Exposure to total dust and respiratory health effects among commercial motorcyclists in Ubungo municipality, Dar es salaam, Tanzania

Saumu Shabani (Bsc. ESM)

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Muhimbili University of health and Allied Sciences
Department of Environmental and Occupational Health

EXPOSURE TO TOTAL DUST AND RESPIRATORY HEALTH EFFECTS AMONG COMMERCIAL MOTORCYCLISTS IN UBUNGO MUNICIPALITY, DAR ES SALAAM, TANZANIA

By
Saumu Shabani

Dissertation Submitted In Partial Fulfillment of the Requirements for the Degree of Master of Science in Environmental and Occupational Health of the Muhimbili University of Health and Allied Science

October, 2018

CERTIFICATION

The undersigned, certify that he has read and hereby recommended for acceptance by the Muhimbili University of Health and Allied Sciences, a dissertation entitled; **Exposure to Total Dust and Respiratory Health Effects Among Commercial Motorcyclists in Ubungo Municipality, Dar es Salaam, Tanzania.** in partial fulfillment of the requirements for the award of the Master of science in Environmental and Occupational Health of the Muhimbili University of Health and Allied Science.

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Dr. Simon H. Mamuya

Supervisor

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Date

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DECLARATION AND COPYRIGHT

I, **Saumu Shabani**, hereby declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature_____ **Date** _____

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DEDICATION

I humbly dedicate this dissertation report to my lovely Husband Hamisi Masoud Mtwale, my children Zamda Hamisi Mtwale and Zakir Hamisi Mtwale, my beloved parents late Shabani Salum Kabelwa and Ms Mwajabu Juma Mngeza.

ABSTRACT

Background: Commercial motorcycles have emerged as a key feature of rural and urban transport services. It is among of occupation in which workers are at high exposure to ambient air pollutants such as road re-suspended dust and prolonged exposure to dust can result in respiratory problems.

Aim of the study: The aim was to determine personal total dust exposure and respiratory health effects among commercial motorcyclist in Ubungo Municipality

Materials and methods: The study was descriptive cross sectional study conducted from March to July 2018. Multistage sampling technique was used to obtain sample of 200 commercial motorcyclists and 100 office attendants. A modified British medical research council questionnaire, EasyOne spirometer and personal sampling pump (SKC Sidekick pump) were used for data collection. Data were analyzed by using Statistical Package for Social Science software.

Results: commercial motorcyclist had exposed to geometric mean concentration 1.60 mg/m^3 (SD=2.12) while office attendants had exposed to geometric mean concentration 0.071 mg/m^3 (SD=1.26) for eight hours which was less than TLV according to the ACGIH. The prevalence of respiratory health symptoms were reported to be higher among commercial motorcyclists compared to office attendants for all symptoms and the differences were statistically significant at P-value <0.001, where morning cough (55.5% vs. 27%); cough last for three months yearly (26% vs 2%); phlegm (53.2% vs 15%), phlegm last for three months yearly (23% vs.0%) wheezing (29% vs 2%) and shortness of breath (47.7% vs. 16%).Prevalence of airflow obstruction (FEV1/FVC<70) for commercial motorcyclists was 10% . Work duration was the most predictor of cough, cough last for three months, phlegm and shortness of breath among commercial motorcyclists.

Conclusion and recommendation: Prevalence of the respiratory health symptoms was higher among commercial motorcyclists. Commercial motorcyclist should use appropriate PPEs (mouth/nose masks) in the course of their work.

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ABBREVIATIONS

ACGIH	-	American Conference of Government Industrial Hygienists
COPD	-	Chronic Obstructive Pulmonary Disease
FEV1	-	Forced Expiratory Volume in one second
FVC	-	Forced Vital Capacity
MUHAS	-	Muhimbili University of Health and Allied Science
NHANES	-	National Health And Nutrition Examination Survey
NIOSH	-	National Institute for Occupational Safety and Health
PEFR	-	Peak Expiratory Flow Rate
PPE	-	Personal Protective Equipment
TLV	-	Threshold Limit Value

DEFINITION OF TERMS

Breathlessness	refers to difficulty in breathing
Cough	involves expelling air from lung suddenly with sharp, short noise usually in a series of efforts.
Exposure	is defined as the state of being in contact with hazardous substance through inhalation, ingestion or skin contacts.
Nasal congestion	is the blockage of the nasal passage due to membrane lining the nose becoming swollen from inflamed blood vessels.
Nose irritation	is an inflammation of the tissues inside the nose
Phlegm	refer to abnormal amount of mucus especially as expectorated from mouth
Sneezing	is reaction of the body to inflammation inside the nose and respiratory tract
Total dust	is the fraction of airborne material which enters the nose and mouth during breathing and is therefore liable to deposition anywhere in the respiratory tract.
Wheezing	is a whistling sound that can be made while breathing that may be a symptom of respiratory illness

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Motorcycles provide a convenient and relatively inexpensive transport alternative to automobiles. They are more maneuverable than automobiles and they deliver higher fuel economy. Motorcycles are prevalent in the developing world, because they are cheap to own and operate and can be faster than other modes on very congested road, by swerving and bypassing other vehicles. Motorcycles now compete with public transport modes in developing countries as residents require greater mobility to access jobs and services(1).

Commercial motorcycles are known in many parts of East Africa as 'bodaboda' have emerged as a key feature of rural and urban transport services. Bodaboda transport services are a Ugandan innovation, which began in the 1960s in the border region with Kenya. Transportation of people between Uganda and Kenya by using motorcycles results into the name Bodaboda(1).

Motorcycles have recently increased in Tanzania, ability to maneuver and avoid traffic jams as well as low fuel consumption and pocket friendly fares have won them a niche in the transport business sector. Majority of people with no formal employment are involved in this business and now they can run their own lives without depending to other people or involving to illegal businesses and for entrepreneurs has increased the diversification of business activities and therefore increased their income(1,(2).

Commercial motorcyclists are among of risk group exposed to total dust. They are at high risk of developing health problems associated with dust exposure, because majority of them are not using any devices for protection from dust and spend more than 8 hours in traffic every day constantly exposed to re-suspended road dust(3).

Study reported that the most affected mode to road traffic pollutants are those who commuting by motorcycle, where exposure is significantly higher than all other modes of transport. This is probable to be because motorcyclists are situated directly to the pollutants' without any shielding(4). Prolonged exposure to dust can result in chronic bronchial problems where many studies found that the prevalence of obstructive, restrictive and mixed type of functional impairment of the lung to have direct relationship with the dust concentration and duration of exposure(5).

Also study confirmed that commercial motorcyclists working in an urban environment with heavy air pollution experience airway symptoms, inflammation and decreased mucociliary clearance (6).

1.2 Problem Statement

Air pollution is a major threat to human health especially in big cities like Dar es Salaam. It reduces the life expectancy of people who are constantly exposed. According to World Health Organization (WHO) states that 3 million people die each year from causes directly attributable to air pollution. Number of deaths and cases of respiratory diseases due to air pollution are increasing worldwide and is a major concern of the developed world and the developing nations. About 90 % of people breathe air that does not comply with the WHO Air Quality Guidelines (7).

Commercial motorcyclists are at high risk of occupational exposure to ambient air pollutants such as road resuspended dust. Studies done in Nigeria and Congo reported on prevalence of respiratory symptoms and pattern of lung function among commercial motorcyclist who are constantly exposed to emissions to be higher as 71% (3). Though none of those studies focused on personal exposure to dust, however exposure to dust can affect respiratory health system of commercial motorcyclists

In Tanzania most of commercial motorcyclists are working in more than 8 hours and majority of them are not using any PPE (mask, full face helmet) to protect themselves from dust and other particulate, this situation make them to be susceptible to respiratory health problems.

Factors that contribute commercial motorcyclists to be exposed to total dust might be; low level of education, low income and lack/ underutilization of PPE. Being exposed to total dust may ultimately make commercial motorcyclists to develop respiratory health effects in which the condition can be aggravated by previously respiratory illness, age, obesity and smoking.

In our country there scantiness of knowledge on personal total dusts exposure and respiratory health effect among commercial motorcyclists. This provides a major research gap which needs to be addressed to see the situation.

