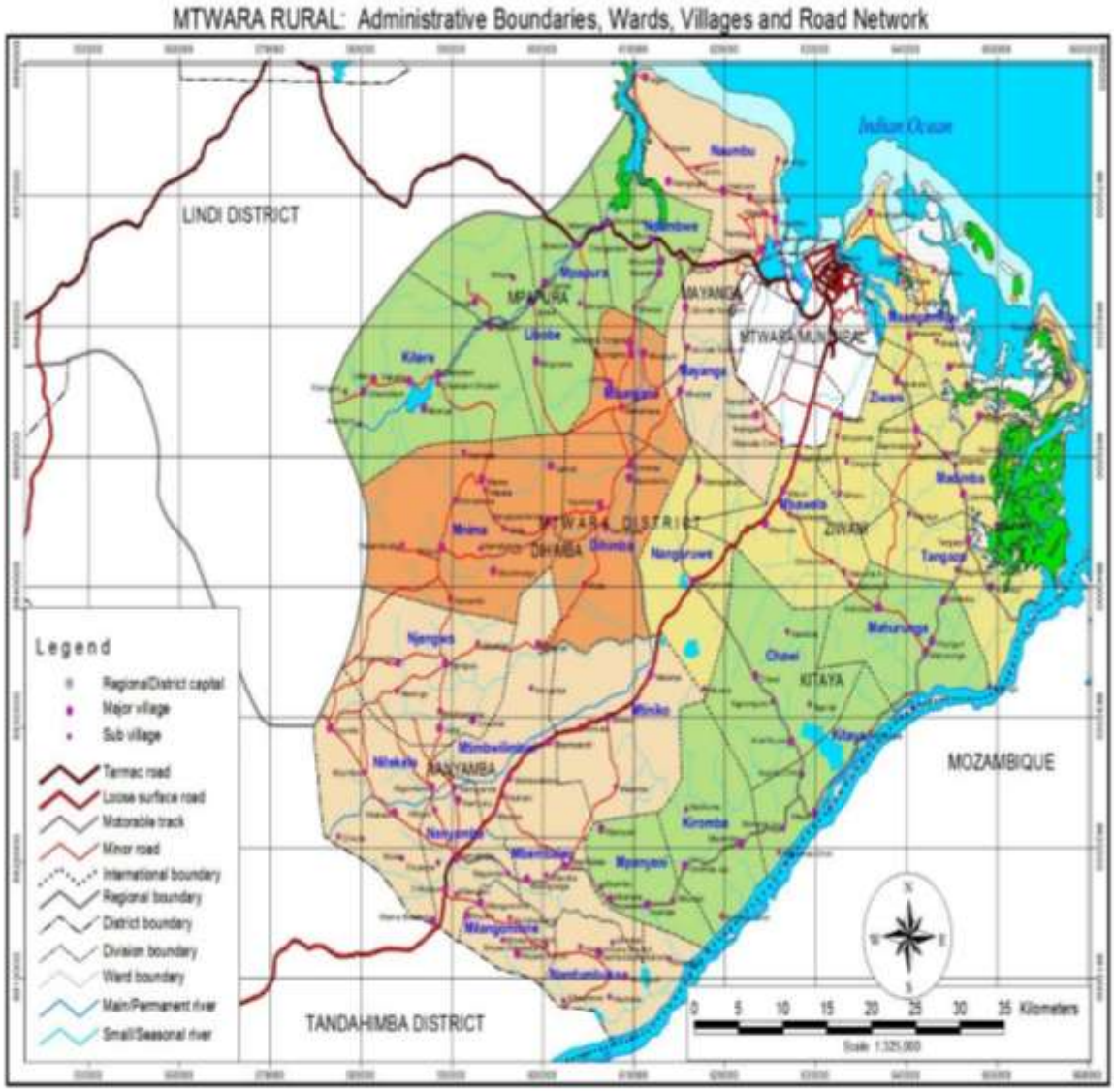


Figure 3.1: A map showing Mtwara District Council where Dangote cement processing factory is located. (Source: Mtwara Regional Office, Census and Statistics Department, 2002)



Figure 3.2: A front view showing the main entrance to Dangote cement processing factory in Mtwara, Tanzania.



Figure 3.3: Main investigator at the main entrance of Dangote cement processing factory, Mtwara.

3.3 Study Population

A study population were workers working in cement dust prone sections which are the clinker production, material processing, filtering, storage and loading and delivery of finished goods at Dangote Cement processing factory and workers at Ndanda springs natural mineral water processing factory where by all factories are located in Mtwara.

3.4 Sample size and sampling technique

3.4.1 Sample size estimation

The Sample size for this study were determined by using the following formula (41):-

$$n = \frac{Z^2 * P (1 - P)}{E^2}$$

Where;

n = sample to determined,

P = prevalence of respiratory symptoms which is 0.62 according to the study of chronic respiratory symptoms and associated factors among cement factory workers in Dejen town, Amhara regional state, Ethiopia (42)

Z = Confidence level (Z = 1.96 for 95%)

E = Margin of error 5% (0.05)

Hence:-

$$n = \frac{1.96^2 * 0.62\ (1 - 0.62)}{0.05^2}$$

n= 362

Then 362 is multiplied by 1.1 for design effect.

Therefore, n = 398

The ratio of sample size is 3:1; 3 for exposed workers and 1 for unexposed hence

Sample size estimation is **298** for exposed and **100** for unexposed.

Total sample size estimation is 398.

3.4.2 Sampling Technique

Simple random sampling technique was used to select samples for study participants for assessment of respiratory symptoms and dust exposure among Dangote cement processing factory workers as exposed group and Ndanda springs natural mineral water processing factory workers as unexposed group. The assignment of provision of number to each worker in the study population was performed then the selection of study participants was performed using a lottery where by all workers in the study population were assigned identification, the written tags and then study participants were selected by lottery until the required sample size was reached.

3.5 Data collection tools and procedures

3.5.1 Data collection tools

3.5.1.1 Respiratory symptoms

Data on respiratory symptoms were collected by using a structured questionnaire adapted from a modified version of the British Medical Research Council questionnaire on respiratory symptoms. These tools were constructed in English and translated into Swahili and again back to English language.

3.5.1.2 Personal total dust sampling

PVC filters of 8-µm pore size on three piece filter cassette mounted Sidekick Casella (SKC) pump were used for personal total dust sampling. Personal total dust measurements were conducted from all study participants in cement and mineral water processing factories. The personal total dust samples were collected on pre-weighed PVC filter membranes of 0.8 micrometer (µm) pore size placed in a closed face 37-mm filter cassette connected to Side Kick Casella (SKC) pumps. The pumps were operated at a flow rate of 2.0 L/minutes. All pumps were calibrated before sampling and flow rate were checked after every 4 hours of sampling. The dust sampling pumps were worn by workers throughout an eight hour work day shift. The cassette was attached on the collar and placed in the breathing zone of the worker. The filter were analyzed gravimetrically after sampling to obtain weight of total dust by Mettle Toledo microbalance at Muhimbili University of Health and Allied Sciences laboratory.

Total dust concentration was calculated as follows:

Weight of the dust on filter (mg) = Weight of the filter after sampling minus (–) weight of the filter before sampling.

Volume of air sampled in m^3 = flow rate of the pump in L/minutes or m^3 per minute multiplied by the time of the sampling in minutes.

Concentration of the dust in mg per m^3 = weight of the dust (mg) divided by the volume of air sampled in m^3.

3.5.1.3 The use of Personal Protective Equipments

Data on the use of Personal Protective Equipments and gears in working environment were collected by using a structured questionnaire which had the part of questions on the use of Personal Protective Equipments. A work through survey observation check list were also used which assessed the use of Personal Protective Equipment and gears in working environment. By using a work through survey check list the researchers were observing and tick in the checklist where appropriate and record what were seen as practiced by workers regularly. This observation were performed several times during data collection days to check for consistence of operations and practices of using Personal Protective Equipment in each factory. These tools were constructed in English and translated into Swahili and again back to English language.

3.5.1.4 Lung function

A portable spirometer were used for lung function tests. The lung function tests were conducted based on ERS/ATS guidelines. Calibration of the spirometer were performed before taking measurements, workers were tested through forced expiratory maneuvers at least three times in a standing position, and the best lung function parameters (FVC, FEV1 and FVC/FEV1 were recorded.

