RESPIRATORY HEALTH PROBLEMS AMONG PUMP ATTENDANTS OF SELECTED PETROLEUM FILLING STATIONS IN DAR ES SALAAM

By

Agnes Lydia Mhina

A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Public Health of the Muhimbili University of Health and Allied Sciences

Muhimbili University of Health and Allied Sciences

May, 2010

DECLARATION AND COPYRIGHT

I, **Agnes Lydia Mhina**, declare that this dissertation is my own original work and that it has not been presented to any other University for a similar or any other degree award.

Signature..........

This dissertation is a copyright material protected under the Berne Convention, the Copyright Act of 1999 and other international and national enactments, in that behalf, on intellectual property. It may not be produced by any means, in full or in part, except for short extracts in fair dealings, for research or private study, critical scholarly review or discourse with an acknowledgement, without the written permission of the Directorate of Postgraduate Studies, on behalf of both the author and the Muhimbili University of Health and Allied Sciences.

CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by the Muhimbili University of Health and Allied Sciences, a dissertation entitled **Respiratory health problems among pump attendants of selected petroleum filling stations in Dar es Salaam** in partial fulfillment of the requirements for the degree of Master of Public Health of Muhimbili University of Health and Allied Sciences.

.....

DR. SIMON H. D. MAMUYA, PhD

(Supervisor)

Date.....10-06-2010.....

ACKNOWLEDGEMENT

Completion of this dissertation has been possible due to the support provided by different individuals who have made useful contributions and provided valuable information to the author on respiratory health problems among pump attendants of petroleum filling stations in Dar es Salaam.

First and foremost, I extend my profound gratitude and appreciation to my supervisor, Dr. Simon H. D. Mamuya who has led me through the whole process of carrying out the research while giving me expert advice and professional guidance important for this research thus ensuring that the report is finalized.

Secondly, I am thankful to the entire academic staff of the School of Public Health and Social Sciences who have taken us through the whole Masters Degree course program for their invaluable and experiential academic guidance which have in many ways supported this study. I would to thank Dr L. M. B. Rongo of SPHSS, Dr J. Masaga of CEEMI; I also convey my appreciation to Mr. Kapinda the project Research Assistant.

Thirdly and most important, I profoundly grateful to my husband, Dr. Joseph V. Chintowa who has tirelessly been on my side supporting in every step of my academic endeavors. His moral support has been a great strength in this achievement.

I am also thankful to my classmates who as colleagues have extended their cordial relationship and cooperation to me that made my studies both enjoyable and interesting.

Finally, I give my special thanks to my daughter Anna Lillian, my sister Veronica Rose Mhina and my mother Lillian Fridah Mwinyipembe who were always praying to the Lord, God Almighty in the name of Jesus Christ for the success and prosperity of our family.

DEDICATION

This work is dedicated to people who are actively engaged in ensuring that the general public is protected from health hazards so protecting human lives in the country.

ABSTRACT

Occurrence of occupational respiratory diseases is important indicator of the quality of working conditions and working environment. However, while petroleum business is rapidly emerging as the more source of employment in urban and suburban areas in Dar es Salaam little is known to the health hazards encountered by petroleum filling station pump attendants and how to prevent them.

This study aimed to explore occurrence of respiratory health problems and contributing factors among petroleum filling station pump attendants, importance and use of preventive measures.
A cross – sectional comparative study was conducted in Dar es Salaam Municipality. Questionnaire was used to obtain information on demographic characteristics, work history, previous dust exposure and respiratory symptoms experienced and use of protective gears. Lung function was assessed using Easy One Portable Spirometer and peak expiratory flow rate meter. Statistical analysis was done using SPHSS software version 15. Proportions were computed from categorical variables while mean and correlations and multiple regression analysis was computed from continuous variable. The criterion of significance association was assumed for p-values less than 0.05.

The major finding of this study was the decreasing peak expiratory flow rate of 1.35showed by petroleum filling attendants as compared to office workers. However the petroleum filling pump attendants reported no respiratory health symptoms when elicited.
Protective gears (PPE) were not available however, some few petroleum filling pump attendants were aware of the risks concerning petroleum station working conditions.

The study recommended dual approach to merge knowledge of respiratory health problems and practice health and safety measures (preventive practices) among petroleum filling pump attendants in order to improve their health and working conditions.
Petrol stations owners should prepare information guidelines concerning prevention and ensure that the information is accessible to all petroleum filling station pump attendants.