1.3 Conceptual Framework

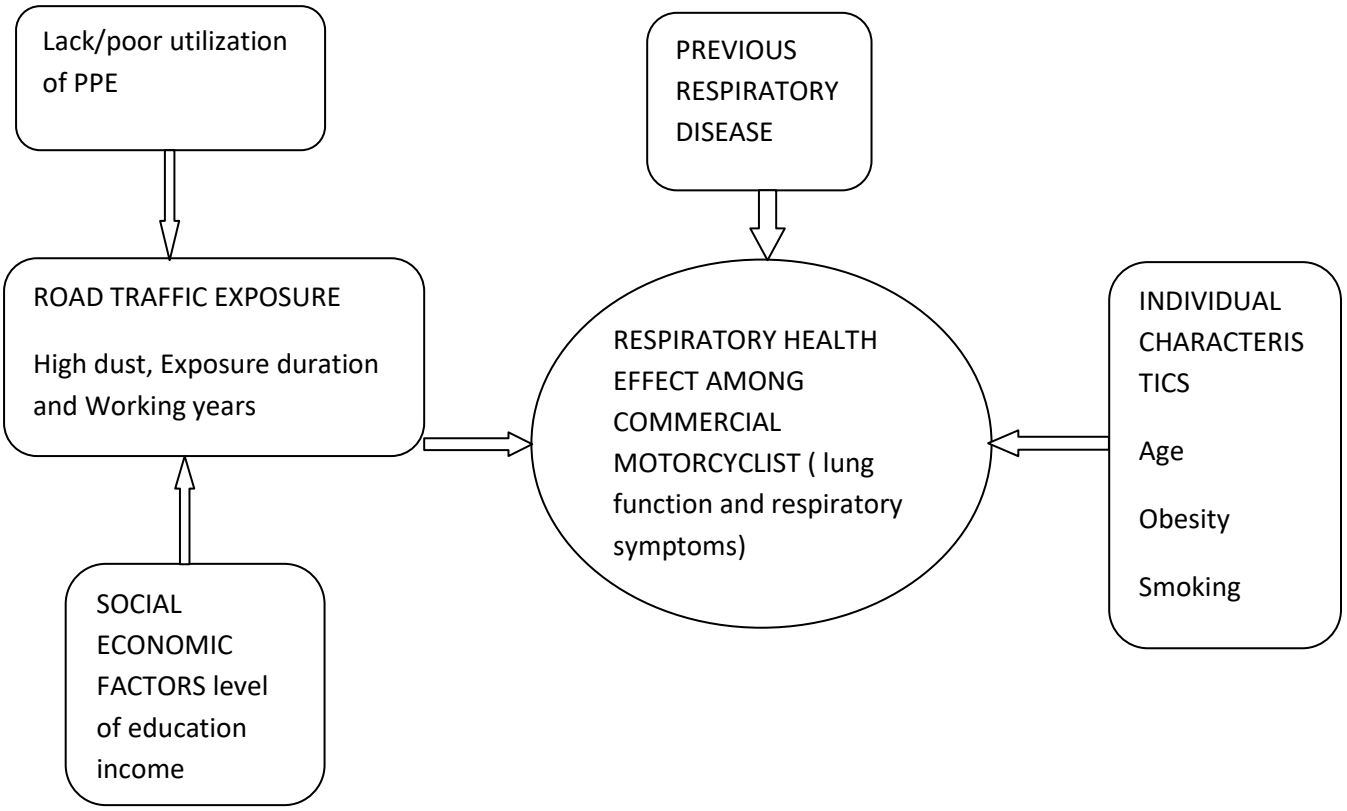


Figure 1: Conceptual Framework

Figure 1 above represents the conceptualization between total dust exposure and respiratory health effects among motorcyclists. Respiratory symptoms are the outcome of total dust exposure, whereas exposure to total dust is the result of social economic factors such as education, income and lack/poor utilization of PPE. Also respiratory health effect can be influenced by individual characteristic such as age, obesity, smoking and previous respiratory disease.

1.4 Rationale of Study

The study was very important because commercial motorcycles are one of the emerging businesses in Tanzania in which large number of youths who do not have formal employment engaged to it, hence findings of the study are useful in establishing the magnitude of the problem and enable the national to make effort to reduce the burden of respiratory effects among commercial motorcyclists, and hence align with sustainable

development goal number 8.8 is to protect workers' rights and promote safe and secure working environment for all workers

Findings from this research will contribute to the body of knowledge and formulating the basis for other research on commercial motorcyclist.

This study was also important for dissertation submission as part of fulfillment for the Master of Science in Environmental and Occupational Health.

1.5. Research Questions

1. What level of total dust are commercial motorcyclists exposed to?
2. What is the prevalence of respiratory health symptoms among commercial motorcyclists?
3. Is the lung function of commercial motorcyclists in a normal condition?
4. What are the factors associated with respiratory health effect among commercial motorcyclists in Ubungo municipality?

1.6. Objectives

1.6.1. Broad Objective

To determine level of personal total dust exposure and respiratory health effects among commercial motorcyclists in Ubungo Municipality

1.6.2. Specific Objectives

1. To determine the level of personal total dust exposure among commercial motorcyclists in Ubungo Municipality
2. To determine respiratory symptoms among commercial motorcyclists in Ubungo Municipality
3. To assess lung function among commercial motorcyclist in Ubungo Municipality
4. To determine factors associated with respiratory symptoms among commercial motorcyclists in Ubungo Municipality

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Road Dust Exposure

According to the International Standardization Organization (ISO 4225 - ISO, 1994), Dust is a small solid particle, conventionally taken as those particles below 75 μm in diameter which settle out under their own weight but which may remain suspended for some time. In occupational hygiene, dust a is particle aerodynamic diameter, defined as the diameter of a hypothetical sphere of density 1 g/cm3 having the same terminal settling velocity in calm air as the particle in question, regardless of its geometric size, shape and true density. The aerodynamic diameter expressed in this way is appropriate because it relates closely to the ability of the particle to penetrate and deposit at different sites of the respiratory tract, as well as to particle transport in aerosol sampling and filtration devices. Generally dusts are solid particles, ranging in size from below 1μm up to at least 100 μm, which may be or become airborne, depending on their origin, physical characteristics and ambient conditions (8,9).

The increasing severity of dispersion and fallout of dusts in urban areas has shown spontaneous linkage with higher degree of health disorders especially, bronchial ailments. The potential adverse health effects following both acute and chronic exposures to air pollution in both living and working environment have prompted local and international focus on both regulation and control of dusts pollution from the point of generation.

Dust particles, especially those emanating from traffic emissions has the ability to penetrate deep into the human lungs and causing scaring of alveolar tissues including both chronic and acute cardiopulmonary effects and related mortalities (10).

2.2. Total Inhalable Dust (1-100um)

Inhalable dust, otherwise called “nuisance dust” is particulate matter consisting of all airborne particulates inhaled through the nose or mouth (including the respirable dust fraction). Dust in air can result in contamination in the nose and in the tubes leading to the lungs which often causes physical discomfort and irritation (runny nose, sneezing, watering eyes, coughing), in turn causing rhinitis or bronchitis. However, generally the larger particle proportion of inhalable dust is simply filtered out in the nose and in the

upper respiratory tract and cleared by the body's natural clearance mechanisms (e.g. nasal hair, mucous membranes, coughing) (9,10,11).

2.3 Road Traffic Pollution Exposure and Respiratory Health Effects

According to the global estimate made by the United Nations Environment Program in 2002, 1.1 billion people breathe unhealthy air (12). This increases number of deaths and hospital admissions throughout the world due to its wide range of effects on human health, especially the respiratory system. Global daily death from diseases related to air pollution is put at 8000 and a yearly death due to air pollution is about 3 million (13). Evidence from epidemiological and toxicological studies on the effects of transport-related air pollution on health has increased substantially. A review of this evidence indicates that transport-related air pollution affects a number of health outcomes, including mortality, non-allergic respiratory morbidity, allergic illness and symptoms (such as asthma) and cardiovascular morbidity. Transport-related air pollution increases the risk of death, particularly from cardiopulmonary causes, and of non-allergic respiratory symptoms and disease (14).

Several study have revealed the direct association between exposure to the poor air quality and increasing rate of morbidity and mortality mostly due to respiratory diseases. Road Traffic Emission is considered as the major environmental risk factor in the incidence and progression of some diseases such as asthma, lung cancer, ventricular hypertrophy, Alzheimer's and Parkinson's diseases, psychological complications, autism, retinopathy, fetal growth, and low birth weight (4, 5).

A study show that commercial motorcycling expose workers to unusual large amount of outdoor ambient air pollutants. The work entails conveying passengers to and from their different destinations within and even to the outskirts of the city for commercial gains. This type of duty may take them from a less busy to a more congested and industrialized parts of the city (4).

The commercial motorcyclists during the course of their duties inhaled these harmful particles, dust, black smoke, mist and volatile organic compounds especially when passing through highly air-polluted corridors such as traffic hold-ups, checkpoints and industrialized areas of the city. Also it reported that there is high prevalence of respiratory

symptoms such as headache, nasal congestion, eye irritation and dry throat among commercial motorcyclist due to constant exposure to urban pollutants which increases the risk of development and aggravation of chronic respiratory diseases, particularly asthma and Chronic Obstructive Pulmonary Disease (13).

Respiratory diseases affecting more in the world, it has estimated that 235 million people suffer from asthma, more than 200 million people have chronic obstructive pulmonary disease (COPD) and 65 million endure moderate-to-severe COPD (15).

2.4 Total Dust Exposure and Lung Function

Lung is the organ which is very vital and vulnerable to human body, 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.

Changes in lung function are considered reliable markers of health that reflect the effects of endogenous and cumulative exposure to exogenous factors that might have adverse health consequences. Reduced lung function is strongly associated with future morbidity from a variety of causes and is a predictor of life expectancy (16).

The prevalence of obstructive, restrictive and mixed type of functional impairment of the lung was found to have direct relationship with the dust concentration and duration of exposure. Prolonged exposure to dust can result in chronic bronchial problems.

The study which has been done by Messan F etal report that lung functions of commercial motorcyclists, with high exposure to automotive pollutants to diagnose overt or latent respiratory infection. Also it reported that motorcycle taxi drivers, both at rest and after exercise, experience high frequencies of asthma symptoms, significant reductions in lung volumes and flow rates and high prevalence of bronchospasm. These results clearly show the existence of respiratory disorders due to chronic exposure to automotive pollutants (17).

2.5 Factors Associated with Respiratory Health Effects

Socio-Economic Status and Respiratory Health Effects

Socio-economic status may be used in order to stratify subjects in society. In epidemiological studies, classification of socio-economic status usually includes income,

occupation and educational level. Most disease, and poor health in general is associated with low socio-economic status (18). Education is a key determinant of lifestyle and status an individual delight in a society and provides people with the skill and knowledge that can lead to a better quality of life (19). Also level of education influences the type of occupation and income which can determine the home living condition. There are close correlations among income, educational level, and occupation (14). Socio-economic status is a determinant of health and is well known to play an important role in the development of several diseases such as respiratory diseases. A study shows that there is a relationship between socio-economic status and asthma where they found that incidence of asthma and symptoms are strongly related to low educational level (18).