3.5.2 Data collection procedure

Questionnaire

During the period of data collection, the researchers introduced themselves and introduce the purpose of the study and ask for the workers to participate in the study. Workers meeting criteria and who were willing to participate were given a consent form to fill and sign. The interviews were carried out at the start of the working day by using the standardized questionnaire (the Modified British respiratory questionnaire) were used to interview workers in cement and mineral water processing factories. The questionnaire included questions on respiratory symptoms (cough, dysponea, wheezing, phlegm, breathlessness etc.), smoking, occupational exposure (duration of the job, working days and hours per week and exposure to other sources of pollution other than the cement dust.

Lung Function test

Spirometer was used to conduct lung function tests to the workers exposed to cement dust. The tests were performed in a standing position. The participant was asked to inhale to the maximum and then put the mouthpiece and exhale as fast and long as possible for a period of not less than 6 seconds. Each worker performed the test at least three times (maneuvers) where the best value for FEV_1 and FVC were recorded. Spirometric parameters such as FEV_1, FVC, FEV_1/FVC, and PEF were recorded for each participant.



Figure 3.4: One of the study participants being given an elaboration on how to perform spirometry.

Dust exposure measurement

PVC filters were weighted prior to sampling and given an identification number. On sampling SKC pump was attached around the waist of each participant. The filter cassette holder was placed in the breathing zone of the participant. The pump were operated at a flow rate of 2.0 litres/min for the whole working shift. After sampling, filter cassettes were sealed and transported to Muhimbili University of Health and Allied Sciences

multipurpose laboratory where the gravimetric analysis of filter were performed by using Mettledo micro balance. The concentrations were calculated as weight of sample divide by volume of total dust sampled as shown below.

Total volume of total dust = Flow rate× Sampling time

Sampling time = Tf – Ti

$$C = \frac{(Wf\text{-}Wi) \times 10^3}{VT} \ (mg/m3)$$

Whereas

C = concentration of total dust (mg/m3)

Wf = final weight of filter, g

Wi = initial weight of filter, g

VT = total volume of air sampled, M^3

Tf = final time after sampling

TI = initial sampling time.

The exposure level (concentration) was compared with threshold limit value for total dust by the ACGIH which is 10mg/m^3



Figure 3.5: A researcher preparing dust pumps ready to be inserted to the workers



Figure 3.6: A packer at packing plant working while dust pump was inserted arround his waist.

Work through observation checklist

A work through survey observation check list were used to assess the use of Personal Protective Equipment and gears in working environment. By using a work through survey check list the researchers were observing and tick in the checklist where appropriate and record what were seen as practiced by workers regularly.



Figure 3.7: A packer at parking plant working.



Figure 3.8: A packer at parking plant working.

3.6 Pre testing of the data collection tools

Data collection tools were pre tested among workers in cement products warehouses dealing with loading cement bags and boards in the warehouse and packing for sale in large warehouse and hardwares in Mtwara. This were performed to check if the questions were understood by study participants, with proper logic and sequence for generating meaningful information. Restructuring, modifications and amendments of the questions were done where necessary before producing a final data collection tool.

3.7 Data management and analysis

The collected data were coded and then entered into Statistical Package for Social Sciences (SPSS) version 20 for cleaning and analysis where by data analysis were done by each research objective. Descriptive statistics such as frequency, proportions cross tabulations, mean and Standard derivation were used to summarize and describe the relationship between independent and dependent variables respiratory symptoms were expressed in prevalence, dust exposure levels and lung function parameters were expressed in mean and standard deviation.

3.7.1 Data Management

The filled questionnaires were checked for completeness and collected by the research assistants on data collection day. Then the data were coded manually and entered in the SPSS version 20 and exported to Stata version 14 for analysis.

3.7.2 Data analysis

Objective 1: To determine prevalence of respiratory symptoms among Dangote cement processing factory workers and Ndanda springs natural mineral water processing factory

Prevalence of respiratory symptoms among workers in cement factory who are exposed group and workers in water factory serving as unexposed group were computed. Chi-square (χ^2) test were used to compare percentages of respiratory symptoms of these groups. The predictors included dust exposure levels in mg/ m^3, smoking habit (yes=1, no=0), years of work, and age. A p-value of less than 0.05 and 95% CI were considered statistically significant.

Objective 2: To determine the personal total dust concentrations among workers in cement factory and mineral water processing factory

Mean total dust concentrations was computed by using SPSS software. Mean total personal dust levels were obtained of the exposed workers in a cement factory and the cumulative mean dust concentration from the mineral water processing factory which serves as control. Mean dust concentrations were computed among the cement factory and non exposed workers in mineral water factory.

Objective 3: To assess the use of Personal Protective Equipment and gears in working environment at Dangote cement processing and Ndanda mineral water processing factories

Information collected on the structured question near and checklists provided the basis for the use of Personal Protective Equipment in cement and water processing factories. Linear mixed effects models were used to determine explanatory factors for the use of these protective gears.

Objective 4: To determine lung function among Dangote cement processing factory and Ndanda mineral water processing factory workers

The scores of each respondents of the lung function test were read direct from the spirometry, the data were exported to SPSS and then exported to Stata for analysis. Values of FEV1, FVC and FEV1/FVC were recorded and the predicted FEV1, FVC and FEV1/FVC. Therefore, a p-value of < 0.05 were considered significant in showing the statistical difference among the groups.

3.8 Recruitment and training of research assistants

Four research assistants with environmental and occupational health background were recruited. They were trained on skills of asking questions by using interviewer administered questionnaire and how to use dust sampling pumps to collect personal total dust samples. Among these four research assistants one was technician for measuring dust concentrations among workers, together with the investigator they were recording and monitoring total dust collection procedures to these workers.

3.9 Ethical Consideration

Ethical clearance was sought from Muhimbili University of Health and Allied Sciences Research and publication as well as Ethical committee review board. Permission to conduct this study was obtained from Dangote Cement processing factory as well as Ndanda springs mineral water processing factory in Mtwara. Informed consent was sought from study participants after the aims and objectives of the study clearly explained to them. Participants were informed about the study including its benefits, those who agreed to participate signed the consent forms. Study participants had been assured that no any harm had occurred to them for participated in the study. Moreover the research assistants provided an assurance on confidentiality to study participants. Participants had the right at any time to withdrew themselves from participating in the study when they are no longer interested. Codes (numbers) were used to identify participants and names were not recorded during data collection. Moreover no any unauthorized person had an access to data collected.

3.10 Inclusion and Exclusion Criteria

3.10.1 Inclusion Criteria

Workers in Dust exposure sections and who gave their consent to participate in the study.

3.10.2 Exclusion Criteria

Sick workers such as those who had recent abdominal surgery, heart disease were excluded from this study.

3.11 Study Variables

3.11.1 Objective 1: Prevalence of respiratory symptoms

Dependent Variable

Occupational respiratory health symptoms among workers

- Cough
- Breathlessness
- Dysponea
- Phlegm
- Wheezing

- Chest pain
- Chest tightness
- Bronchitis

Independent Variables

- Social-demographic factors such as age, sex, marital status, Level of education, past respiratory diseases).
- Behavioral factors such as smoking, utilization of PPE.
- Environmental factors such as working department, length of working hours, work experience (service years), training on respiratory health, past dust exposure history, energy used at home.
- Occupational history such as dust exposure in work places before employed in the cement factory or chemical/gas exposure.
- Chronic respiratory disease (co-morbidities).
- Chronic bronchitis, Tuberculosis (TB), least disease, Asthma and Lung Cancer.

3.11.2 Objective 2: Personal total cement dust concentration

Dependent variable

Cement dust concentration

Independent variable

- Inadequate ventilation
- Machine design
- Availability of hygiene facilities
- Working section
- Working Duration
- Employment Duration
- Occupational Health and Safety Training (OHS)

3.11.3 Objective 3: Use of Personal Protective Equipment

Dependent variable

Personal Protective Equipment

Independent variable

Provision of Personal Protective Equipments.