TABLE OF CONTENTS

Certification.....I
Declaration of copyright.....II
Acknowledgement.....III
Dedication.....IV
Abstract.....V
List of tables.....IX
Abbreviations.....X
CHAPTER ONE.....1
1.0 Introduction.....1
1.1 Background.....1
1.2 Health effects of petroleum products on pump attendants.....2
1.3 Problem statement.....3
1.4 Research questions.....4
1.5 Significance of the study.....4
1.6 Research objectives.....5
1.6.1 General objective.....5
1.6.2 Specific objectives.....5
1.6.3 Problem analysis diagram.....6
CHAPTER TWO.....8
2.0 Literature review.....8
2.1 The effects of petroleum on humans.....8
2.2 Other causative factors in occupational health hazards.....10
2.3 Overall effects of occupational exposure to petroleum products.....11
2.4 The prevailing situation in Tanzania.....12
CHAPTER THREE.....14
3.0 Research methodology.....14
3.1 Study design.....14
3.2 Study area.....14
3.3 Study population.....14
3.3.1 Inclusion criteria.....14

3.4 Sampling methods..... 15
3.5 Data collection techniques.....16
3.6 Lung function tests.....18
3.7 Experimental variables.....18
3.8 Ethical consideration.....18
3.9 Limitation of the study.....19
3.10 Planning for data processing and analysis.....19
3.10.1 Data processing.....19
3.10.2 Data analysis.....19
CHAPTER FOUR.....20
4.0 Results.....20
4.1 Social demographic characteristics of the study population.....20
4.2 Respiratory health problems.....22
4.2.1 Acute respiratory health problems.....22
4.2.2 Chronic respiratory health problems.....22
4.2.3 Use of personal protective equipment.....22
4.2.4 Mean values for the lung function.....25
CHAPTER FIVE.....27
5.0 Discussion.....27
CHAPTER SIX..... 31
6.0 Conclusion and recommendations.....31
6.1 Conclusion.....31
6.1.2 Recommendations.....31
REFERENCES.....33

APPENDICES

Appendix 1: Questionnaire English Version

Appendix 2: Questionnaire Swahili Version

Appendix 3: Consent Form English Version

Appendix 4: Consent Form Swahili Version

LIST OF TABLES

Table 1: Petroleum Companies, studied filling stations and studied pump attendants

Table 2: Social Demographic Characteristics

Table 3: Mean Spirometric values by place of work

Table 4: Lung function indices by working period on the particular job

Table 5: Mean values for FVC, FEV1 and PEF by working period

Table 6: Multiple Regression Analysis

ABBREVIATIONS

EAPHA	Air Pollution and Health European Approach
COPD	Chronic Obstructive Pulmonary Disease
EWURA	Energy and Water Utilities Regulatory Authority
FEV1	Forced Expiratory Volume in one (1) second
FVC	Forced Vital Capacity
Hb	Hemoglobin
HIV/AIDS	Human Immuno- Deficiency Virus and Acquired Immuno-Deficiency Syndrome
HSE	Health and Safety Executive
IARC	International Agency for Research on Cancer
NIOSH	American National Institute for Occupational Safety and Health
NHLB	National Heart, Lung and Blood Institute
OSHA/TZ	Occupational Safety and Health Agency
OSHA/USA	Occupational Safety and Health Administration
PCV	Packed Cell Volume
PEF	Peak Expiratory Flow
PPE	Personal Protective Equipment
ppm	Part per million
RBC	Red Blood Cells
WBC	White Blood Cells

CHAPTER ONE

1.0 Introduction

1.1 Background

In Tanzania like other countries, the selling of petroleum products is done in filling stations. The most common fuels sold are petroleum, diesel and kerosene. Most filling stations are built in a similar manner, with most of the fueling installations being located underground, pump machines in the forecourt and a point of service inside a building. Single or multiple fuel tanks of varying sizes, depending on the needs of local market, are usually deployed underground (Chilcott,2008). Local regulations and environment concerns may require a different method, with some stations storing their fuel in container tanks, entrenched surface tanks or unprotected fuel tanks deployed on the surface (MHSR, 1999). In Tanzania (Dar es Salaam) as observed in the present study fuel tanks are normally installed underground. Fuel is usually offloaded direct from a tanker truck into the tanks through a separate valve, located on the filling station's perimeter. Fuel from the tanks travels in the dispenser pumps through a system of underground pipes. At the pump there is an operator who is responsible to attend customers and operate the pump to fill the petrol to the client's vehicle or container. In recent times, filling stations have also begun to sell gas and have added shops to their primary business; convenience stores are now a familiar sight alongside pumps. The number of petrol pump operators in a petroleum station range from 1to 10 depending on the size of the station and pump available. These workers are exposed to different exposure levels of petroleum and exhaust fumes from vehicles while working depending on the task performed and the duration of exposure. The study by Kesavachandran et al (2006) showed that, petroleum evaporates more readily in hot than cold countries. In Tanzania petroleum filling pump attendants attend each car rather than self service thus increasing the opportunity for exposure. Petroleum filling pump attendants do not wear personal protective equipment and personal hygiene is variable in workplaces. Under prevailing conditions, benzene can be absorbed in the lungs by inhalation. There were no studies done in Tanzania on health conditions in petroleum filling

pump attendants. The study aimed at assessing respiratory and lung impairment among petroleum filling pump attendants exposed to petroleum fumes in Tanzania.