2.6. Obesity and Respiratory Health Effects

Obesity is defined as a body mass index (BMI) greater than or equal to 30 kg/m2. Over 1.9 billion adults worldwide are overweight, of which 600 million are obese (20). Obesity is also strongly linked with respiratory symptoms and diseases, including exertional dyspnea, and chronic obstructive pulmonary disease (COPD), asthma, pulmonary embolism, and aspiration pneumonia (21). Studies have shown that a rise in BMI lowers forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) (20,21). Overweight and obese individuals are more likely to have respiratory symptoms than individuals with a normal BMI, even in the absence of demonstrable lung disease (23).

2.7. Smoking and Respiratory Health Symptoms

Tobacco smoking may harm many parts of the human body and cause a broad range of diseases, many of which could be fatal. Smoking can also aggravate many other illnesses. The risk of dying from any respiratory disease is three times higher for smokers and nearly five times higher for heavy smokers than for never-smokers (24). Tobacco smoke can cause significant diseases within the nose and sinuses. In the lungs of susceptible smokers, tobacco smoke severely and irreversibly damages the tissues. Most significant is chronic obstructive pulmonary disease (COPD), which results in sustained inflammation and narrowing of the airways; as well as emphysema, where holes form within the lung tissues. This is the cause of the smokers' cough due to chronic bronchitis. COPD often causes shortness of breath and loss of fitness as the lungs are unable to supply the body with

enough oxygen. At least 85% of COPD and emphysema cases are attributable to smoking. Smokers experience also more lung infections such as bronchitis and pneumonia (25).

2.8. Age and Respiratory Health Symptoms

The most important physiological changes associated with ageing are: a decrease in the static elastic recoil of the lung, a decrease in compliance of the chest wall and a decrease in the strength of respiratory muscles(26,28). Throughout life the lungs are constantly exposed to injurious materials in the inspired air and the ageing process itself is associated with gradual deterioration of lung performance Nevertheless, the morphological and physiological changes occurring during the process of ageing lead to a higher incidence and prevalence of acute and chronic respiratory diseases in the elderly as compared to young subjects(27). Environmental pollution and work-related noxious exposures can have an additional negative effect on the ageing respiratory system, accelerating the decline in pulmonary function (28).

2.9. Duration of Exposure and Respiratory Health Effects

Total dust concentration increases with increasing intensity and duration of exposure Occupational exposures to dust, fumes, and gases are associated with increased prevalence of respiratory symptoms and impairment of lung function which was found to have direct relationship with the dust concentration and duration of exposure(29). Study done in Congo shown that long-term exposure to traffic and PM2.5 at relatively low levels concentration ($\mu g/m^3$) were reported to be associated with lower forced expiratory volume in first second (FEV1) and forced vital capacity (FVC), whereas they conclude that exposed groups who worked for five years or more were at greater risk to impaired pulmonary function and they presented more pulmonary symptoms than the control group (3).

2.10. Personal Protective Equipment

Personal protective equipment is anything used or worn by a person to minimize risk to the person’s health or safety and include a wide range of clothing and safety equipment. In any workplace, whereas workers are exposed to any injurious or offensive substance or environment, effective protective equipment shall be provided and maintained by employer for the use of the persons employed. The acute respiratory health effects can likely be

reduced by proper dust control measures such as personal protective devices (respirators), training and education (30).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

The chapter presents the research design, sample size and selection method, study population, data collection and data analysis which were used in the study.

3.2 Study Area

The study area was Ubungo Municipality. Ubungo Municipal Council is among the five Municipalities of Dar-es-salaam region established in the year of 2015 from the former Dar es Salaam City Council.

Ubungo Municipality was selected for study because no previous study had been carried out related to personal exposure to total dust and respiratory health effects among commercial motorcyclists. Also the municipal had been chosen because it possess both high ways with tarmac road such as road found in Ubungo, Manzese, Sinza, Mburahati, Kimara, Saranga, Makurumula and Makuburi and unpaved road found in Mbezi, Goba, Msigani, Kwembe and Kibamba in which commercial motorcyclists operate their business, Ubungo municipal is the one which experiences road traffics congestion in Dar es Salaam.

3.3. Study Design and Duration

Descriptive cross sectional study was conducted for five months from March to July 2018, whereas commercial motorcyclists were exposure group and office attendants were controls. The study design was take on because of resources; it is less expensive and takes short time to be completed.

3.4 Study Population

The study populations for this cross-sectional study were male commercial motorcyclists as exposed group and male office attendants as unexposed group working in the Ubungo Municipality. Office attendants (controls) were chosen by considering their similarity with commercial motorcyclists in term of level of income, age and level of education.

3.4.1 Commercial Motorcyclists

Total of 200 male commercial motorcyclists in selected wards who consented and exposed in the dust for one year and above, aged 18 years and above have studied as exposed group.

3.4.2 Office Attendants

Total of 100 male office attendants were used as unexposed group who not engaged in commercial motorcyclist occupation for current and previous and not involved in activities associated with dust exposure such as sweeping. All were aged 18 years and above and who worked in that occupation for one year and above. Office attendants were chosen by considering their similarity with commercial motorcyclists in term of level of income, age and level of education.

3.5 Sample Size

The Sample size for this study has been determined by using the below formula:

$$n = \frac{Z^2 * P(1 - P)}{E^2} \quad (31)$$

Where;

n = sample was determined;

P = prevalence of respiratory symptoms is 0.92 according to the study of Mucociliary clearance, airway inflammation and nasal symptoms in urban motorcyclists (6).

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

E = Margin of error 5% (0.05)

$$n = \frac{1.96^2 * 0.92(1 - 0.92)}{0.05^2}$$

n= 113

Then 1.5 was multiplied by 113 for design effect.

Therefore, n = 169

Sample size estimation for exposed 169 and 169 for unexposed.

Total sample size estimation was 338.

Inclusion:

a. Motorcyclist/office attendants with 18 years of age and above
b. Motorcyclist /office attendants with at least one year in a work
c. Provided informed consent

Exclusion:

Motorcyclist/ office attendants with conditions that were interfere lung function tests by spirometry such as the presence of abdominal or dental pain were excluded from the study.

3.6 Sample Size for Total Dust

Selection of motorcyclists to be sampled for dust were done from 6 waiting area, whereas in each waiting area was categorized as homogeneous exposure group. Due to shortage of pump and cassette only five participants were selected randomly from each selected waiting area. Therefore total of 30 commercial motorcyclists and 5 office attendants were included in dust exposure assessment.

3.7 Sampling Procedure

A multistage sampling technique was used to select participant from study area at first stage simple randomly selection by lottery method was done to select 10 wards out of 14 wards in Ubungo municipal. At second stage simple randomly selection was done to obtain 2 registered waiting stations in each ward, where 20 waiting stations were included in the study. And the last stage was simple randomly selection in each selected waiting station where a registered and consented commercial motorcyclist and office attendants who were eligible and worked for one year and above were selected.

3.8 Data Collection Tools

a. Modified British medical research council questionnaire, was used for respiratory symptoms
b. EasyOne spirometer for lung function test and
c. Personal sampling pump (SKC Sidekick pump)

3.9 Pre Testing of the Data Collection Tool

Questionnaire in Swahili version was pre tested in Mwembechai to check if the tool was relevant and understood.

3.10. Data Collection Procedures

3.10.1 Anthropometric Measures

Anthropometric parameters such as weight (Kg) and height (m) were measured. The Body Mass Index (BMI) was obtained by the ratio: weight (Kg)/ (height (m)) ^{2}. Body mass index (BMI) was calculated and classified according to WHO guidelines for BMI.

A BMI of <18.5 was regarded as underweight, 18.5 - 24.9 normal, 25 - 29.9 overweight and ≥30 obese.

3.10.2 Lung Function Measurements

Lung function tests was conducted by using EasyOne spirometer, the tests was performed by allowing participant to be in standing position, where the participant inhaled maximally and puts mouthpiece in his mouth and exhales as hard and fast and long as possible. Each commercial motorcyclist and control was performing at least six times each of the lung tests where the best value was recorded. Spirometric parameters such as forced expiratory volume in one second (FEV1), forced vital capacity (FVC), (FEV1/FVC), peak expiratory flow (PEF) were recorded for each participant.

The impaired pulmonary function was calculated in accordance with the American Thoracic Society (ATS) guidelines, in this way: Obstructive syndrome defined by: FEV1/FVC ratio <70% of predicted.



Figure 3.1: Participants performing lung function test using EasyOne spirometer

3.10.3 Assessment of reported respiratory health symptoms

The Modified British medical research council questionnaire was used in the study and include questions on respiratory symptoms (cough, wheezing, phlegm, shortness of breath etc.), smoking, occupational exposure (duration of the job, working days and hours per week). The questionnaire was translated in Swahili language by using back translation and interview was done in Swahili.



Figure 3.2: Interview on respiratory health symptoms to commercial motorcyclist

3.10.4 Dust Exposure Measurement

Total dust exposure was conducted by using a personal sampling pump (Side Kick Casella) which operated at flow rate of 2.0L/minute with PVC filter which was weighted before sampling. The field information such as date, pump number, filter number, time and flow rate were recorded in the sampling sheet. The pump was attached on a belt around each of the commercial motorcyclist's waist. The sampling train consisting of tubing, pump, and the filter cassette holder was attached onto the collar in such that the intake was in the breathing zone. The pump switched on to start sampling and collection of the dust for eight hours. The time was noted in the sampling sheet when the pump starts, and when the pump switched off. After sampling, sampling train was disconnected from the participant's collar and the personal sampling pump was removed from the belt. The cassette sealed with plugs on both ends for transportation. The sample was transported to MUHAS multipurpose laboratory where the gravimetric analysis of filter was done by using micro balance (Mettle Toledo xp 205, capacity of 0.01mg-220g), the difference of filters prior and after use in weight is the weight of the total dust trapped on the filter during sampling. The mass concentration was 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

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

Whereas

C = mass 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 3.3: Sampling train attached at personal breathing zone

3.11 Study Variables

Dependent variable

Respiratory health effects

Independent variables

Age

Obesity

Working years

Smoking status

Dust exposure

Exposure time

PPE utilization

Previous respiratory disease

Income and

Level of education

3.12 Data Management and Analysis

3.12.1 Data Management

The principal investigator was responsible for regular supervising researchers and checked the data. The investigator was always assured that equipment are calibrated and participants are well understood on how to perform test for lung function test also to ensure that sampling train consisting of tubing, pump, and the filter cassette holder clipped onto the collar at breathing zone for eight hours.