3.11.4 Objective 4: Lung function

Dependent variable

Lung function test

Independent variables

- Smoking habit
- Previous respiratory symptoms
- Past dust exposure
- Age
- Sex
- Education level
- Improper use of PPE

CHAPTER FOUR

4.0 RESULTS

4.1 Social demographic characteristics of the study participants

A total of 398 workers were included in this study. 298 workers were from cement processing factory and 100 workers were from mineral water processing factory. In cement processing factory there were 86.58% male and 13.42% female while in control there were 18% male and 82% female. Regarding past dust job exposure there were 14.43% of workers in cement processing factory who reported past job dust exposure and 85.57% with no past dust job exposure. While in mineral water processing factory (control) there were 0% of past dust job exposure. Table 4.1 shows the comparison in Social demographic characteristics of the respondents.

Table 4.1: Socio-demographic characteristics of workers in cement processing and mineral water processing factories

Parameter	Cement workers n = 298	Water workers n = 100	Total n = 398
Sex			
Male	258 (86.6%)	18 (18%)	276 (69.4%)
Female	40 (13.4%)	82 (82%)	122 (30.7%)
Age category			
< 30 Years	162 (54.4%)	59 (6%)	222 (55.6%)
30+ Years	136 (45.6%)	41 (41%)	176 (44.4%)
Education level			
None	12 (4%)	0 (0%)	12 (3%)
Primary	114 (38.3%)	56 (56%)	170 (42.7%)
Secondary	103 (34.6%)	44 (44%)	147 (36.9%)
College (Tertiary)	69 (23.2%)	0 (0%)	69 (17.3%)
Job category			
Repair& Maintenance	28 (9.4%)		28 (7.1%)
Clinker	74 (24.9%)		74 (18.6%)
Packing	86 (29%)		86 (21.7%)
Loading	60 (19.9%)		60 (14.9%)
Cleaner	50 (16.8%)		50 (12.6%)
Other (Controls)		100 (100%)	100 (26%)
For how long in job			
1 Year	76 (25.5%)	0 (0%)	76 (19.1%)
2 Years	139 (46.6%)	58 (58%)	197 (49.5%)
3 Years	66 (22.2%)	42 (42%)	108 (27.1%)
4 Years	17 (5.7%)	0 (0%)	17 (4.3%)
Smoking habit			
Smokers	48 (16.1%)	4 (4%)	52 (13.1%)
Nonsmokers	250 (83.9%)	96 (96%)	346 (87%)
Past dust exposure			
Past exposed	43 (14.4%)	0 (0%)	43 (10.8%)
Past not expose	255 (85.6%)	100 (100%)	355 (89.2%)
Mean (SD)			
Age [Years]	30.3 (4.7)	29.2 (11.8)	29.8 (8.3)
Weight [Kg]	66.3 (8.6)	61 (5.3)	63.7 (7)
Height [cm]	164.6 (6.9)	160.9 (5.8)	162.8 (6.3)

4.2 Prevalence of respiratory symptoms

4.2.1 Distribution of Prevalence of respiratory symptoms among workers in cement processing and those in mineral water processing factory

Table 4.2 shows relationship of respiratory symptoms between workers in cement processing factory and in mineral water processing factory where by among workers in cement processing factory 45.6% were with respiratory symptoms and among workers in mineral water processing factory 34% were with respiratory symptoms.

Table 4.2: Relationship of respiratory symptoms between workers in cement processing and mineral water processing factories

Parameter	**Cement workers n = 298**	**Water workers n = 100**	**Total n = 398**
Respiratory symptoms			
Yes	136(45.6%)	34(34%)	170(42.7%)
No	162(54.4%)	66(66%)	228(57.3%)

4.2.2 Relationship between respiratory symptoms and risk factors among workers in cement processing factory

Table 4.3 shows relationship between respiratory symptoms and risk factors among workers in cement processing factory.

Table 4.3: Relationship between respiratory symptoms and risk factors among workers in cement processing factory

Risk Factor	Total n = 298	Respiratory symptoms		x^2	p - value
		Yes	No		
Smoking					
Yes	48 (16.11%)	35 (11.75%)	13 (4.36%)	17.16	0.0001
No	250 (83.89%)	101 (33.89%)	149 (50%)		
Past dust exposure					
Yes	43 (14.43%)	21 (7.05%)	22 (7.38%)	1.0304	0.5974
No	255 (85.57%)	115 (38.59%)	140 (46.98%)		
Age category					
<30 Years	161 (54.03%)	73 (24.49%)	88 (29.53%)	0.0101	0.9199
30+ years	137 (45.97%)	75 (25.17%)	62 (20.81%)		
Employment duration					
<3 Years	215 (72.15%)	95 (31.88%)	120 (40.27%)	0.6556	0.4181
3+ years	83 (27.85%)	41 (13.76%)	42 (14.09%)		

4.2.3 Relationship between respiratory symptoms and job category among workers in cement processing and mineral water processing factories

Table 4.4 shows relationship between respiratory symptoms and job category of cement processing and mineral water processing factories whereby workers who are working in sections (job category) with high cement dust exposure proves to be with high respiratory symptoms than those working in sections (job category) with low cement dust exposure. The findings are statically significant $p<0.05$. For example workers who are working in packing section (job category) had higher prevalence of respiratory symptoms than those who are working in repair and maintenance section ($p<0.05$).

Table 4.4: Relationship between respiratory symptoms and job category in cement processing and mineral water processing factories

Job category	Respiratory symptoms		x^2	P - value
	Yes	No		
Repair (n = 28)	6 (21.4%)	22 (78.6%)	24.6331	0.0002
Clinker (n = 74)	38 (51.3%)	36 (48.7%)		
Packing (n = 86)	50 (58.1%)	36 (41.9%)		
Loading (n = 60)	18 (30.0%)	42 (70.0%)		
Cleaner (n=50)	25 (50.0%)	25 (50.0%)		
Other [Control] (n=100)	34 (34.0%)	66 (66.0%)		

4.3 Personal total cement dust concentration

4.3.1 Personal dust exposure levels among workers in cement processing and mineral water processing factories

The total of 12 personal dust samples were collected from the participants in cement processing factory while 3 samples were collected among controls. The average Arithmetic mean (AM) of personal total dust level was 14.1033 with Standard Deviation (SD) of 4.3571 for cement processing factory while for the control the average Arithmetic Mean (AM) of personal total dust level was 0.0867 with Standard Deviation (SD) of 0.035 all with mean sampling time of 8 hours. The workers of cement processing factory were exposed above the allowable recommended limit (10gm/$m^{3)}$ set by **ACGIH).** Table 4.5 shows dust concentrations.

Table 4.5: The average dust exposure concentration between workers in cement processing and mineral water processing factories

Factory	Number of dust sample taken	Average Arithmetic Mean (AM)	Standard Deviation (SD)
Cement processing	12	14.1033	4.357
Water processing	3	0.0867	0.035

4.3.2 Personal dust exposure levels between similar exposure groups

The workers of cement processing factory were divided into four similar exposure groups according to jobs they perform (sections). These were Clinker, Packing, Loading and Cleaner. Packing and cleaner were the sections with higher total cement dust concentration which was above Occupational Exposure Limit 33.2433 and 15.3933 respectively.

Table 4.6: Personal total cement dust samples among similar exposure groups (sections) in cement processing factory

Similar exposure group (sections)	Number of cement dust sample taken	Arithmetic Mean (AM)	Standard Deviation (SD)	Number of dust samples exceeding 10mg/m^3
Clinker	3	1.6267	1.3514	0
Packing	3	33.2433	10.2575	3
Loading	3	6.1500	3.2836	0
Cleaner	3	15.3933	2.5361	3

4.4 The use of personal protective equipment

Regarding the use of Personal Protective Equipment at the working environment, on the part of the questionnaire modified by British Medical Research Council there were questions on the Personal Protective Equipment and the response of the workers by job categories regarding Personal Protective Equipment at the working Environment were statistically significant p – value <0.05 as shown on table 4.7.