1.2 Health Effects of Petroleum Products on Pump Attendants

Petrol vapor at low doses may cause irritation to eyes, respiratory tract and skin, it may also cause muscle weakness, cramps, dizziness and nausea (Chilcott, 2009). Exposure to higher concentration of vapor may produce effects such as staggered gait, slurred speech and confusion. Very high concentrations may result in rapid unconsciousness and death due to respiratory failure, and may also cause lung, brain and kidney damage (Chilcott, 2009). Prolonged dermal exposure to liquid petrol or inhalation of vapor has been associated with renal dysfunction, attributed to lipid degeneration of the proximal convoluted tubules and glomeruli. The clinical manifestation of which include haematuria, proteinuria and myoglobinuria. (Chilcott, 2009). Pulmonary sequel following inhalation of petrol vapor or secondary to pulmonary elimination of volatile hydrocarbons following ingestion or dermal absorption includes persistent atelectasis and petechial haemorrhage. A study carried out in India showed that there was impairment of lung function. The Forced Vital Capacity (FVC), Forced Expiratory Volume in one (1) second (FEV1) and Peak Expiratory Flow (PEF) declined significantly with increasing years of work among pump station workers compared to others. Cigarette smoking appears to accelerate the impairment, while exposure to automobile exhaust and fuel vapors impairs lung function in a time dependent manner (Chawla and Lavania, 2008). The study also concluded that, petrol filling pump attendants have higher risk to occupational health hazards outlined above through inhalation of the volatile fraction of petroleum components during refueling (Chawla and Lavania, 2008).

1.3 Problem statement

Petrol (gasoline) is a complex combination of hydrocarbons. About 95% of the components in petrol vapor are aliphatic and alicyclic compounds and less than 2% aromatics (Kesavachandran et al, 2006). The benzene content of petrol has typically been in the range of 1-5%, but may have risen following the removal of lead additives. Typical 8 hour benzene exposure concentrations in distribution and retail operations average less than 1 part per million (ppm), although exposures can reach 2-3 part per million (ppm) for shorter (say: 30 – 120 min) periods (Kesavachandran et al, 2006). In Tanzania occupational safety and health of petroleum filling pump attendants need to be addressed. The regulatory framework which exists in Tanzania regarding petrol station concentrate only on quality of petrol and the price control and that is done by the Energy and Water Utilities Regulatory Authority (EWURA, 2008). The authority does not cover the health of workers. Petroleum filling pump attendants occupational exposure to petroleum products and its health effects is not well established. Lack of awareness and lack of protective measures during work among petroleum pump workers may have shown to increase lung function abnormality among them (Chawla, 2008). In Tanzania Petroleum pumping is done by dispensing equipment without protecting workers from direct contact and inhalation of vapors when refueling automobiles and discharging oil tankers. Petroleum filling pump attendants work bare handed, without face masks or respirators and goggles on their daily activities. Moreover these workers are normally hired to work like in any other job, there is no formal qualification needed. (Even level of education is not necessary as you know how to read and write). All these factors contribute significantly to the higher risk of exposure and consequently to the health effects. The task of supervising the existing regulatory framework is supposed to be done by the Department of Occupational Safety and Health, but it has never been done due to lack of funds and shortage of staff. The major health problem found affecting petroleum station pump attendants is respiratory health problem and it has been shown that air quality guidelines are necessary to safeguard petroleum station environment and the petroleum filling workers (Singhal et al, 2007). The same is the case in Tanzania; there are no air quality guidelines to safeguard petroleum filling environment and petroleum station pump attendants. So there is a

need to study pulmonary function and other factors among petroleum pump attendants in order to find out how it is associated with exposure to petroleum products. The findings of this study are expected to be of importance to Department of Occupational Safety and Health, petroleum companies and petroleum filling stations so that they may take appropriate measures to safeguard the health of petroleum pump attendants.

1.4 Research Questions

The study was carried out aimed at giving answers to the following questions:

- What is the proportion of petroleum filling pump attendants with reported acute and chronic respiratory health problems?
- What is the proportion of petroleum filling pump attendants regularly using personal protection equipment?
- What is the proportion of petroleum filling pump attendants who are exposed to other factors or work processes potentially harmful to the lungs?

1.5 Significance of the study

Petrol pumping is associated with high risk of respiratory problems. Therefore this study has led to the determination of the magnitude of the respiratory health problems and associated factors among petroleum filling pump attendants in Dar es Salaam. The findings of this study are important in addressing prevention and control of occupational hazards facing petroleum filling pump attendants in Da res Salaam and the whole country. The results of study are also of importance to companies that employ petroleum filling pump attendants, and to policy makers in our country. It is also a basis for safeguarding the public health in the country at large. Also further research on the health status of public workers can be carried out based on this study.