3.12.2 Data Analysis

The collected data were cleaned, coded, entered, and analyzed by using Statistical Package for Social Sciences (SPSS). Continuous variables were described by mean and standards deviation (mean; SD) and categorical variables were described by proportion (%).Chi-square test, Fisher exact test and Independent t- test were used for comparison of categorical and numerical variables respectively. The results were summarized in tables and graphics. Statistical significance was defined as a 2-sided P value less than 0.05

3.13 Ethical Consideration

Ethical clearance was obtained from Muhimbili University of Health and Allied Sciences research and publication committee with reference number DA.287/298/01.A/. A letter was sent to Regional Administrative Secretary at Ubungo - Municipal requesting permission to conduct research study, the written permission was approved and distributed to 10 selected wards for information and cooperation. The study methods and aims were explained to each individual and were free to participate or not. Those who meet the criteria for study and agreed to participate was given Swahili written consent and signed before data collection begun. Issues of rights, privacy and confidentiality were taken into consideration.

CHAPTER FOUR

4.0 RESULTS

4.1. Introduction

In this chapter data was analyzed, from 200 commercial motorcyclists as exposed group and 100 office attendants as unexposed group. Total of 300 respondents were included in the study. To compare the two groups, Chi-square test, Fisher exact test and Independent t-test were performed for categorical and numerical variables respectively. The results were summarized in tables and graphics. Continuous variables were represented by mean and standards deviation (mean; SD) and categorical variables were represented by proportion (%). Statistical significance was defined as a 2-sided P value less than 0.05. All analyses were performed using SPSS Software.

4.2. Demographic and Social Characteristics of the Study Population

The results for socio-demographic characteristics are summarized in Table 4.1. The mean age of commercial motorcyclists were 30.32(SD 5.83) and office attendants were 27.59 (SD 5.64). Majority of commercial motorcyclists and office attendants they had normal BMI with the mean of 23.94(SD 3.06) and 22.75(SD 2.44) respectively. Most of commercial motorcyclists and office attendants had primary education level 65.5 % and 61% respectively. The participants married were 61.5% commercial motorcyclist and 59% office attendants. About 61% of commercial motorcyclists had more than four years in working while for office attendants were 50%. Also It was revealed that majority of commercial motorcyclists (97.5%) were working for more than eight hours while 100% of office attendants working for eight hours. Also study showed that 81% to both commercial motorcyclists and office attendants were nonsmokers.

Table 4.1: Demographic and social characteristics of the study population (n=300)

Characteristics	motorcyclist n=200	Office attendants n= 100	Total n=300
Age(years) Mean (SD)	30.32(5.83)	27.59(5.64)	29.41(5.9)
Weight(kg) Mean (SD)	60.05(9.99)	59.68(9.03)	63.92(10.12)
Height(cm) Mean (SD)	165.94(6.67)	161.71(7.47)	164.53(7.22)
BMI(kg/m^2) Mean (SD)	23.94(3.06)	22.75(2.44)	23.55(2.92)
Education level n (%)			
None	1(0.005)	0	1(0.33)
Primary school	139(69.5)	61(61)	200(66.67)
Secondary school	60(30.5)	39(39)	99(33)
Marital status n (%)			
Single	56(28)	31(31)	87(29)
Married	123(61.5)	59(59)	182(60.67)
Cohabitate	21(10.5)	10(10)	31(10.33)
Working years n (%)			
1-4years	78(39)	50(50)	128(42.67)
> 4years	122(61)	50(50)	172(57.33)
Number of working day per week n (%)			
5 days	2(1)		2(0.67)
6 days	54(27)	100(100)	154(51.33)
7 days	144(72)		144(48)
Number of working hours per day n (%)			
≤8 hours	5(2.5)	100(100)	105(35)
≥8 hours	195(97.5)		195(65)
Smoking status n (%)			
Yes	38(19)	19(19)	
No	162(81)	81(81)	

% Percentages, Abbreviations: SD, Standard Deviation, BMI, Body mass index

4.2: Personal Total Dust Exposure Level

A total of 35 total dust samples were collected, the result showed that, commercial motorcyclists had exposed to geometric mean 1.60 mg/m^3 (SD=2.12) while office attendants had exposed to geometric mean 0.071 mg/m^3 (SD=1.26) of total dust for eight hours which were below the threshold limit value (10mg/m^3) according to the ACGIH.

4.2.1 Comparison of total dust exposure among commercial motorcyclists and office attendants

The independent t-test on log transformed data showed significant statistical difference on total dust exposure among commercial motorcyclist and office attendant at t (9.09) and p < 0.001 see (Table 4.2.)

Table 4.2: Comparison of total dust exposure among commercial motorcyclists and office attendants

WORK CLASSES	No of sample	GM mean	t	P-value
Commercial motorcyclist	30	1.60 ±2.12	9.09	0.001
Office attendants	5	0.071 ±1.26		

Independent t-test, p<0.05.

4.3 Prevalence of Respiratory Health Symptoms among Commercial Motorcyclists and Office Attendants

The prevalence of respiratory health symptoms were reported to be higher among commercial motorcyclists compared to office attendants for all symptoms and the differences were statistically significant at p-value <0.001

Prevalence of respiratory symptoms for motorcyclists and office attendants were expressed in respectively manner as follow: morning cough 111 (55.5%) and 27 (27%); cough last for three months 52(26%) and 2(2%); phlegm 106(53.2%) 15(15) and phlegm last for

three months 46(23%) and 0(0%) wheezing 58(29%) and 2(2%);shortness of breath 94(47.7%) and 16(16%) , see (Table 4.3)

Table 4.3 Prevalence of respiratory health symptoms among commercial motorcyclists and office attendants group

Respiratory Health Symptoms	Commercial Motorcyclists	Office Attendants	$\chi 2$	P-Value
Morning Cough				
Yes	111(55.5)	27(27)	20.667	0.001
No	89(44.5)	73(73)		
Cough last for three months yearly				
Yes	52(26)	2(2)*	24.416	0.001
No	148(74)	98(98)		
Phlegm production				
Yes	106(53)	15(15)	38.438	0.001
No	94(47)	85(85)		
Phlegm last for three months yearly				
Yes	46(23)		41.358	0.001
No	154(77)	100(100)		
			28.711	0.001
Wheezing				
Yes	58(29)	2(2)*		
No	142(71)	98(98)		
Shortness of breath				
Yes	94(47)	16(16)	28.473	0.001
No	106(53)	84(84)		
Chest pain				
Yes	41(20.5)	13(13)	2.058	0.151
No	159(79.5)	87(87)		

Chi-square test, * fisher exact test, $p<0.05$, values in parentheses are percentages.

4.3.1 Relationship between Respiratory Health Symptoms and other Factors among Commercial Motorcyclists.

Duration of Job

Prevalence of respiratory symptoms among commercial motorcyclists working for more than 4 years were reported to be higher than those commercial motorcyclist working for 1-4 years, this include morning cough 76(62.3%), cough last for three months 42(34.4%),

phlegm production 76(62.3%), phlegm last for three months 38(31.1%) and shortness of breath 65(53.3%) and the difference were statistically significant with $p < 0.001$, except for the wheezing 36(29.5%) which was higher to commercial motorcyclists working for more than 4 years but not statistically significant , see (Table 4.4.)

Table 4.4: The relationship between prevalence of respiratory symptoms and working job duration among commercial motorcyclists

Respiratory Health Symptoms	Working Duration 1-4 years (n= 78)	>4years (n=122)	$\chi 2$	P-Value
Morning Cough				
Yes	35(44.9)	76(62.3)	5.164	0.023*
No	43(55.1)	46(37.7)		
Cough Last For Three Months Yearly				
Yes	10(12.8)	42(34.4)	10.448	0.001*
No	68(87.2)	80(65.6)		
Phlegm				
Yes	30(38.5)	76(62.3)	9.914	0.002*
No	48(61.5)	46(37.7)		
Phlegm Last For Three Months Yearly				
Yes	8(10.3)	38(31.1)	11.885	0.003*
No	70(89.7)	84(68.9)		
Wheezing				
Yes	22(28.2)	36(29.5)	0.001	0.969
No	56 (71.8)	86(70.5)		
Shortness of breath				
Yes	29(37.2)	65(53.3)	4.325	0.038*
No	49(62.8)	57(46.7)		

Chi-square test,* $p<0.05$, values in parentheses are percentages

Working hours

Results were showed to have no significant relationship between working hours and all reported respiratory among commercial motorcyclists with p value >0.05, see (Table 4.5).

Table 4.5: Comparison of prevalence of respiratory symptoms by working hours among

Respiratory Health Symptoms	Working hours ≤8hours(n=5)	≥8hours(n=195)	$\chi 2$	P-Value
Morning Cough				
Yes	2(40)	109(55.9)	0.063	0.802
No	3(60)	86(44.1)		
Cough last for three months				
Yes	2(40)	50(25.6)	0.043	0.836
No	3(60)	145 (74.4)		
Phlegm production				
Yes	2(40)	104(53.3)	0.019	0.892
No	3(60)	91(46.7)		
Phlegm last for three months				
Yes	1(20)	45(23.1)	0.046	0.977
No	4(80)	150(76.9)		
Wheezing				
Yes	2 (40)	56 (28.7)	0.002	0.960
No	3 (60)	139(71.3)		
Shortness of breath				
Yes	3(60)	91(46.7)	0.019	0.892
No	2(40)	104(53.3)		

Fisher exact test, values in parentheses is percentages.