Table 4.7: Relationship of the response of the workers in cement processing factory between Job category and Personal Protective Equipment

P.P.E		Job category					x^2	P - value
		Repair	Clinker	Packing	Loading	Cleaner		
Are you provided with P.P.E?	Yes	22(7.4%)	71(23.8%)	84(28.2%)	51(17.1%)	47(15.8%)	16.970	0.002
	No	6(2%)	3(1%)	2(0.7%)	9(3%)	3(1%)		
Have you trained on the use of P.P.E?	Yes	22(7.4%)	48(16.1%)	69(23.2%)	43(14.4%)	44(14.8%)	10.489	0.333
	No	6(2%)	26(8.7%)	17(5.7%)	17(5.7%)	6(2%)		
Are you using proper P.P.E for work?	Yes	25(8.4%)	71(23.8%)	0(0.0%)	57(19.1%)	46(15.4%)	8.292	0.081
	No	3(1%)	3(1%)	86(28.9%)	3(1%)	4(1.3%)		
Have you ever used any of P.P.E?	Yes	25(8.4%)	73(24.5%)	86(28.9%)	58(19.5%)	47(15.8%)	10.577	0.032
	No	3(1%)	1(0.3%)	0(0.0%)	2(0.7%)	3(1%)		
According to nature of your job have you used P.PE?	Yes	25(8.4%)	1(0.3%)	86(28.9%)	58(19.5%)	3(1%)	10.577	0.032
	No	3(1%)	73(24.5%)	0(0.0%)	2(0.7%)	47(15.8%)		

4.5 Lung Function

Lung function tests were conducted on 120 (40.26%) workers in cement processing factory out of 298 workers while among workers in mineral water processing factory (control group), 29 (29%) workers performed the lung function test. Only 112 (93.33%) workers in cement processing factory were able to achieve acceptable maneuvers while 8 (6.67%) participants were unable to achieve acceptable maneuvers even after 8 blows. The prevalence of air flow obstruction was (4.6%) for cement workers while in water workers group (8.7%) had air flow obstruction. The prevalence of obstruction defect $FEV_1/FVC < 70$ is shown in figure 4.1 and 4.2.

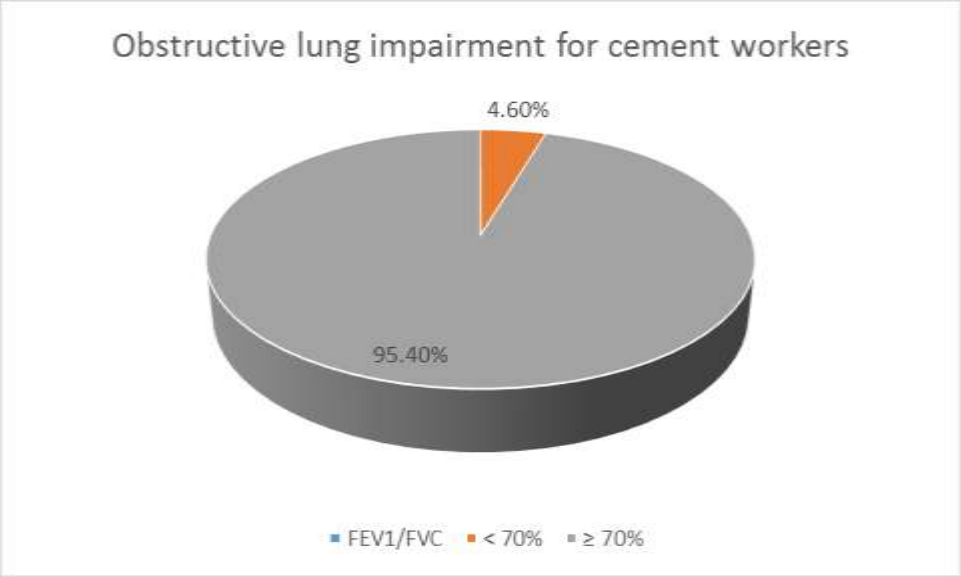


Figure 4.1: Obstructive lung impairment for cement workers

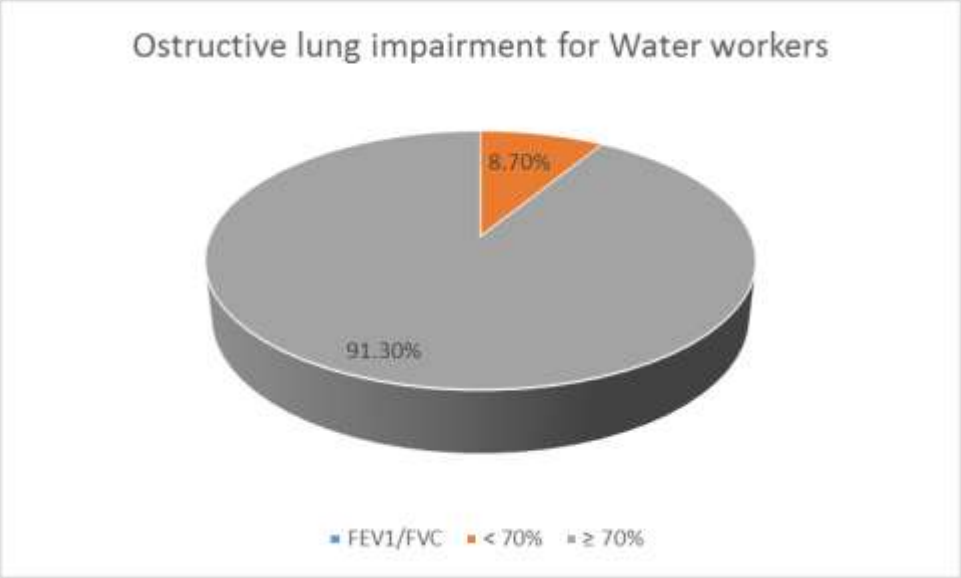


Figure 4.2: Obstructive lung impairment for water workers

CHAPTER FIVE

5.0 DISCUSSION

The main objective of this study was to assess respiratory symptoms and dust exposure among Dangote cement processing factory workers in Mtwara, Tanzania. The study founded higher prevalence of respiratory symptoms among workers of cement processing factory than mineral water processing factory (control), 45.64% and 34% respectively, whereby this difference was statistically significant. Also the study founded high dust concentrations among exposed workers 14.1033 mg/m^3 (SD = 4.357). This exceeded the TLV for total dust which is $10mg/m^3$. The findings from this study could lay foundation for developing exposure limit values for dust exposure levels at Dangote cement processing factory, Mtwara as well as interventions for managing dust exposures from similar factories.

5.1 Respiratory symptoms among workers in cement processing and mineral water processing factories

Prevalence of respiratory symptoms were higher among workers in cement processing factory than mineral water processing factory (control), 45.64% and 34% respectively. These findings were higher than those in the study done in United Arab Emirate among cement factory workers (30) which reported prevalence of respiratory symptoms among exposed group; cough (19.5%), phlegm (14.8%), wheezing (2.0%), shortness of breath (4.7%), chronic bronchitis (16.0%) than in non exposed group. The findings from this study was similar to the study done in North west Ethiopia among cement factory workers (43) whereby prevalence of respiratory symptoms were higher among cement workers (66.2%) than in controls (31.2%). Also the findings of this study was similar to the study done in Tanzania which showed that the prevalence of respiratory symptoms in cement plant workers in 2010 was elevated compared with control but was drastically reduced in 2011, this implies that even in our study if control measures will be in place prevalence of respiratory symptoms might decline (32). The findings from this study were coherent with other studies which reported higher prevalence of respiratory symptoms among workers in cement processing factory (28), (29), (33), (38), (39), (42).

In this study there were no statistically significant association between duration of employment and respiratory symptoms. The findings of this study were contrary to the study done in Pakistan (31) which found that duration of exposure to dust was associated with impairment of respiratory function among exposed workers with employment duration of 10 years and above.

5.2 Dust Exposure Level

The workers in cement processing factory were exposed to higher dust levels than controls. The mean concentration was (14.1033mg/m^3) among workers in cement processing and (0.09mg/m^3) among the controls, the difference in exposure levels among the two groups was statistically significant $p<0.05$. 46% of workers in cement processing factory were exposed to total dust concentrations above the occupational exposure limits set by American Conference of Governmental Industrial Hygienist (8). The results in our study correlate with the study done in United Arab Emirate where the exposure concentration among workers in cement processing factory was high (30). The average total dust concentration in some cement processing factories varied up to 120 mg/m^3 which is above Occupational Exposure Limit. (7), (28), (39), (42).