1.6 Research Objectives

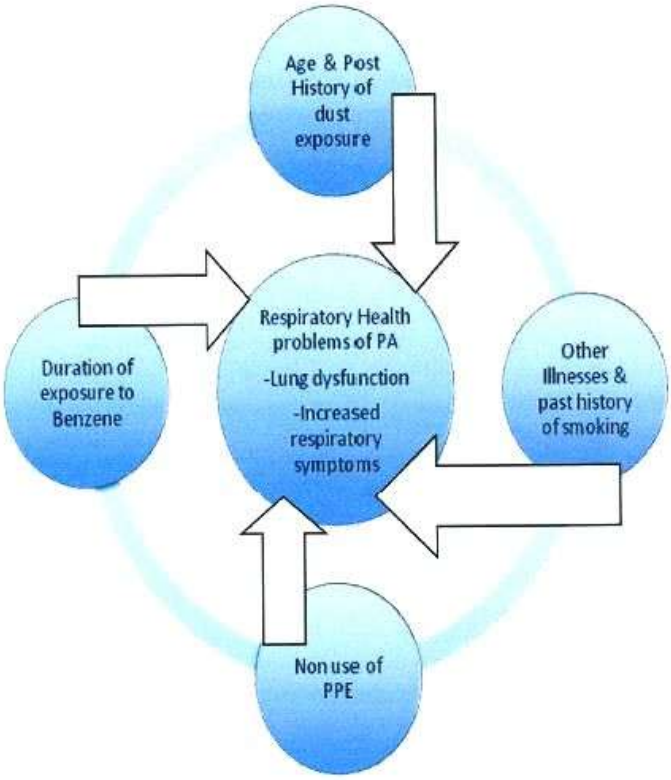
1.6.1 *General objective*

To assess respiratory health problems and related factors among selected petroleum filling pump attendants in Dar es Salaam.

1.6.2 *Specific objectives*

1. To determine the proportion of petroleum filling pump attendants and office workers with pulmonary dysfunction.
2. To assess the respiratory health symptoms among petroleum filling pump attendants and office workers.
3. To assess the use of personal protective equipment among petroleum filling pump attendants.

1.6.3 Problem Analysis Diagram



*PA - Petroleum filling pump attendants

*PPE – Personal protective equipment

- Age, socioeconomic status, occupation are important variables that may contribute to the increase of respiratory symptoms among petroleum pump attendants.
- The past history of dust occupation, duration of the workers to the dusty occupation may also contribute to the elevated respiratory symptoms.

- Other illnesses such as bronchitis, heart problems, tuberculosis and HIV/ AIDS may significantly affect the respiratory health problem of workers.
- The history of cigarette smoking either being current smokers on ever smoked have shown to affect significantly the respiratory healthy problems of workers.
- Use of personal protective equipment (PPE) where engineering and environmental control fail have shown to protect workers from exposure hazardous to their health.
- Duration of exposure to petroleum products is independent variable capable of causing respiratory health problems among petroleum pump attendants.

CHAPTER TWO

2.0 Literature review

2.1 The effect of petroleum products on humans

Occupational exposure to petroleum fumes have been reported to have toxic effects on various body organs and systems. Organs such as heart, lungs, skin and kidneys are affected by these toxic effects resulting in various diseases and different forms of genotoxic, mutagenic, immunotoxic, carcinogenic and neurotoxic manifestations (Becker et al, 1985). Pump attendants are exposed to petroleum fumes and have higher risk to pulmonary diseases through inhalation of vapours during refueling than other workers. Most occupational lung diseases are caused by repeated, long-term exposure to certain irritants that may have lasting effects even after exposure ceases. Occupational lung diseases are preventable, although smoking can increase both the severity of an occupational disease and the cancer (NIOSH, 2008). When a person is breathing the lungs take in oxygen and deliver it to the bloodstream. That way the cells in the body get oxygen to work and grow and to get rid of carbon dioxide. During a normal day, a healthy person breathes nearly 25,000 times. People with lung disease have difficulty breathing. These problems may prevent the body from getting enough oxygen (Koren, 1995). The air contains mostly oxygen and nitrogen, but also contains particulates (air pollutants) that can hurt lungs, such as bacteria, viruses, tobacco smoke, car exhaust and other pollutants. Some recent studies suggest that some air pollutants like car exhaust may contribute to occupational asthma, lung cancer other lung diseases (Vigotti, 1999). Materials inhaled in the workplace can lead to all the major chronic lung diseases. So identifying workplace-related particles that can cause disease is important because it can lead to cure and prevention for others, because one respiratory disease may have several occupational causes (Beckett, 2009). Occupational asthma is caused by inhaling certain irritants in the work place, such as dusts, gases, fumes and vapors. It is characterized by common asthma symptoms such as a chronic cough and wheezing. Occupational asthma is a reversible condition when diagnosed at an early stage as reported by Guidelines for the Diagnosis and Management of Asthma (2002). Gas station workers who pump gasoline are