Age

Result showed that there is no statistical significant difference among motorcyclist's age group and prevalence of respiratory symptoms $p>0.05$, see (Table 4.6)

Table 4.6: Comparison of prevalence of respiratory symptoms by age among commercial motorcyclists

Respiratory Health Symptoms	Age(years) 15-24 (n=29)	25-34 (n=125)	>35 (n=46)	$\chi 2$	P-Value
Morning Cough					
Yes	14(48.3)	75(60)	22(47.8)	2.730	0.255
No	15(51.7)	50(40)	24(52.2)		
Cough last for three months					
Yes	8(27.6)	35(28)	9(19.6)	1.345	0.510
No	21(72.4)	90(72)	37(80.4)		
Phlegm production					
Yes	10(34.5)	69(55.2)	27(58.7)	4.872	0.088
No	19(65.5)	56(44.8)	19 (41.3)		
Phlegm production last for three months					
Yes	4(13.8)	29(23.1)	13(28.3)	3.180	0.528*
No	25(86.2)	96(76.8)	33(71.7)		
Wheezing					
Yes	6 (20.7)	35(28)	17(37)	2.450	0.294
No	23(79.3)	90(72)	29(63)		
Shortness of breath					
Yes	11(37.9)	60(48)	23(50)	1.186	0.553
No	18(62.1)	65(52)	23(50)		

Chi-square tests,*Fisher exact test values in parentheses are percentages.

Level of education

Result showed that there is no statistical significant difference among motorcyclist's level of education and prevalence of respiratory symptoms $p>0.05$, except for shortness of breath, see (Table 4.7)

Table 4.7: relationship between prevalence of respiratory symptoms by level of education among commercial motorcyclists

Respiratory Health Symptoms	Level of education		$\chi 2$	P-Value
	Primary	Secondary		
Morning cough				
Yes	28(20.1)	13(21.7)	0.319	0.853
No	111(79.9)	47(78.3)		
Cough last for three months				
Yes	38(27.3)	14(23.3)	0.702	0.704
No	101(72.7)	46(76.7)		
Phlegm				
Yes	73(52.5)	32(53.3)	0.902	0.637
No	66(47.5)	28(46.7)		
Phlegm last for three months				
Yes	35(25.2)	10(16.7)	5.421	0.247
No	10474.8)	50 (83.3)		
Wheezing				
Yes	43(30.9)	15(25)	1.128	0.569
No	96(69.1)	45(75)		
Shortness of breath				
Yes	73(52.5)	21(35)		
No	66(47.5)	39(65)	6.054	0.048*

Chi-square test, * $p<0.05$, values in parentheses are percentages.

Uses of nose/mouth mask

Commercial motorcyclists responded yes on using nose/mouth masks showed no significant different in all respiratory health symptoms in comparison with those not using nose/mouth mask $p>0.05$, see(Table 4.8).

Table 4.8: Relationship between prevalence of respiratory symptoms and uses of nose/mouth mask among commercial motorcyclists

Respiratory Health Symptoms	Uses of nose/mouth mask Yes(n=3)	No (n=197)	$\chi 2$	P-Value
Morning Cough				
Yes	1(33.3)	110(55.8)	0.037	0.847
No	2(66.7)	87(44.2)		
Cough last for three months yearly				
Yes	1(33.3)	51(25.9)	0.000	1
No	2(66.7)	146(74.1)		
Phlegm				
Yes	1(33.3)	105(53.3)	0.011	0.916
No	2(66.7)	92(46.7)		
Phlegm last for three months				
Yes	1(33.3)	45(22.8)	0.225	0.897
No	2(66.7)	152(77.2)		
Wheezing				
Yes	0(0)	58(29.4)	0.216	0.635
No	3 (100)	139(70.6)		
Shortness of breath				
Yes	0(0)	94(47)	1.125	0.289
No	3 (100)	103(53)		

Fisher exact tests, values in parentheses are percentages.

Previous respiratory diseases

Previous diseases reported by motorcyclists had ever been diagnosed were chocking cough 29 (14.5%), asthma 6(3%) and tuberculosis 3(1.5 %)

Choking cough

Commercial motorcyclists reported had ever been with choking cough showed significant different at p<005 in morning cough, cough last for three month, phlegm, phlegm last for three month and shortness of breath but the other respiratory health symptoms were statistically not different in comparison with those not ever been with choking cough at p>0.05, see (Table 4.9).

Table 4.9: Relationship between prevalence of respiratory symptoms and previous reported choking cough among commercial motorcyclists

Respiratory Health Symptoms	Choking cough		$\chi 2$	P-Value
	Yes (n= 29)	No (n=171)		
Morning Cough				
Yes	22(75.9)	89(52)	4.771	0.029*
No	7(24.1)	82(48)		
Cough Last For Three Months Yearly				
Yes	17(58.6)	35(20.5)	16.829	0.001*
No	12(41.4)	136(79.5)		
Phlegm				
Yes	20(69)	86(50.3)	2.762	0.097
No	9(31)	85(49.7)		
Phlegm Last For Three Months Yearly				
Yes	12(41.4)	34(19.9)	7.031	0.030*
No	17(58.6)	137(80.1)		
Wheezing				
Yes	12(41.4)	46(26.9)	1.870	0.171
No	17(58.6)	125(73.1)		
Shortness of breath				
Yes	21(72.4)	73(42.7)	7.641	0.006*
No	8 (27.6)	98(57.3)		

Chi-square test, * p<0.05, values in parentheses are percentages.

4.3 Lung Function Test

A total of 60 out of 100 and 20 out of 30 for commercial motorcyclists and office attendants respectively were able to achieve acceptable curves. The rest 40 commercial

motorcyclists and 10 office attendants could not produce an acceptable and reproducible curve even after 6 consecutive maneuvers.

Lung function tests showed that FEV1/FVC was more reduced among motorcyclist than office attendants and the different was statistically significant (p < 0.03), see (table 4.10).

Table 4.10: Comparison on lung function test among commercial motorcyclists and office attendants

Parameter	Lung function test Commercial motorcyclist (n=60)	Office attendants (n=21)	t	P-Value
FVC	2.8± 0.5	2.8±0.7	0.331	0.741
FEV1	3.6 ± 0.6	3.4±0.6	1.063	0.291
FEV1/FVC	79.1±9.5	84.1±6.7	-2.180	0.032
PEFR	558.9±116.9	473.4 ±112.5	-0.474	0.637

4.3.1. Prevalence of Lung Function Impairment

Prevalence of airflow obstruction (FEV1/FVC<70) was 10% for commercial motorcyclists as shown in figure (4.1)

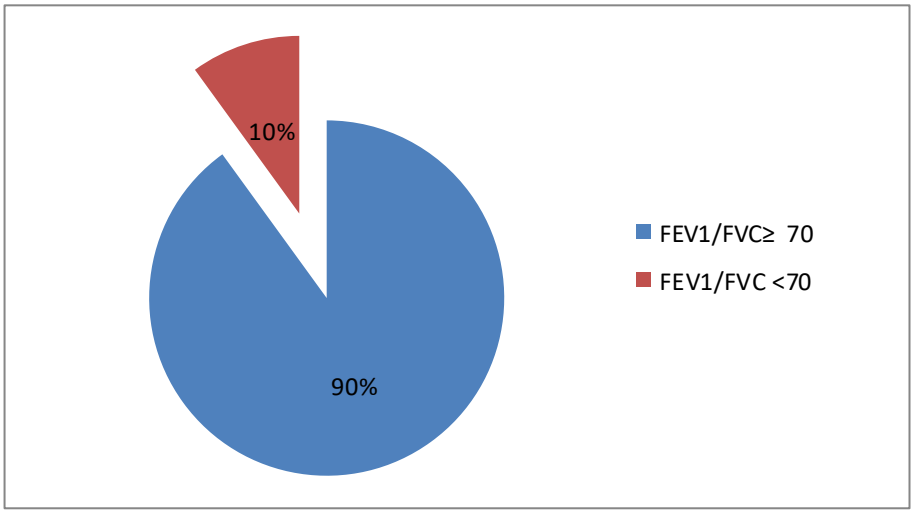


Figure 4.1: Prevalence of Airflow obstruction FEV1/FVC <70 among commercial motorcyclists

4.4 Lung function impairment and associated predictors among commercial motorcyclists

Age, cigarette smoking, BMI and previous dust illness could not predict an outcome of lung function impairment

Table 4.11: predictors for lung function among commercial motorcyclists

Predictors	β	SE	OR (95%CI)	P value
Age	0.053	0.70	1.055(0.920-1.209)	0.446
Cigarette smoking	-18.943	10350.881	0.00	0.999
Previous disease	1.702	0.953	5.484(0.847-35.486)	0.446
BMI	-0.282	0.706	0.755(0.189-3.012)	0.847

Logistic regression, odds ratio, 95% Confidence Interval

4.4 Associated Factors with Respiratory Health Symptoms among Commercial Motorcyclists

Predictors of respiratory health symptoms

Binary logistic regression showed that work duration was the most predictor of respiratory symptoms after adjusting for important confounders such as smoking, BMI, and previous respiratory diseases, whereas cough (OR = 1.66, 95%CI (1.04 - 2.65)) , cough last for three months (OR = 3.682, 95% CI (1.694 -8.001)), phlegm (OR = 2.767, 95%CI ((1.522-5.029)) and shortness of breath (OR = 2.031, 95%CI (1.122-3.678)) (Table 4. 12).