5.3 The use of personal protective equipment and gears in their working environment

The findings from this study showed that there were inadequate and improper use of Personal Protective Equipments by workers of Dangote cement processing factory regardless of the responses from the questionnaire. At packing plant the packers were not using respirators, gloves and eye gogles to protect themselves from cement dust instead they were just using a piece of cloth around their face to protect them from cement dust generated while they were working. These findings are similar with the findings from the study done in Ethiopia which showed none of the exposed workers observed was using a proper personal respiratory mask; 15% of the workers in the packing section had some kind of cloth to cover their mouth and nose during their 8-hour work shift, whereas the others did not use any respiratory protective devices (12).

The findings of our study is similar to the study done in United Arab Emirate which revealed that Respiratory protection devices (N95 particulate respirator masks) were available for the factory workers but were not used. One hundred and eighteen (79.2%) workers claimed that they used masks, 19 (12.8%) subjects used an ordinary cloth mask, and 12 (8.1%) subjects never used any respiratory protection devices to protect themselves from the cement dust. Twenty-nine (24.6%) out of the 118 workers who claimed to use the masks used them all the time, and the remaining 89 (75.4%) workers used them sometimes. Twenty five (86.2%) out of the 29 workers who reported using the masks all the time were found wearing them during the walk-through survey. Out of the 29 workers who claimed to use the mask all the time, 20 workers (69%) said that their jobs were very dusty, and 9 (31%) of them said mildly or a little dusty. In addition, 18 (62.1%) workers of them worked in areas where dust was higher than the standard, the packaging and raw mills areas. Interestingly, 21 (72%) and 18 (81.8%) exposed workers who respectively claimed to have cough and phlegm, said they never or rarely used personal protective equipments (masks) (30).

5.4 Lung function test

The findings from our study was similar to the study done in Shiraz Iran where by the results of lung function test had reduced VC, FVC, FEV1 and FEV1/FVC (33) while in our study those with obstructive lung impairment among workers in cement processing factory were 4.6% (figure 4.1) and among the water processing factory (control) were 8.7% (figure 4.2). This implies that if workers in cement processing factory will continue to be exposed to higher levels of cement dust their lung function will also decline. Moreover the findings of our study was consistent with the study done in Mashdad Iran which showed FVC, FEV1 and FEV1/FVC to be lower in the exposed workers compared with unexposed (7).

According to the study done in Greece, the prevalence of the patient with the ratio FEV1/FVC<70% was numerically higher in cement workers than office workers 14.4% versus 1.1% respectively (19), these findings were similar with the findings of our study. The findings from our study were similar to other studies where by the results of lung function test were with the reduction in VC, FVC, FEV1 and FEV1/FVC. (28), (31), (32), (38).

5.5 Limitation of the study

- Insufficient number of dust samples collection tools especially filters therefore we ended up with fewer number of dust samples in contrary to the NIOSH guideline for sampling strategy. This affected the effective analysis of the second study objective of determinants of dust exposure as we could not sampled for repeated personal dust samples.
- The study methodology was cross-sectional type thus no causal relationship could be established.

5.6 Strength of the study

- Despite study type being cross-sectional, it was possible to establish association between exposure and non exposed group, by choosing the non-exposed group of similar socio-demographic characteristics with the exposed group. This scenario in occupational cross-sectional studies where the cause could not be ascertained but association between the exposed and non-exposed could have been seen through the statistical tests.
- For exposed workers, association of respiratory symptoms and proportions of workers with previous respiratory disease was not statistically significant and also apart from dust exposure there was no association of proportion of workers with respiratory symptoms and previous dusty jobs; therefore significant association remained between dust exposure and the prevalence of respiratory symptoms.
- After adjusting for confounders, the odds of developing respiratory symptoms among workers in cement processing factory were still higher compared to controls.
- The tool BMRC questionnaire modified and used in data collection for interviewing participants on respiratory symptoms was validated tool, standardized and accepted for assessment across continents and it has been used in similar studies in the country thus enabled comparison of results.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study has demonstrated higher number of workers in cement processing factory to experience respiratory health symptoms than workers in mineral water processing factory.

Cement dust concentration among Dangote cement processing factory workers in the processing sections are exposed to cement dust above exposure limits.

Regarding the use of personal protective equipments and gears in working environment at Dangote cement processing factory in Mtwara, Most of the workers are not using personal protective equipments and gears while working.

Lung function impairment is high among workers in cement processing factory due to its percentage, where obstructive lung function impairment was 4.6% this revealed that if these workers will continue to be exposed to cement dust their lung function will decline.

6.2 Recommendation

1. The cohort study should be conducted in order to establish the causal effect relationship between dust exposure and presence of respiratory symptoms.
2. Engineering, administrative and personal control measures should .be put in place in order to improve the working environment and protect workers from higher cement dust exposure level.

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APPENDICES

Appendix I: Respiratory symptoms assessment tool (Questionnaire English Version)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

SCHOOL OF PUBLIC HEALTH AND SOCIAL SCIENCES

P.O.BOX 65015, DAR ES SALAAM, TANZANIA,

Telephone: +255-22-2153371, E-mail: dsphss@muhas.ac.tz

Name of interviewer…… Date……

Questionnaires number ……

Please, put check (√) in front of the correct question number which to indicate number and write a correct number example age put in a years

A: SOCIAL DEMOGRAPHIC

S/N	Question	Coding classification	Respond
1.	Sex: (observe)	1= Male	
		2= Female	
2.	Age …….. DATE		
3.	Weight		
4.	Height		
5.	Level of education	1 = No education	
		2 = Primary school	
		3= Secondary school	
		4 = College (Tertiary)	
6.	What is your job category	1= Maintenance and repair 2= Clinker 3= Packing 4= Loading 5= Cleaner	

S/N	Question	Coding classification	Respond
		6= Other	
7.	For how long have you been in this job?	……	
8.	How many hours do you work per day?	……	
9.	How many hours do you work per week		

B: RESPIRATORY SYMTOMS

S/N	Question	Coding classification	Respond
COUGH			
10.	Do you usually involve expel air from lungs suddenly with sharp, short noise usually in a series of efforts first thing in the morning?	0=No 1=Yes	
11.	Do you usually involve expel air from lungs suddenly with sharp, short noise usually in a series of efforts at day or at night?	0=No 1=Yes	
12.	Do you usually involve expel air from lungs suddenly with sharp, short noise usually in a series of efforts as much as 4 to 6 times a day or 4 or more days in a week?	0=No 1=Yes	
13.	Do you usually involve expel air from lungs suddenly with sharp, short noise usually in a series of efforts on most days for 3 consecutive months or more in a year?	0=No 1=Yes	
PHLEGM			
14.	Do you usually bring up phlegm first	0=No	

S/N	Question	Coding classification	Respond
	thing in the morning?	1=Yes	
15.	Do you bring up phlegm during a day or night	0=No 1=Yes	
16.	Do you usually bring up phlegm as much 4-6 times a day or 4 or more days in a Week?	0=No 1=Yes	
17.	Do you bring up phlegm on most days for 3 consecutive months or more in a year?	0=No 1=Yes	
WHEEZING			
18.	Have you had attacks of wheezing at any time?	0=No 1=Yes	
If the answer is no to the above skip to question no.20			
19.	For how long have you had wheezing in your chest	……	
20.	Do you usually experience chest tightness while at work or just at work	0= No 1= Yes	
If the answer is no to the above skip to question no.23			
21.	How long do you have this problem	**……**	
22.	Have you ever required medicine or treatment for the (se) attack(s)?	0= No 1= Yes	
BREATHLESSNESS			
If subject is disabled from walking by any condition other than heart or lung disease skip these section			
23.	Are you troubled by shortness of breath when hurrying the level ground or walking up a slight hill?	0= No 1= Yes	
24.	Do you get shortness of breath walking with other people of your own age on	0= No 1= Yes	

S/N	Question	Coding classification	Respond
	level ground?		
25.	Do you have to stop for breath when walking at your own pace on level ground?	0= No 1= Yes	
CHEST TIGHTNESS			
26.	Does your chest ever feel tight or your breathing becomes difficult?	0= No 1= Yes	
If the answer is no to the above skip to question no.29			
27.	Do you usually experience chest tightness while at work or after work	0= No 1= Yes	
28.	For how long do you have this problem?		
CHRONIC BRONCHITIS			
29.	During the past three years have you had any chest illiness which had kept you from your usual activities for as much as a week?	0= No 1= Yes	
If the answer is no to the above skip to question no.32			
30.	Did you bring up more phlegm than usual in any of these illnesses?	0= No 1= Yes	
31.	Have had more than one illness like this in past three years?	0= No 1= Yes	