liable to absorb not only the products present in the fuel fumes, but also the products emitted by engines (Santos-Mello et al, 1992). Hydrocarbons like benzene, metals like lead and volatile nitrates have shown to produce harmful effects on the bone marrow, spleen and lymph nodes. They also destroy or inhibit the hematopoietic component in the red marrow (Marieb, 1995). Benzene, which is an aromatic hydrocarbon contained in petroleum is known to introduce leukemia (Austin et al, 1988). According to the International Agency for Research on Cancer (IARC), the exposure to gasoline vapors is classified as carcinogenic to humans, especially on the basis of the well-established carcinogenicity of some components such as benzene (Carere et al, 1995). Long-term exposure to benzene – a human carcinogen may result in consistent structural and numerical chromosomal aberration in lymphocytes and bone marrow cells which may be observed for at least five (5) years after cessation of occupational exposure. This chemical substance has a role as leukaemogen.The situation is different in developed countries where exposure to benzene is now subjected to very strict limits by ensuring protection measures are enforced. For example in Italy, Genoa community directive requires the employer, where there is a risk concerning the safety or health of workers to avoid their exposure to carcinogens or to reduce it as low level as possible by abiding with the rules of personal protection (Chilcott, 2007). In this case the distributor is required to ask the supplier to supply petrol with the lowest possible benzene content, together with gas and fumes recovery devices to be fitted to the distribution system, in order to protect the health of its employees in petroleum filling stations it operates. In most developing countries, pump attendants are working more than eight (8) hours a day. This has resulted to more exposure thus higher doses of benzene with implications of being at higher risk of chronic pulmonary diseases and various cancers (Singhal et al, 2006). The daily use of petroleum products both in and outside petroleum industries may have effects on users, especially those who are occupationally exposed than those who do not work in these industries (Smith et al, 1993). There is linkage between lung cancer and working as filling station attendant, as it was the exceeding cause of death in men employed in retail oil and gasoline stations in Denmark in 1970 (Grandjean et al, 1991). Workers in a variety of occupational settings have the potential to be exposed to hazardous substances. They can be present in the form of gases, vapours,

fumes and mist or particles. Exposure can take place through inhalation as the first route and can also take place through dermal absorption or ingestion. Most workers are exposed to these substances and illness in some of them can be attributed to the exposure (Keshava et al, 1999). Gas station workers who pump gasoline are liable to absorb not only the products present in the fuel fumes, but also the products emitted by engines (Santos-Mello et al, 1992). In the study done by Uzma et al, in 2008 it was indicated that, long-term exposure to solvents and air pollutants can lead to toxic effects on respiratory, haematological and thyroid function. Therefore improved detection and prevention technologies are needed to answer environmentally related questions for petroleum filling station workers. Automobile exhaust chemicals such as benzene, lead, other heavy metals, carbon monoxide and volatile nitrites have been shown to produce harmful effects on the blood, bone marrow, spleen and lymph nodes. The United States National Institute for Occupational Safety and Health (NIOSH) has recommended an occupational exposure limit in air of 0.1 part of benzene per million parts of air (ppm). The Occupational Safety and Health Administration's (OSHA) in the United States legally enforceable limit is an average of 0.1 part per million (ppm) over the standard 8 (eight) hour work day, 40 (forty) hour work week (Jaffe et al, 1994). In the study on occupational contribution to the burden of Chronic Obstructive Pulmonary Disease (COPD) by Balmes (2005) it was concluded that, the biological plausibility of the capacity of occupational exposures to irritating dusts, gases and fumes to cause chronic obstructive pulmonary disease is high. Epidemiological studies have shown that prolonged diesel exhaust exposure can impair pulmonary function, causing pulmonary inflammation: i.e. emphysema, pneumonia influenza and other chronic obstructive lung disease (Mauderly, 1994).

2.2 Other Causative Factors in Occupational Health Hazards

Cigarette smoking has shown to reduce lung function to pump attendants more than non smokers. For example, in the study done by Edward and Priestly (1993) assessed occupational exposure in petroleum workers employed in suburban petroleum retail outlets, found that there was significant increase of sister chromatid exchange with combined exposure to petrol and cigarette smoking but not with either factor alone. Also

emissions resulting from the internal combustion of automobile engines produce cytotoxic and genotoxic properties. Pollutants from diesel exhaust (hydrocarbons, oxides of nitrogen and carbon) have been shown to cause symptoms like chronic coughing, wheezing and breathlessness and at high ambient concentrations a well defined and marked systemic pulmonary inflammatory response is also observed (Hadnagy and Seemayer, 1998).

2.3 Overall Effects of Occupational Exposure to Petroleum Products

Various occupational exposures to petrol and diesel products have been shown to affect different systems of the body. So filling station pump workers are continuously exposed to the organic and inorganic substances present in petrol. The average daily exposure to these chemicals generally exceeds about 10 hours per day. In India, some attendants have been working for more than ten years (Singhal et al, 2006). In different, researches on benzene results have shown that, benzene exposure is one of the most fatal risks petrol attendants have to face every day. For example in Brunei and Lucknow in India the studies stressed for the need for pump attendants to be educated about health hazards they are exposing themselves on the course of their daily work. In the study carried out in Calabar, Nigeria (2006), on the effect on petroleum products inhalation on some haematological indices of fuel attendants the result have shown that, exposure to petroleum fumes decreases red cell indices in a manner that is duration dependent. Thus it can be concluded that inhalation of petroleum fumes causes depression of total white blood cells count as well as red blood cell count and its dependent haematological indices namely Packed cell volume (PCV), Red blood cell (RBC), Haemoglobin (Hb), Mean corpuscular haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC) and White blood cells (WBC) (Okoro et al, 2006).