Table 4.12: Predictors for respiratory health symptoms among commercial motorcyclists

Variables	OR (95% CI)	P-value
Morning Cough		
Working duration (ref: 1 to 4 years)		
More than 4 years	1.66 (1.04 - 2.65)	0.04*
Previous disease (ref: No)		
Yes	1.98 (0.32 - 12.49)	0.47
BMI (ref: < 18.5 Underweight)		
18.5 – 24.9 (Normal weight)	0.27 (0.04 - 1.77)	0.17
25 – 29.9 (Overweight)	0.68 (0.15-3.13)	0.622
≥30 (Obesity)	0.56 (0.12 - 2.75)	0.48
Smoking status (ref: No)		
Yes	0.97 (0.54 - 1.76)	0.93
Dust concentration	1.156(0.845-1.581)	0.364
Cough last for three months		
Working duration (ref: 1 to 4 years)		
More than 4 years	3.682(1.694 -8.001)	0.001*

Previous disease (ref: No)		
Yes	2.880 (0.402-20.632)	0.292
BMI (ref: < 18.5)		
18.5 – 24.9 (Normal weight)	1.785 (0.089-35.875)	0.705
25 – 29.9 (Overweight)	1.614 (0.259-10.070)	0.608
≥30 (Obesity)	2.288(0.339-15.452)	0.396
Smoking status (ref: No)		
Yes	0.994(0.429-2.302)	0.989
Dust concentration	1.152(0.773-1.810)	0.540
Phlegm		
Working duration (ref: 1 to 4 years)		
More than 4 years	2.767(1.522-5.029)	0.001*
Previous disease (ref: No)		
Yes	1.192(0.566-2.511)	0.505
BMI (ref: < 18.5)		
18.5 – 24.9 (Normal weight)	6.951(0.350-138.035)	0.204
25 – 29.9 (Overweight)	1.797(0.300-10761)	0.521
≥30 (Obesity)	2.784(0.442-17.551)	0.276
Smoking status (ref: No)		
Yes	1.192(0.566-2.511)	0.643
Dust concentration	1.277(0.777-2.098)	0.335
Wheezing		
Working duration (ref: 1 to 4 years)		
More than 4 years	1.089(0.576-2.059)	0.792
Previous disease (ref: No)		
Yes	1.673(0.268-10.456)	0.582
BMI (ref: < 18.5)		
18.5 – 24.9 (Normal weight)	1.043(0.054-20.072)	0.978
25 – 29.9 (Overweight)	1.331(0.232-7.641)	0.749
≥30 (Obesity)	1.113(0.184-6744)	0.907
Smoking status (ref: No)		
Yes	1.011(0459-2.224)	0.971
Dust concentration	1.452(0.737-2.098)	0.281
Shortness of breath		
Working duration (ref: 1 to 4 years)		
More than 4 years	2.031(1.122-3.678)	0.019*
Previous disease (ref: No)		
Yes	0.973(0.148-6.407)	0.977
BMI (ref: < 18.5)		
18.5 – 24.9 (Normal weight)	5.822(0.298-113.744)	0.245
25 – 29.9 (Overweight)	2.326(0.398-13.580)	0.348
≥30 (Obesity)	2.024(0.330-12.420)	0.446
Smoking status (ref: No)		
Yes	1.923(0.907-4.081)	0.088
Dust concentration	1.173(0.797-1.726)	0.419

*****Logistic regression, odds ratio, 95% Confidence Interval, $p<0.05$

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

The aim of the study was to determine level of personal total dust exposure and respiratory health effects (phlegm, cough, wheezing, chest pain, shortness of breath and lung impairment) among commercial motorcyclists in Ubungo Municipality. The study was very important because commercial motorcyclist is an emerging businesses in Tanzania in which large number of youths who do not have formal employment engaged to it.

5.2. Personal Total Dust Exposure Levels

The results showed that, commercial motorcyclists and office attendants had exposed to geometric mean 1.60 mg/m^3 (SD=2.12) and 0.071 mg/m^3 (SD=1.26) of total dust for eight hours respectively. This finding was contrary with studies done in Nigeria, Copenhagen and Taipai, Taiwan which showed that people use motorcycles on road, have exhibited to high personal particulate matter exposure than other mode of transport (12, 13, 16, 32). The low level of dust exposure to commercial motorcyclist obtained in this study might be contributed by weather condition during sampling, where most of the samples were taken one week after rain season therefore, there was high possibility that dust were suppressed by rain. Also result show that one motorcyclist had exposed to concentration of 22mg/m3 total dust for eight hours which is above TLV, this might be contributed by number of routes and location taken by the motorcyclist during sampling, where the participant did his activities in unpaved road where there was number of cars passing through.

5.3 The Prevalence of Respiratory Health Symptoms among Commercial Motorcyclist and Office Attendants.

Study showed high prevalence of respiratory health symptoms among commercial motorcyclist than office attendants and the difference were statistically significant. Morning coughs (55.5% vs. 27%); cough last for three months (26% vs 2%); phlegm production (53.2%vs 15%), phlegm production last for three months (23% vs.0%) wheezing (29% vs. 2%) and shortness of breath (47.7% vs. 16%) as shown in figure 4.3. These findings were similar to the study done in Nigeria (34) where the prevalence of cough (71% vs. 21%) and sputum (67% vs. 20%) was higher among the commercial

motorcyclists than controls. Also these finding was consistent with another study done in Ethiopia where more respiratory symptoms were found among exposed cobblestone paving workers than control(33). Differences in the prevalence of respiratory symptoms noted among motorcyclists and the office attendants, can be explained based on their occupation, the commercial motorcyclists are exposed daily to traffic road air pollutants for more than 8 hours, compared with control subjects who are more often work in indoor environment for 8 hours per day. Since these individuals in both groups were not subjected to the same level and duration of exposure to air pollutants, it can be presumed that this fact can explain the differences noted in prevalence of respiratory health symptoms. Also there is similar finding on the study done in Brazil (6) which showed more reported respiratory symptoms from motorcyclists although in the mentioned study did not involve control.

5.4 Prevalence of Lung Function Impairment

Study showed that lower FEV1/FVC among motorcyclist and office attendants were statistically significant different at $p < 0.03$, this finding were similar to the study done in Bangkok, Thailand where FEV1/FVC among motorcyclists found significant lower than that of the taxi driver (32). This different can probably be explained by considering that motorcycles are not enclosed, therefore it allow all dust and fugitive particles to reach direct to the motorcyclists, in addition most of motorcyclists are exposed daily to air pollutants for more than 8 hours without using any protective gears on dust and particles to respiratory system therefore long term exposure to the dust and other particles result to decline in lung function.

Moreover in this study, we found that prevalence of airflow obstruction (FEV1/FVC<70) for commercial motorcyclists was 10%, the result were low compared to the result found in Nigeria (34, 12) where the prevalence of an airflow obstruction for commercial motorcyclists were 21% and 37.5% respectively. These results could be explained by “survivor effect” where the motorcyclists found at work during sample collection are usually the “healthy” ones.

5.5 Associated Factors with Respiratory Health Symptoms among Commercial Motorcyclists.

In this study work duration was the most predictor of cough, cough last for three months, phlegm and shortness of breath among commercial motorcyclists at $p < 0.05$ after adjusting confounders such as smoking, previous disease, age and BMI. Study revealed that the motorcyclists working for more than 4 years had 1.66, 3.68, 2.77 and 2.03 times the odds of developing morning cough, cough last for three months, phlegm and shortness of breath respectively compared to those commercial motorcyclists worked for 1-4 years. Our findings are similar to the studies done in Congo and Nigeria (3, 4, 12) where they found that transit workers with more years on the job had higher risk of respiratory problems compare to those with few years in working, this could be due to the cumulative effect of air pollutants which weaken the respiratory system and make motorcyclist with many years on work to be more vulnerable with their respiratory system.

Strengths and limitations

This is the first study to assess personal total dust exposure and respiratory health effects among commercial motorcyclist in Tanzania, using the Modified British medical research questionnaire, personal dust sampler (SKC) and spirometer. Despite of the strength, the study has some limitations; First a cross-sectional design that could not establish the causal relationship between the exposed groups and the occurrence of respiratory effects. Second, it has been conducted in men only because the work of commercial motorcyclist is mainly done by men in Ubungo municipal.

CHAPTER SIX

6.0: CONCLUSION AND RECOMMENDATIONS

6.1: Conclusion

Prevalence of the respiratory health symptoms which were cough, phlegm, wheezing and shortness of breath were higher among commercial motorcyclists than office attendants despite low level of personal total dust exposure for eight hours. And work duration was the most associated factor of cough, cough last for three months, phlegm and shortness of breath among commercial motorcyclists.

6.2 Recommendations

i. Commercial motorcyclists should use appropriate PPEs (mouth/nose masks) to reduce risk of respiratory problems.
ii. The future use of cohort study designed which cover different season (weather condition) will be able to establish causal-effect relationship between total dust exposure and occurrences of occupational respiratory health effects.

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APPENDICES

Appendix I: Questionnaire- English Version

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

SCHOOL OF PUBLIC HEALTH AND SOCIAL SCIENCES

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

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

Date of interview…… Questionnaires number ……

Name of interviewer…… Name of ward/ waiting station…….

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.

RESPIRATORY QUESTIONNAIRE

Questionnaire based on BMRC respiratory questionnaire 1986 which has been extensively validated. This questionnaire is intended to be completed by interviewer rather than by respondent.

Additional question have been added to cover clinical aspect of bronchial hyper responsiveness validated by the department of occupational and environmental medicine, national lung institute.