C: PREVIOUS RESPIRATORY ILLNESSES

S/N	Question	Coding classification	Question
32.	Have you ever had any of the Lung conditions confirmed by a doctor as mentioned bellow	0= No 1=Yes	
	1. Chronic bronchitis		
	2. Breathlessness		
	3. Asthma		
	4. Heart attack.		
	5. Lung cancer.		
	6. Tuberculosis (TB)		
OCCUPATIONAL HISTORY			
33.	Have you ever worked for any other dusty job before like 1. Road sweeping 2. Cotton 3. Milling 4. Tea/coffee 5. Other (mention)	0= No 1= Yes	
If the answer is no to the above skip to question no.36			
34.	For how long?	……years	
35.	What perceived level of dust has been exposed in that job?	1= mild 1= Moderate 3= High	
36.	Have you ever been exposed to gas or chemical fumes in any of the following industries 1. Steel 2. Garage 3. Paints	0= No 1= Yes	

	4. Other (mention)		
37.	For how long exposed?	……years	
38.	What perceived level of fume has been exposure in that job?	1= mild 1= Moderate 3= High	
SMOKING HABIT			
39.	Do you smoke cigarette?	0= No 1= Yes	
40.	Have ever smoked as much as one cigarette a day for as long as a year?	0= No 1= Yes	
41.	How many cigarettes do you smoke per day?	0= No 1= Yes	
42.	For how long have you been smoking?	……	

D. PERSONAL PROTECTIVE EQUIPMENT

S/N	**Question**	**Coding classification**	**Respond**
43.	Are you provided with Personal Protective Equipment?	0=No 1=Yes	
44.	Have you ever been trained or given guidance on the use of the PPE?	0=No 1=Yes	
45.	Have you ever use any of the Personal Protective Equipment mentioned below	0=No 1=Yes	
	1.Respirators		
	2.Gloves		
	3.Eye gogles		
	4.Masks		
	5.helmets		
	6.Boots		
46.	According to the nature of your job have you ever use any kind of Personal	0=No 1=Yes	

S/N	Question	Coding classification	Respond
	Protective Equipment mentioned below?		
	1.Respirators		
	2.Gloves		
	3.Eye gogles		
	4.Masks		
	5.Helmets		
	6.Boots		
47.	Are you using proper Personal Protective Equipment for work?	0=No 1=Yes	

SPIROMETER

FEV1 (litres) **FVC (litres)**

Readings 1 ☐ . ☐☐ ☐ . ☐☐☐

2 ☐ . ☐☐ ☐ . ☐☐☐

3. ☐ ☐☐ ☐ ☐☐☐

PERF (Litre/min)

1 ☐☐☐

2 ☐☐☐

3 ☐☐☐

THANKS FOR YOUR COOPERATION

Kiambatanisho II: Fomu ya kukusanyia taarifa za dalili za magojwa katika mfumo wa njia ya hewa (swahili version)

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI
S.L.P 65001 DAR ES SALAAM TANZANIA

Jina la Mdodosaji…… Tarehe ……

Namba ya dododoso ……

Weka vema (√) mbele ya Jibu sahii na andika Namba kila panapohitajika

SEHEMU A: TAARIFA ZA AWALI

Na.	**SWALI**	**Chaguo**	**Jibu**
1.	jinsia: (angalia)	1= Me	
		2= Ke	
2.	Umri……..miaka		
3.	uzito		
4.	Urefu		
5.	Kiwango cha elimu	1. Sina elimu	
		2. Elimu ya msingi	
		3. Elimu ya sekondari	
		4. Elimu ya juu (eleza)/ufundi, chuo	
6.	Upo kitengo gani?	1. Kuchimba na kukusanya mali ghafi 2. Kupika mali ghafi ili kupata saruji 3. Kutunza saruji 4. Kupakia saruji kwenye malori	
7.	Una miaka mingapi kazini?	……	
8.	Unafanya kazi masaa mangapi kwa siku	……	
9.	Unafanya kazi masaa mangapi kwa wiki?		

SEHEMU B: DALILI ZA MARADHI YA MFUMO WA UPUMUAJI

Nitakuuliza maswali kuhusu kifua chako. Ningependa ujibu NDIYO au HAPANA pale inapobidi.

Na	Swali	Chaguo	Jibu
KIKOHOZI			
10.	Je? huwa unatoa hewa kutoka kwenye mapafu gafla kwa sauti kali na inayokatika kwa kutumia nguvu unapoamka asubuhi?	0= Hapana 1= Ndiyo	
11.	Je? huwa unatoa hewa kutoka kwenye mapafu gafla kwa sauti kali na inayokatika kwa kutumia nguvu mchana au usiku?	0= Hapana 1= Ndiyo	
12.	Je? huwa unatoa hewa kutoka kwenye mapafu gafla kwa sauti kali na inayokatika kwa kutumia nguvu mara 4 mpaka 6 kwa siku au zaidi ya siku 4 kwa wiki	0= Hapana 1= Ndiyo	
13.	Je? huwa unatoa hewa kutoka kwenye mapafu gafla kwa sauti kali na inayokatika kwa kutumia nguvu namna hii kwa zaidi ya miezi mitatu kwa mwaka?	0= Hapana 1= Ndiyo	
KUKOHOA NA KUTOA MAKOHOZI			
14.	Je! Huwa unakohoa na kutoa makohozi mara unapoamka asubuhi?	0= Hapana 1= Ndiyo	
15.	Je! Huwa unakuhoa na kutoa makohozi wakati wa mchana au usiku	0= Hapana 1= Ndiyo	
16.	Je! huwa unakohoa na kutoa makohozi mara 5- 6 kwa siku au zaidi ya siku 4 kwa wiki	0= Hapana 1= Ndiyo	

Na	Swali	Chaguo	Jibu
17.	Je! huwa unakohoa na kutoa makohozi kwa miezi mitatu mfululizo kwa mwaka	0= Hapana 1= Ndiyo	
KUPUMUA KWA KUKOROMA(MAPAFU KULIA KAMA FILIMBI			
18.	Je, ulishawahi kupumua na kutoa sauti kama ya filimbi kutoka kwenye mapafu	0= Hapana 1=Ndiyo	
Kama jibu ni hapana endelea na swali namba 20			
19.	Ni kwa muda wa miaka mingapi umekuwa ukitoa sauti kama filimbi unapopumua	……	
20.	Je huwa unabanwa na kifua ukiwa kazini	0= Hapana 1=Ndiyo	
Kama jibu in hapana endelea na swali namba 23			
21.	Ni kwa muda wa miaka mingapi umekuwa na tatizo hilo	.....	
22.	Ulishawahi kutibiwa kwa tatizo hilo	0= Hapana 1=Ndiyo	
KUPUMUA KWA SHIDA			
Kama mshiriki atakua na ugonjwa wa moyo au mapafu usimuulize maswali haya			
23.	Je! Unapata shida ya kupumua unapotembea kwenye tambarare au mwinuko kidogo?	0= Hapana 1=Ndiyo	
24.	Je! Inakulazimu kutembea taratibu zaidi ya watu wa umri wako kwenye eneo la tambarare?	0= Hapana 1=Ndiyo	
25.	Huwa inakulazimu kusimama ili uweze kupumua unapotembea na watu wa rika lako eneo la tambarare?	0= Hapana 1=Ndiyo	
KUBANWA KIFUA			

Na	Swali	Chaguo	Jibu
26.	Je umewahi kubanwa na kifua au kushindwa kupumua?	0= Hapana 1=Ndiyo	
Kama jibu ni hapana nenda swali namba 29			
27.	Je huwa unabanwa kifua au kushindwa kupumua uwapo kazini au mara baada ya kazi?	0= Hapana 1= Ndiyo	
28.	Umekuwa na shida hii kwa muda gani?		
KUKOHOA KWA KUKOROKOTA			
29.	Ndani ya miaka mitatu (3) iliyopita, je umewahi kupata ugonjwa wowote wa kifua kiasi cha kushindwa kufanya shughuli zako za kila siku kwa muda wa wiki moja?	0= Hapana 1= Ndiyo	
Kama jibu ni Hapana nenda swali namba 32			
30.	Ndani ya kipindi hicho je ulipata makohozi kuliko kawaida?	0= Hapana 1= Ndiyo	
31.	Je umewahi kuugua ugonjwa huu zaidi ya mara moja ndani ya kipindi cha miaka mitatu?	0= Hapana 1= Ndiyo	