In the study which was done in Nigeria on chronic exposure to petroleum products on petroleum station attendants, due to inhalation and skin exposure there were symptoms of abdominal pain, headache, eye irritation, dizziness and chest pain. Due to oral exposure to petroleum there were symptoms of constipation, nausea, sometimes watery stool, cough, chest pain, increased sputum production and itching throat. The findings suggest that, chronic

exposure to petroleum products may have deleterious effects on the health of the petroleum filling station attendants (Akintola et al, 2005).

2.4 The Prevailing Situation in Tanzania

Tanzania cities and towns are characterized by mushrooming of petroleum filling stations along the main highways and sometimes in residential areas. Subsequently, there are many people who are employed as petroleum filling pump attendants in these areas. The average daily exposure to petroleum products exceeds about 8 to 10 hours a day and some of the attendants have been working for more than 15 years. They experienced repeated exposure to fumes evaporating from petrol, diesel and kerosene with little or no personal protection from direct contact and inhalation. Naturally they are unaware of the situation, they are hired and work as pump attendants because of economic hardships a home and lack of further education for some of them. As has been the case of India, those who have been working for a long time they are at high risk of experiencing respiratory health problems. They need health education before being hired and on job training to make them aware of the hazardous chemical substances commonly emitted in petroleum filling stations in order to protect themselves. There is no cooperation between local and international petroleum companies, at least to exchange ideas about safety and health of petroleum filling pump attendants, safety on petroleum business and general updating of working conditions of all petroleum filling pump attendants in local and international petroleum companies. In most local petroleum companies jobs are not permanent, they hire and fire and some of petroleum filling pump attendants are given a renewable contract of six months to one year. Some of local petroleum filling stations do not have safety guidelines placate in place for the attendants to observe. This makes petroleum filling pump attendants unaware of the danger of daily exposure. It is important to have a system of voluntary registry to report occupational respiratory diseases, as it seemed underreported in many countries. As it was reported in Catalonia, that information was lacking on the incidence of occupational respiratory diseases, a surveillance programme based on voluntary reporting on the incidence and characteristics of occupational respiratory diseases (Orriols, 2006). Occupational respiratory diseases can be prevented. The best way is to avoid

inhaled substances that cause lung diseases, as recommended by the Guidelines for the Diagnosis and Management of Asthma (2009). These include the following:

1. Do not smoke. Smoking can increase the risk for occupational lung disease.
2. Wear proper protective devices, such as facial masks, when around airborne irritants and dusts.
3. Evaluate lung function with spirometer.
4. Employers - educate your workers concerning the risks of lung disease.
5. Employers – hire a specially – trained occupational health expert to investigate your work environment for risks for occupational diseases.

In the United Kingdom there are several measures on petrol filling stations dispensing control which are good examples and it is possible to follow them in Tanzania. For example, petrol should dispensed only by means of dispensing equipment of an appropriate standard into the fuel tanks of internal combustion engines (i.e. on vehicles, motorbikes, boats, planes, mowers etc) or to appropriate marked or labeled portable containers suitable for keeping petrol. As far as reasonably practicable, persons under the age of 16 years should be denied access to petrol. Petrol should be dispensed by using fuel cards, under Attended Self-Service Operation (ASS) or Unattended Self-Service Operation (USS), as documented by Agency for Petrol Filling Stations – Dispensing Control Measures (2009). This is to make sure that everything is being done according to safety and health regulations on petroleum products.



A pump attendant operates petrol dispenser without necessary protective gears at a petroleum filling station.

CHAPTER THREE

3.0 Research methodology

3.1 Study Design:

This cross-sectional comparative study included the use of questionnaire, interviews about exposures and lung function measurements. The design was chosen due to limited resources and time available for this study. The study was done among petroleum filling pump attendants and office workers nearby who were on duty during the survey period.

3.2 Study area: Dar es Salaam

Dar es Salaam city is located at 6048 south, 390 17 East (-6.8000, 39.2833) of the county (Tanzania).The city is situated on a massive natural harbor on the eastern Indian Ocean cost of Africa. Administratively, Dar es Salaam City is divided into three (3) Municipal councils of Kinondoni to the north, Ilala in the centre and Temeke in the south of the Region. The City is further divided into seven divisions, 73 Wards and a total of 302 Hamlets. Filling stations in these municipalities are widely spread at the central part and at the main trunk roads to the South and North parts of the City. Social services include health, education, social welfare, urban and rural water supply, solid waste management and cooperative societies. Economic activities include heavy and light industries, small scale farming, Cooperate and Microfinance banking, Stock exchange activities, tourism activities and Cargo handling activities at Dar es Salaam Harbor.

3.3 Study Population

The population of this study included all petroleum filling pump attendants in the selected petroleum filling stations. This group was selected as the exposure group, while office workers in public and private organizations were selected as non- exposed group.