Preamble

Iam going to ask some questions, mainly about your chest. I would like to answer Yes or No

S/N	QUESTION	CODING CLASSIFICATION	RESPONSE
1	Sex: (by observation)	0 = Male	
		1 = female	
2	Age(years)		
3	Marital status	1 = Single	
		2 = Married	
		3 = Cohabiting	
		4 = Separated	
		5 = Widow	
4	Level of education	1 = No education	
		2 = Primary school	
		3 = Secondary school	
		3 =Technical education	
		5 = Diploma	
		6 = Higher education	
5	When did you start this job?		
6	How long in this job?	…….years.	
7	How many working hours per day?	……. hours.	
8	How many working hours' per a week?	……..hours.	
9	What is your working time?	……..to …….. hours	
10	What is your income per month?	……..Tshs	
11	Weight	……..kg	
12	Height	…….cm	

Cough

1. Do you usually cough first thing in the morning in winter?

   Yes ☐ No ☐

2. Do you usually cough during the day-or at the night-in the winter?

   Yes ☐ No ☐

   If no to both question 1 and 2 go to question 4

3. Do you cough like this on most days for as much as three month each year?

   Yes ☐ No ☐

Phlegm

4. Do you usually bring up phlegm from your chest first thing in the morning in winter?

   Yes ☐ No ☐

5. Do you usually bring up phlegm from your chest during the day-or at the night-in the winter?

   Yes ☐ No ☐

If no to both question 4 and5 go to question 9

6. Do you usually bring up phlegm like this on most days for as much as three month each year?

   Yes ☐ No ☐

Period of cough and phlegm

7. In the past three years, have you had a period of increased cough and phlegm lasting for three weeks or more?

Yes ☐ No ☐

If no to question 7 go to question 9

If yes to question 7 go to question 8

8. Have you had more than one such episode?

   Yes ☐ No ☐

9. Have you ever coughed up blood?

   Yes ☐ No ☐

If no to question 9 go to question 11

If yes to question 9 go to question10

10. Was this in the past year?

    Yes ☐ No ☐

Shortness of breath and wheezing

11. Are you troubled by shortness of breath when hurrying the level or walking up a slight hill?

    Yes ☐ No ☐

If no to question 11 go to question14

If yes to question 11go to question12

12. Do you get short of breath walking with other people of your age on level ground?

    Yes ☐ No ☐

13. Do you have to stop for breath when walking at your own pace on level ground?

    Yes ☐ No ☐

14. If you run, or climb stairs fast do you ever

	Yes	No
a. Cough?		
b. Wheeze		
c. Get tight in the chest?		

15. Is your sleep ever broken?

	Yes	No
a. By wheeze		
b. Difficulty in breathing		

16. Do you ever wakeup in the morning

	Yes	No
a. With wheeze		
b. Difficulty with breathing		

17. Do you ever wheeze?

	Yes	No
a. If you are in smoky room?		
b. If you are in dusty place		

If yes to either Q15, Q16 andQ17:

18. Are your symptoms better when you are at holiday?

Yes ☐ No ☐

Chest illness

19. During the past three years have you had any chest illness that has kept you from usual activities for as much as a week?

Yes ☐ No ☐

If yes to question 19 go to 20

20. Did you bring up more phlegm than usual in any of these illnesses?

Yes ☐ No ☐

21. Was either of your past life ever told by a doctor that you had a chronic lung condition as mentioned below?

	Yes	No
chronic bronchitis?		
Choking cough?		
Asthma		
Heart attack?		
Lung cancer?		
Tuberculosis (TB)?		
Other lung trouble?		

UTILIZATION OF PPE

S/N	Type of PPE	Wearing of PPEs during working.	
	Answer	Yes	No
1	Respirator		
2	Nose/mouth masks		
3	Helmet		
4	Full face motorcycle helmet		
5	Jacket for wind protection while you ride		

TOBACCO SMOKING

22. Do you smoke?

Yes ☐ No ☐

If no to question 22 go to question 23

23. Have you ever smoked as much as one cigarette a day for as long as one year ☐ ☐

If no to both question 22 and 23 ends here

24. How old were you when you started smoking regularly ----------

25. Do (did) you smoke manufactured cigarettes?

a. On weekdays?

Yes ☐ No ☐

b. At weekends?

Yes ☐ No ☐

26. Do you smoke any other form of tobacco?

Yes ☐ No ☐

If yes to question 26: record detail under additional notes

For ex- smokers

27. When did you give up smoking altogether? Month …… Year……..

SPIROMETER

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

PERF (Litre/min)

1 

2 

3 

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Appendix II: Questionnaire – Swahili Version

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI CHA MUHIMBILI

SHULE YA AFYA YA JAMII

IDARA YA AFYA MAZINGIRA NA MAHALA PA KAZI

S.L.P. 65015, DAR ES SALAAM, TANZANIA

Tarehe ya usaili …… Nambari ya dodoso ……

Jina la mhoji maswali…… jina la kituo/ kata .....

Weka alama ya vema mbele ya jibu sahihi, na andika numbari/jibu kwenye nafasi husika.

DODOSO LA KASORO KATIKA MFUMO WA UPUMUAJI

Hili dodoso limetokana na dodoso lililotengenezwa na BMRC 1986 ambalo limehakikiwa vya kutosha. Dodoso hili linatazamiwa kutumika na mtafiti/ muhojaji na si mgonjwa, maswali mengine ya ziada yameongezewa kujumuisha taarifa nyingine muhimu, dodoso hili limehakikiwa na idara ya afya mazingira mahala pa kazi.

UTANGULIZI

Nitakuuliza maswali machache kuhusu matataizo katika mfumo wa upumuaji.

SEHEMU A: UTAMBULISHO

Na		
1	Taja umri wako ……miaka Ulizaliwa lini taja tarehe/mwezi/mwaka …… ……..	
2	Jinsia:	0 = Mume
		1 = Mke
3	Hali ya ndoa	1 = Sijaoa/ olewa
		2 = Nimeoa/olewa
		3 = Naishi na mwenza bila ndoa
		4= imetengana/achana
		5 = Mjane
4	Kiwango cha elimu ulionayo	1 = Sijasoma
		2 = Elimu ya msingi
		3 = Elimu ya sekondari
		4 = Elimu ya sekondari
		5 = Diploma

		6 = Elimu ya juu
5	Ulianza kazi lini? Taja mwaka …….	
6	Una muda gani tangu uanze kufanya kazi hii? Taja miaka……..	
7	Unafanya kazi hii kwa masaa mangapi kwa siku? Taja masaa ……	
8	Unafanya kazi hii siku ngapi kwa wiki? Taja idadi ya siku …….siku.	
9	Unafanya kazi kuanzia saa ngapi mpaka saa ngapi? Taja muda unaoanza kazi na kumaliza kazi …….-…….saa. je umefanya muda gani kwa hii shifti ……..miaka.	
10	Kipato chako kwa mwezi shilingi ngapi? Taja kiasi Tshs……	
11	Uzito ……kg	
12	Urefu ……..cm	

SEHEMU B: DALILI ZA MARADHI YA MFUMO WA UPUMUAJI KIKOHOZI

1	Je huwa unakohoa pale tu uamkapo asubuhi wakati wa kipindi cha baridi?	Ndio
		Hapana
2	Je huwa unakohoa kipindi cha mchana au usiku wakati wa msimu wa baridi	Ndio
		Hapana
	Kama jibu hapana kwa swali 1 na 2 nenda swali la 4	
3	Je huwa unakohoa kama hivi karibu siku zote kwa muda karibu miezi mitatu kila mwaka?	Ndio
		Hapana

MAKOHOZI

4	Je huwa unatoa makohozi mara tu uamkapo asubuhi kipindi cha msimu wa baridi?	Ndio
		Hapana
5	Je huwa unatoa makohozi yoyote wakati wa mchana au usiku kipindi cha msimu wa baridi?	Ndio
		Hapana
	Kama jibu hapana kwa swali 4 na 5 nenda swali la 7	
6	Je huwa unatoa makohozi karibu siku zote kwa muda na karibu miezi mitatu kila mwaka	Ndio
		Hapana

VIPINDI VYA KIKOHOZI NA KUTOA MAKOHOZI

7	Katika kipindi cha miezi mitatu iliyopita, umewahi kupata cha kuongezeka kukohoa na kutoa makohozi vilivyodumu kwa siku tatu au zaidi?	Ndio
		Hapana
	Kama jibu hapana kwa swali 4 na 5 nenda swali la 9	
8	Je umeshawahi kupata hali hiyo kwa zaidi ya mara moja?	Ndio
		Hapana

KUSHINDWA KUPUMUA NA KUTOA SAUTI NYEMBAMBA WAKATI WA KUPUMUA

9	Je unapata shida ya upumuaji wakati unatembea haraka au kupanda kilima?	Ndio Hapana
	Kama jibu ni ndio kwa swali 9 nenda swali 10	
10	Je unapata shida ya upumuaji wakati unapotembea na watu wengine wa umri wako kwenye ardhi tambarare?	Ndio Hapana
11	Je inakubidi usimame ili upumue wakati unapotembea katika ardhi tambarare	Ndio Hapana
12	Kama ukikimbia au kupanda ngazi kwa haraka je huwa unatokewa na yafatayo: a. kukohoa b. Kutokwa na kisauti chembamba wakati unapumua **c.** Unahisi kubanwa kifua	 Ndio Hapana Ndio Hapana Ndio Hapana
13	Je usingizi wako unakatishwa na: a. Kutoa sauti ya mkwaruzo wakati wa kupumua b. Kushindwa kupumua vizuri	 Ndio Hapana Ndio Hapana
14	Je huwa ukiamka asubuhi a. Kutoa sauti ya mkwaruzo wakati wa kupumua b. Kushindwa kupumua vizuri	Ndio Hapana Ndio Hapana
15	Je huwa unatoa sauti ya kukwaruza wakati wa kupumua	
	a. Kama upo kwenye chumba cha moshi b. Kama upo kwenye vumbi sana	Ndio Hapana Ndio

		Hapana
	Kama jibu namba 13,14 na 15	
16	Je dalili za matatizo ya mfumo wa upumuaji hupungua? Wakati wa mapumziko	Ndio Hapana

MAUMIVU YA KIFUA

17	Katika kipindi chamiaka mitatu iliyopita umewahi kupata kuumwa kifua ambachokilikufanya usiende kwenye shughuli zako za kawaida kwa muda karibu wiki	Ndio Hapana
18	Je uliwahi kupata kutoa makohozi zaidi ya kawaida katika kipindi chochote cha kuumwa kwako?	Ndio Hapana
19	Je uliwahi kuumwa zaidi ya mara moja katika kipindi cha miaka mitatu	Ndio Hapana