C: HISTORIA YA MAGONJWA NA KAZI ULIZOFANYA AWALI

MAGONJWA ULIYOPATA AWALI			
S/N	**SWALI**	**JIBU**	
32.	Je! Ulishawahi kuambiwa na daktari kwamba una moja kati ya magonjwa yafuatayo?	0=Hapana) 1= Ndiyo	
	1.Kikohozi sugu		

	2.Kuvimba Mapafu/Kikohozi chaKupaliwa		
	3.Pumu		
	4.Mshtuko wa moyo		
	5. Kansa ya mapafu.		
	6.Kifua kikuu		
KAZI NYINGINE YA VUMBI			
33.	Ulishawahi kufanya kazi nyingine sehemu ya vumbi? Kama 1.Kufagia barabrara 2.Kiwanda cha pamba 3.Kwenye mashine za kusaga 4.Kiwanda cha chai/kahawa 5. Sehemu nyingine (taja)……	0=Hapana 1= Ndiyo	
Kama jibu ni hapana nenda swali namba 36			
34.	Ulifanya kazi hiyo kwa miaka mingapi? …….		
35.	Unafikiri ulikuwa unapata kiasi gani cha vumbi?	1= Kidogo 2= kawaida 3= kikubwa	
36.	Ulishawahi kufanya kazi eneo la gesi au kemikali ? Kiwanda cha nondo/bati/chuma/ kuchomelea vyuma Gereji rangi kazi nyingine (taja)	0=Hapana 1= Ndiyo	
37.	Ulifanya kazi hiyo kwa muda wa miaka mingapi? ……..……..		
38.	Unafikiri ni kiasi gani cha gesi/kemikali	1= Kidogo	

	ulivuta?	1= kawaida 3= kikubwa	
UVUTAJI WA SIGARA			
39.	Je, unavuta sigara?	0= Hapana 1= Ndiyo	
40.	Je umeshawahi kuvuta sigara moja au zaidi kila siku kwa muda wa mwaka mzima?	0= Hapana 1= Ndiyo	
41.	Unavuta sigara ngapi kwa siku? ……		
42.	Una miaka mingapi toka ulipoanza kuvuta sigara? ……		

D. VIFAA KINGA BINAFSI

Na.	**Swali**	**Chaguo**	**Jibu**
43.	Je, Mnapatiwa vifaa kinga na kampuni mnapoanza kazi?	0=Hapana 1=Ndiyo	
44.	Je umewahi kupewa elimu jinsi ya kutumia, na faida ya kutumia vifaa kinga?	0=Hapana 1=Ndiyo	
45.	Je, Umewahi kutumia kifaa kinga chochote kati ya hivyo vilivyotajwa hapo chini?	0=Hapana 1=Ndiyo	
	1.Kipumulio		
	2.Glofsi		
	3.Miwani ya macho		
	4.Maski		
	5.Kofia ngumu ya kichwa		
	6.Mabuti		
46.	Kutokana na aina ya kazi unayofanya, umewahi kutumia kifaa kinga chochote kati ya hivyo vilivyotajwa hapo chini?	0=Hapana 1=Ndiyo	
	1.Kipumulio		

Na.	Swali	Chaguo	Jibu
	2.Glofsi		
	3.Miwani ya macho		
	4.Maski		
	5.Kofia ngumu ya kichwa		
	6.Mabuti		
47.	Je unatumia vifaa sahihi vya kujikingia kilingana na kazi yako?	0=Hapana 1=Ndiyo	

VIPIMO VYA UWEZO WA MAPAFU *(Afanye akiwa amesimam*a)

	FEV1 (litres)	FVC (litres)
1.	☐ . ☐☐☐	☐ . ☐☐☐
2.	☐ . ☐☐☐	☐ . ☐☐☐
3.	☐ . ☐☐☐	☐ . ☐☐☐

PEF (Litre/min)

1. ☐☐☐

2. ☐☐☐

3. ☐☐☐

ASANTE KWA USHIRIKIANO WAKO

Appendix III: Workplace Assessment Checklist (English Version)

SN	ITEM	YES	NO	COMMENT
1	**AVAILABILITY OF PERSONAL PROTECTIVE EQUIPMENTS (PPEs)**			
	Respirators			
	Hand gloves			
	Eye protectors/goggles			
	Foot wear (boots)			
	Clothing/aprons/overalls			
	Reflectors			
	Helmets			
	Nose/mouth masks			
2.	**UTILIZATION OF PERSONAL PROTECTIVE EQUIPMENTS (PPEs)**			
	Respirators			
	Hand gloves			
	Eye protection/goggles			
	Foot wear (boots)			
	Clothing/aprons/overalls			
	Reflectors			
	Helmets			
	Nose/mouth masks			

Appendix IV: Orodha ya Ufuatiliaji Mahali pa Kazi (Swahili Version)

Na.	KIFAA	NDIO	HAPANA	MAONI
1.	**UPATIKANAJI WA VIFAA VYA KINGA BINAFSI**			
	Kipumulio			
	Glovsi za mikononi			
	Miwani ya macho/uso			
	Viatu vya buti			
	Ovaroli			
	Koti la kun'gaa			
	Kofia ngumu ya kichwa			
	Kiziba mdomo/pua			
2.	**MATUMIZI YA VIFAA KINGA BINAFSI**			
	Kipumulio			
	Glovsi za mikononi			
	Miwani ya macho/uso			
	Viatu vya buti			
	Ovaroli			
	Koti la kun'gaa			
	Kofia ngumu ya kichwa			
	Kiziba mdomo/pua			

Appendix V: Informed Consent Form (English Version)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Title of the Research: **Respiratory symptoms and dust exposure among Dangote cement processing factory workers in Mtwara, Tanzania**

Principal Investigator: Epaphroditus Canute Sabuni

Institution and address:
MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES (MUHAS)
P.O Box 65001,
DAR ES SALAAM, TANZANIA
FORM NO: ……

Introduction

This consent form contains information of the above named study. Please we ask you to read or listen careful as we read for you this forms that you may be informed about participating in this research. You will also be asked to sign or make your mark in this form if you agree to participate. This form may contain some words that are unfamiliar to you, please ask us so that we may elaborate them. You will remain with the copy of this form.

The Objective is to assess respiratory symptoms and dust exposure among Dangote cement processing factory workers, Mtwara.

Participation

You will be asked some questions related to respiratory symptoms in regard to your occupation. After that some measurements on lung function will be taken before and after your working shift. Those found with severely lung dysfunction will be referred to the district hospital. Some of you will be asked to wear personal respirable dust equipments for the whole entire shift. Feel free to participate.

Confidentiality

No names will be written in the forms or report, all your responses will be treated as confidential. Also no any unauthorized person will have access to this information also the report will be compiled without referring to individual response.

Risks

No harm or risk will be involved for those who will voluntarily participate in this study.

Right to Withdraw and Alternatives

You have the choice to participate in this study. If you choose to participate or withdraw from the study you will get no harm. If you decide to withdraw from the study even after signing this consent form no harm will come to you.

Benefits

Participating in this study will help to establish the magnitude of respiratory symptoms and lung impairment among cement processing factory workers. This information will create awareness to decision makers on creating various interventions on how to help those who are working in cement processing factories.

Contact

The research has been reviewed and approved by Ethical Research Committee of Muhimbili University of Health and Allied Sciences, MUHAS. Please if you have any question about your rights as a participant, you may contact.

Dr. Bruno Sunguya,
Chairman of the Senate Research and Publications Committee,
P.O Box 65001, Dar es Salaam (Tel 022-21503002-54 06, 2152489 Mobile 0685217272)

Dr. Simon Mamuya,
MUHAS, P.O Box 65015, Dar-es Salaam.
(Tel. 0787 721 377) who is the supervisor of this research.

Epaphroditus Sabuni,

MUHAS, P.O Box 65015, Dar-es-salaam

(Tel. 0788 418 823) who is the principal investigator of this research.

Agreement Part

I therefore request your participation in this study;

DO YOU AGREE? YES:…… NO……. (Tick for appropriate response)

If you agree, sign below

Participants sign…….. Date…….