3. 3.1 Inclusion criteria

- Petroleum filling pump attendants aged 18 – 59
- Secretaries, office assistants, messengers and tea makers aged 18 - 59

- No history of Tuberculosis or other chronic infectious diseases
- Those who granted consent
- Those who have been working continuously for more than six months

3.4 Sampling Methods

Selection of study participants

The selection of study participants was made after doing a walk through survey carried out along the high ways and main roads in the three municipalities i.e. Kinondoni, Ilala and Temeke in Dar es Salaam City. Petroleum filling stations were listed according to leading petroleum companies. Also several public and private offices which were nearby were selected. 26 petroleum filling stations and 39 public and private offices were conveniently selected for study. This is because some owners of petroleum filling stations, petroleum filling pump attendants and some of office workers were not willing to participate. Therefore 12 petroleum filling stations, one (1) public office and one (1) private office gave the consent. Petroleum filling pump attendants and office workers who were present during visitation were included in the interview and sample of 139 (97 petroleum filling pump attendants and 42 office workers) was reached.

The selected petroleum companies and petroleum filling stations real names were not revealed due to security reasons but given initial names i.e. company A, B, C, D and E as shown in table 1.

Table 1: Petroleum companies, number of filling stations, selected filling stations, studied filling stations and studied petroleum pump attendants

Petroleum Company	Number of filling stations	Selected filling stations	Studied filling stations	Studied pump attendants
Company A	20	8	1	8
Company B	20	8	4	32
Company C	15	5	3	21
Company D	6	3	3	20
Company E	5	2	1	16
Total	66	26	12	97

The selected public and private offices were named as office F and office G respectively. Office workers were selected as comparison group because they do not handle petroleum products; they work in the office environment where there is no smell of petroleum.

3.5 Data Collection Techniques:

The research study was conducted qualitatively and quantitatively. Collection of data was done through questionnaire, interviews and experimental work.

Respiratory health questionnaire:

We conducted the respiratory health survey of 97 petroleum pump attendants and 42 office workers through face to face interview using a questionnaire. The questionnaire consisted of three parts including personal and work characteristics, respiratory health symptoms and smoking habit. A modified version of the British Medical Research Council questionnaire was used for respiratory health questions. The questionnaire was prepared in English and was translated in Kiswahili, the national language of Tanzania before it was used. The questionnaire was pre-tested among 30 selected petroleum filling pump attendants and discussed for clarity of questions before the study started. The questions on personal and work

characteristics include sex, age, height, educational level, employment history, years worked in petroleum filling station, and years worked elsewhere. Respiratory health symptoms included questions on cough, breathlessness and wheezing. The responses required were either 'yes' or 'no' for having symptoms or not having symptoms respectively. Questions on cough were whether a person experience cough in the morning, cough during day and night, and as much as 4-6 times a day for four (4) or more days in a week and cough for most of days for as much as 3 consecutive months or more in a year. Cough with sputum first thing in the morning, during day and night, and as much as 4-6 times a day for more than a week and whether that takes most of days for as much as 3 consecutive months or more in a year. Questions on breathlessness were based on whether a person experiences breathlessness when hurrying on level ground or walking up slight hill, walking with other people of their own age on level ground and stop for breath when walking at own pace on level ground. Questions on wheezing were whether a person had attacks of chest tightness and experiences wheezing. The subjects were asked whether they had bronchial asthma and or other chronic illnesses such as Tuberculosis and Bronchitis. Questions on acute symptoms were elicited as whether a worker had the following symptoms: dry cough, shortness of breath, runny nose, irritated nose and sneezing during or after the previous shift. Smoking status included questions on whether a person was smoking at the time of the study (current smoker), whether he had smoked previously and stopped more than a year ago (ever-smoker), the year he had stopped, and number of cigarettes smoked per day. For current smokers the number of cigarette packets per year was calculated by multiplying number of cigarettes smoked per day times duration of smoking in days divided by 20. Never smokers were defined as individual who had never smoked. Questions on other pulmonary diseases which might have confounded our results were elicited. A person was asked whether he had injury or operation affecting chest, whether he had any of the heart problems, bronchitis, pneumonia, pleurisy, pulmonary tuberculosis, bronchial asthma or any other chest problems in the past three years. Those found with any of the mentioned pulmonary problems were excluded from the study.

3.6 Lung Function Tests

Lung (Pulmonary) Function Tests were carried out using an electronic computerized spirometer (Easy One Portable Spirometer) according to the guidelines recommended by the American Thoracic Society and the European Respiratory Society. The questionnaire was filled up and relevant data (name, age, sex, height, weight, occupation, smoker or non smoker) was recorded. The spirometer was calibrated each day prior to use. The subject was connected to the mouthpiece and was asked to breath in and out to familiarize himself with the equipment. During the tests the subjects were adequately encouraged to perform their optimum level and also a nose clip was applied during the entire maneuver. Tests were repeated three times and the best results were considered for analysis. The parameters measured by the apparatus were Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1) and Peak Expiratory Flow (PEF).