TAARIFA YA MAGONJWA YA MFUMO WA UPUMUAJI

20	Je ulishawahi kuambiwa na daktari kuwa una mojawapo ya magonjwa kati ya haya yaliyotajwa hapa chini?	**Ndio**	**Hapana**
	1. Kukohoa kusikokoma		
	2. Kikohozi cha kupaliwa		
	3. pumu		
	4. Ugonjwa wa moyo.		
	5. Kansa ya mapafu		
	6. Kifua kikuu (TB)		
	7. Ajali/upasuaji ulioathiri kifua chako		
	8. Matatizo mengine ya kifua		

MATUMIZI YA VIFAA VYA KINGA BINAFSI

S/N	Jina/aina ya kifaa vya kinga binafsi	Vifaa vya kinga binafsi unavyovaa ukiwa unaendesha bodaboda	
		Ndio	Hapana
1	Kipumulio		
2	Kiziba mdomo na pua		
3	Kofia ngumu ya kichwa		
4	Kofia ngumu ya kichwa inayoziba uso		
5	Jacket /koti kwa ajili ya kujikinga na upepo		

UVUTAJI WA SIGARA

21	Je unavuta sigara	Ndio
		Hapana
22	Je umewahi kuvuta sigara angalau moja kwa siku kwa kipindi cha mwaka mmoja	Ndio
		Hapana
	Kama jibu hapana kwa swali namba 21 na 22 ishia hapa.	
23	Je ulikuwa na umri gani ulipoanza kuvuta sigara	**.....**
24	Unavuta/ ulishawahi kuvuta sigara zinazotengenezwa viwandani	Ndio
		Hapana
25	Unavuta sigara ngapi kwa siku a. Siku za kazi ……. b. Siku za kupumzika.....	

26	Unavuta aina nyingine ya tumbaku?	Ndio
		Hapana
	Kama jibu ni ndio kwa swali la 26 jaza majibu	
27	Kwa walioacha kuvuta sigara: lini uliacha kuvuta sigara kabisa? Mwezi..... mwaka	

VIPIMO VYA UWEZO WA MAPAFU KUFANYA KA

Spirometer

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

PEF(Litre/min)

1. ☐☐☐

2. ☐☐☐

3. ☐☐☐

Appendix III: Informed Consent for The Commercial Motorcyclist

ID NO: ……

Introduction

Hello! My name is Saumu Shabani, a student of Masters of science in environmental and occupational health at Muhimbili University of Health and Allied Sciences (MUHAS). On behalf of Muhimbili University of Health and Allied Sciences (MUHAS), I am conducting a research on personal exposure to total dust and respiratory health effects among commercial motorcyclists in ubungo municipality.

Purpose of the study

To determine level of personal exposure to total dust and respiratory health effects among commercial motorcyclist in Ubungo Municipality, and come up with the magnitude of the problem and enable the national to make effort to reduce the burden of respiratory effects among commercial motorcyclists.

Participation

I would like you to participate in this study. You have been chosen to participate because i think you can provide valuable information related to respiratory symptoms and allow me to measure personal dust exposure by attaching a sampling pump on your belt and clipped their sampling train on your collar for eight hours, and to test your lung function. If you choose to participate you will be interviewed for about 15-20 minutes. The questions that you will be asked will be related to respiratory symptoms (cough, nose irritation, wheezing, nasal congestion, cough, phlegm, sneezing, breathlessness), smoking and occupational exposure (duration of the job, working days and hours per week and exposure to other sources of pollution other than road dust).

Benefits

If you agree to participate, it will be beneficial for improvement of your working conditions for the purpose of public health protection. This is because the findings of this study will help to know the magnitude of personal total dust exposure and respiratory effect among commercial motorcyclist in Ubungo municipal and finding can be used by the government in priority setting during planning for interventions in Ubungo municipal.

Risks

I do not expect any harm to you as a result of participation in this study. Although some questions will be personal, but the information obtained from you and others will be used to generalized for the whole of Ubungo municipal.

Confidentiality

All responses will be kept confidential and will be used only for the purpose of this study and will be private. No identification information will be collected from you during the interview, except your age, sex and education level.

Right to Refuse / Withdraw

Participation to this study is voluntary. You may decide to participate or not to. No measure will be taken upon your refusal to participate if you decided not to. You are free not to answer any question or any part of the discussion.

Whom to Contact

In case of any question or query concerning this study, please contact the principal investigator, Ms. Saumu Shabani from MUHAS, P. O. BOX 65001, Dar es Salaam, mobile number 0712 347 094. If you have any question about your rights as a participant you may contact Dr. Joyce Masalu, Chairperson of the research and Publications Committee, MUHAS. P.O. Box 65001, Dar es Salaam-Tanzania, Tel +2552150302-6)

I ……... have read the contents of this form and understand and my questions have been adequately answered. I agree to participate in this study.

Signature of participant…… Date…….

Signature of researcher …… Date……..

Appendix IV: **Fomu ya Ridhaa kwa Waendesha Bodaboda**

Namba ya utambulisho……

Utambulisho

Habari, naitwa Saumu Shabani, ni mwanafunzi wa shahada ya uzamili ya sayansi ya mazingira na afya mahala pa kazi katika chuo cha afya na sayansi shirikishi cha Muhimbili. Katika sehemu ya mafunzo yangu ninafanya utafiti ili kujua wingi wa vumbi linalovutwa wakati wa kupumua huku wakiendesha bodaboda na madhara ya mfumo wa upumuaji kwa waendesha bodaboda wa manispaa ya ubungo.

Madhumuni ya utafiti

Kutambua wingi wa vumbi linalovutwa wakati wa kupumua huku wakiendesha bodaboda na madhara ya mfumo wa upumuaji kwa waendesha bodaboda wa manispaa ya ubungo, kujua ukubwa wa tatizo ambao utapelekea taifa kutafuta mbinu za kukabiliana na matatizo ya mfumo wa upumuaji.

Ushiriki

Ningependa ushiriki katika utafiti huu kwa kuwa ninahisi unaweza kutoa taarifa zitakazoweza kufanikisha utafiti huu. Kama utakubali kushiriki utahojiwa/ au kupewa dodoso ujaze kwa muda wa dakika zisizozidi 15-20 maswali utakayoulizwa yatahusiana na dalili za ugonjwa katika mfumo wa upumuaji (kukohoa, maumivu ya kifua, kutoa sauti nyembamba wakati wa kupumua, kutoa makohozi, mafua na kupumua kwa shida) uvutaji wa sigara, na muda ulionao toka umeanza kazi, masaa unayotumia katika kazi yako. Pia nitahitaji kuchukua sampuli kwa ajili ya kupima wingi wa vumbi unalovuta wakati upo kazini, hivyo nitakuvisha pampu kwenye belti ya suluali na kukuwekea vifaa vya kuchukulia sampuli kwenye kola ya shati yako na utakaa na hivi vifaa kwa masaa nane, pia nitahitaji kukupima uwezo wako wa mapafu kufanya kazi kwa kutumia spirometer, hivyo nitakuelekeza jinsi ya kufanya.

Faida

Ushiriki wako katika utafiti huu ni wa thamani kwani itakusaidia wewe kuboresha mazingira yako ya kazi na kulinda afya ya jamii kiujumla. Hii ni kwa sababu matokeo ya

utafiti huu yatabaini kujua wingi wa vumbi unalolivuta pindi unaendesha na madhara katika mfumo wa upumuaji kwa waendesha bodaboda katika manispaa ya ubungo, pia matokeo ya tafiti hii yatatumiwa na serikali katika mpango wa kutatua hili tatizo katika manispaa ya ubungo.

Athari

Sitarajii mshiriki kupata madhara ya aina yeyote kwa kuamua kushiriki kwake. Ingawa baadhi ya maswali ni binafsi, lakini matokeo ya utafiri huu yatakuwa ya jumla kwa washiriki wote wa manispaa ya Ubungo.

Usiri

Taarifa zitakazokusanywa ni siri na hakuna mtu yeyote atakayeambiwa ulichosema bali zitatumika kwa madhumuni ya utafiti huu tu. Hapatakuwa na utambulisho wa mshiriki kwenye dodoso, isipokuwa mwaka wa kuzaliwa, jinsi na kiwango cha elimu tu.

Haki ya kukubali au kukataa kushiriki

Ushiriki katika utafiti huu ni wa hiari. Unaweza kukubali kushiriki au kukataa. Hapatakuwa na adhabu yeyote itakayochukuliwa dhidi yako kama utaamua kukataa kushiriki. Pia jisikie huru kuokujibu swali ambalo hutapenda kulijibu.

Mawasiliano

Kama uatahitaji ufafanuzi zaidi juu ya utafiti huu, usisite kuwasiliana na Mtafiti Mkuu bi. Saumu Shabani, mwanafunzi wa shahada ya Uzamili ya sayansi ya mazingira na afya mahala pa kazi, S. L. P 65001, chuo kikuu cha afya na sayansi ya jamii Muhimbili, Dar es Salaam au namba ya kiganjani 0712 347 094. Kama una swali juu ya stahili zako unaweza kuwasiliana na Dkt. Joyce Masalu, ambaye ni mwenyekiti wa kamati ya utafiti na uchapaji, S. L. P 65001, Chuo kikuu cha Afay na Sayansi ya Jamii Muhimbili, Dar es Salaam au simu namba +2552150302-6.

Mimi ……Nimesoma/nimesikia na kuelewa madhumuni ya utafiti huu na maswali yangu yamejibiwa ipasavyo. Hivyo, nimeridhia kwa hiari yangu kushiriki.

Saini ya mshiriki…….……

Tarehe…….

Saini ya mtafiti ……

Tarehe……..