Investigators sign…… Date…….

Kiambatanisho VI: Fomu ya ridhaa ya kushiriki kwenye utafiti (Swahili Version)

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI

IDARA YA MAZINGIRA NA AFYA KAZINI

NAMBA YA FOMU: …….

Utafiti juu ya : Dalili za matatizo katika njia ya hewa na kiwango cha vumbi kwa wafanyakazi wa kiwanda cha kutengeneza saruji cha Dangote kilichpo Mtwara, Tanzania

Jina la Mtafiti: Epaphroditus Canute Sabuni
Jina na Anwani ya Taasisi: CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI (MUHAS)
S.L.P 65001,

DAR ES SALAAM – TANZANIA

Utangulizi

Fomu hii inaelezea kuhusu utafiti tajwa hapo juu. Tafadhali somo fomu hii au sikiliza kwa makini tunapokusomea fomu hii ili uweze kupata habari zinazohusu utafiti huu kwa ufasaha kabla hujaamua kushiriki au kutoshiriki. Kwa yule atakayekubali kujitolea kushiriki tutamwomba aweze kusaini au kuweka alama ya dole gumba mwishoni. Tafadhali kama kuna eneo lenye utata tuulize ili tulifafanue. mwisho Yule atakayeshiriki atapatiwa nakala ya fomu hii.

Dhumuni la utafiti huu

Utafiti huu una lengo la kupata taarifa juu ya kiwango cha vumbi linaloweza kuingia katika mfumo wa upumuaji pamoja na kupata taarifa juu ya dalili za magonjwa ya njia ya hewa kwa watu wanaofanya kazi katika kiwanda cha kutengeneza saruji cha Dangote kilichopo Mtwara.

Ushiriki

Tutakuuliza maswali kadhaa yanayohusiana na matatizo ya mfumo wa upumuaji kutokana na kazi unayoifanya. Baada ya hapo tutachukua vipimo vya uwezo wa mapafu yako kufanya kazi kabla na baada ya muda wa kazi. Wale wataokutwa na matatizo kwenye mapafu yao watapewa rufaa ya kwenda hospitali ya wilaya. Baadhi yenu tutawaomba wavae vifaa maalum kwa ajili ya kupima kiwango cha vumbi linaloweza kuingia katika mfumo wa upumuaji.

Usiri

Unahakikishiwa kwamba taarifa zote juu ya ushiriki wako kwenye utafiti huu zitakua siri. Tutaandaa taarifa moja kutokana na maelezo na vipimo vya washiriki mbalimbali hapa kiwandani. Hatutaandika jina lako wala hatutaonyesha utambulisho wowote kutokana na taarifa utakazotupatia.

Madhara

Utafiti huu hautakuwa na madhara yoyoye kwa mshiriki.

Haki ya kujitoa kwenye utafiti

Kushiriki katika utafiti huu ni uchaguzi wako. Endapo utachagua kutoshiriki au utaamua kusimamisha ushiriki wako, hutapata madhara yoyote. Unaweza kusimamisha ushiriki katika tafiti huu muda wowote hata kama ulisharidhia kushiriki.

Faida

Ushuriki wako katika utafiti huu utatusaidia kujua kiwango cha fumbi la saruji kinachoweza kuingia katika mfumo wa hewa na matatizo ya njia ya hewa yanayoweza kuwapata watu wanaofanya kazi katika viwanda vya saruji. Hatimaye taarifa hizi zitasaidia kushauri namna kazi ya utengenezaji wa saruji inavyoweza kufanyika kwa usalama zaidi, pia itawasaidia watunga sera namna ya kutafuta mbinu za kulinda afya za watu wanaofanya kazi katika mazingira kama yenu.

Mawasiliano:

Utafiti huu ulipitiwa na kukubaliwa na kamati ya mapitisho ya utafiti ya chuo kikuu cha cha afya na sayansi shirikishi Muhimbili. Iwapo una maswali kuhusu utafiti huu, unaweza kuwasiliana na Dr.Bruno Sunguya ambaye ni Mwenyekiti wa kamati ya chuo utafiti na

machapisho, S.L.P 65001, Dar es Salaam (Simu 022-21503002-06, 2152489 Simu ya mkononi 0685 217 272), au Dr. Simon Mamuya, MUHAS, S.L.P 65015, Dar-es Salaam. (Simu 0787 721 377) ambaye ni msimamizi wa utafiti huu, au Epaphroditus Sabuni, MUHAS, S.L.P 65015, Dar-es Salaam. (Simu 0788 418 823) ambaye ni mtafiti mkuu katika utafiti huu.

Makubaliano

Hivyo basi, unaombwa kushiriki katika utafiti huu; tutauliza maswali ambayo yatahitaji kupata maelezo kutoka kwako,pia tutachukua vipimo vya uwezo wa mapafu yako kufanya kazi. Baadhi yenu tutawaomba wavae vifaa maalum vya kupimia kiwango cha vumbi laini linaloweza kufika ndani ya ufizi wa mapafu kwa kipindi chote cha muda wa kazi siku nzima.

JE UNAKUBALI? NDIYO:…… HAPANA……. (Weka alama ya vema panapohusika)

Endapo umekubali, tia saini hapa chini:

Saini ya mshiriki …….. Tarehe…….

Saini ya mtafiti……..... ....Tarehe …….

Appendix VII: Approval of ethical clearance

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

P.O. Box 65001
DAR ES SALAAM
TANZANIA
Web: www.muhas.ac.tz

Tel G/Line: +255-22-2150302/6 Ext. 1015
Direct Line: +255-22-2151378
Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. DA.287/298/01A/

24th June, 2019

Mr. Epaphroditus C. Sabuni,
MSc. Environmental and Occupational Health,
MUHAS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED: " RESPIRATORY SYMPTOMS AND DUST EXPOSURE AMONG DANGOTE CEMENT PROCESSING FACTORY WORKERS, MTWARA "

Reference is made to the above heading.

I am pleased to inform you that, the Chairman has, on behalf of the Senate, approved ethical clearance for the above-mentioned study. Hence you may proceed with the planned study.

The ethical clearance is valid for one year only, from **19th June, 2019 to 18th June 2020.** In case you do not complete data analysis and dissertation report writing by **18th June, 2020,** you will have to apply for renewal of ethical clearance prior to the expiry date.

Dr. Emmanuel Balandya
ACTING: DIRECTOR OF POSTGRADUATE STUDIES

cc: Director of Research and Publications
cc: Dean, School of Public Health, MUHAS

Appendix VIII: Introduction letter

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

P.O. Box 65001
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Tel G/Line: +255-22-2150302/6 Ext. 1015
Direct Line: +255-22-2151378
Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. HD/MUH/T.339/2017

25th June, 2019

Plant Director
Dangote Cement Limited
P.O. Box 1241
MTWARA.

Re: INTRODUCTION LETTER

The bearer of this letter Mr. Epaphroditus C. Sabuni is a student at Muhimbili University of Health and Allied Sciences (MUHAS) pursuing MSc. Environmental and Occupational Health.

As part of his studies he intends to do a study titled: "***Respiratory symptoms and dust exposure among Dangote Cement processing factors workers, Mtwara".***

The research has been approved by the Chairman of University Senate.

Kindly provide him the necessary assistance to facilitate the conduct of his research.

We thank you for your cooperation.

Ms. Sharifa Kamby
For: DIRECTOR, POSTGRADUATE STUDIES

cc: Dean, School of Public Health and Social Sciences

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

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Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. HD/MUH/T.339/2017

25th June, 2019

Plant Director
Ndanda Springs Natural Mineral Water
P.O. Box 18
Ndanda- Masasi
MTWARA.

Re: INTRODUCTION LETTER

The bearer of this letter Mr. Epaphroditus C. Sabuni is a student at Muhimbili University of Health and Allied Sciences (MUHAS) pursuing MSc. Environmental and Occupational Health.

As part of his studies he intends to do a study titled: "***Respiratory symptoms and dust exposure among Dangote Cement processing factors workers, Mtwara".***

The research has been approved by the Chairman of University Senate.

Kindly provide him the necessary assistance to facilitate the conduct of his research.

We thank you for your cooperation.

Ms. Sharifa Kamby
For: DIRECTOR, POSTGRADUATE STUDIES

cc: Dean, School of Public Health and Social Sciences