3.7 Experimental Variables

i. Dependent variables used:

- Acute and chronic respiratory symptoms
- Lung function using Peak Expiratory Flow rates
- Chronic Obstructive Pulmonary Disease

ii. Independent variables used:

- Age
- Cigarette smoking (Current smoker, ever smoker and never smoker).
- Past history of dust and fumes exposure
- Duration of working as pump attendant or as office worker
- Use of personal protective equipment (PPE)

3.8 Ethical consideration

The ethical approval was obtained from Research and Publication committee of the Muhimbili University of Health and Allied Sciences (MUHAS). The permission to conduct the study was obtained from the Dar es Salaam Regional Commissioner's Office and Dar es Salaam City Council, Local and International Petroleum Companies, Public and Private Offices. The participants were asked for their consent orally after being informed on the aim

and objectives of the study. They were assured that names would not in any case be exposed and the information provided by them will be confidential but would only be used to improve the health of petroleum pump attendants

3.9 Limitation of the Study

In this study the major limitation was on recruitment of respondents for carrying out the research in the three districts of Dar es Salaam region. Only two international petroleum companies responded well and three local petroleum companies gave consent. Another problem faced were the delays due to lack of cooperation, total reluctance of some owners of petroleum stations and some respondents to provide information.

3.1.0 *Planning for Data Processing and Analysis*

3.*10.1* Data processing

The responses to the closed ended questions were coded every day after data collection while those of open ended questions were coded after completion of data gathering (at the end of collection exercise).

3.*10.2* Data analysis

SPSS was used to get means and variance of lung function indices among petroleum filling pump attendants and office workers. The differences were significant when P values were less than 0.05. Regression analysis for Peak Expiratory Flow while controlling for age, height, smoking and duration of work were computed to find the difference between petroleum filling pump attendants and office workers. Proportion was determined among categorical variable and comparison between petroleum filling pump attendants and office workers were done using Chi Square test. Peak Expiratory Flow (β values) and results were summarized on a table.

CHAPTER FOUR

4.0 Results

4.1 Social Demographic Characteristics of the Sample Population

This study covered a total of 139 respondents including 97 petroleum pump attendants and 42 office workers. This means the petroleum pump attendants comprised of 69.8% while office workers make 30.2% of the total number of respondents. The age distribution of the respondents, sex, marital status, working period, smoking status and level of education are shown in Table 2. The mean age of the study populations was 38.80. There were more male employees than females in both groups of sample population. Cigarette smoking among filling station pump attendants is 25 (25.8%) and office workers 2 (4.8%).

Table 2: Social Demographic Characteristics

Characteristics	Petroleum pump attendants N = 97	Office workers N = 42
Age mean (SD)	32.5 (8.4)	36.8 (8.7)
Sex		
Males	60 (61.9%)	25 (59.5%)
Females	37 (38.1%)	17 (40.5%)
Level of education		
Primary	46 (47%)	3 (7.1%)
Above primary	51 (52.6%)	39 (92.9%)
Working period		
< 12 months	69 (71.1%)	8 (19.0%)
1 - 5 years	17 (17.5 %)	18 (42.9%)
> 5 years	11 (11.3%)	16 (38.1%)
Cigarette smoking		
Yes	25 (25.8%)	2 (4.8%)
No	72 (74.2%)	40 (95.2%)

Mean age of office workers is slightly higher than petroleum pump attendants.

4.2 Respiratory health problems

The study assessed the respiratory health symptoms to all respondents: petroleum filling pump attendants and office workers. This was done by categorizing them into acute respiratory health symptoms which were those symptoms a worker acquire while working or soon after the shift i.e. nasal irritation; throat irritation; sneezing and flu. Chronic respiratory symptoms were elicited as chronic cough (more than three months consecutively), asthma (chest tightness) and any other prolonged chest problem.

4.2. 1 Acute respiratory health problems

In case of acute respiratory health problems, the results indicated that out of 97 petroleum pump attendants 1 (1%) alleged to have experience nasal; irritation. Out of 42 office workers 41(100%) alleged to have experience nasal irritation.

4.2.2 Chronic respiratory health problems

All respondents reported not having any of the respiratory symptoms elicited. The workers reported that they were treated very well by the management as they were getting milk supplies whenever reported to the working shift as prevention for respiratory problems.

4.2.3 Use of Personal Protective Equipment (PPE) among petroleum pump attendants

Petroleum filling pump attendants were asked if they use personal protective equipment when working and whether they know the importance of using them. It was found that the proportion of petroleum pump attendants, who were using personal protective equipment, was 19 out of 97(19.6 %). The reasons for not using PPE included: personal protective equipment not being available for all petroleum filling pump attendants. This implies that filling station owners are not providing personal protective equipment to their employees. The other reason was feeling uncomfortable due to Dar es Salaam weather which is too hot to wear some personal protective equipment; such as face mask, gum boots, gloves and overalls.

Table 3: Mean spirometric values by place of work

Participant sex	Working code	FVC[1] Mean(SD)	FEV1[2] Mean(SD)	PEF[3] Mean(SD)
Male	Petroleum pump attendants (N = 55)	3.59(0.60)	3.02(0.49)	7.55(1.53)
	Office workers (N = 25)	3.43(0.64)	2.88(0.55)	6.43(2.02
Female	Petroleum pump attendants (N = 36)	3. 40(1.30)	2.70(1.37)	5.88(2.09)
	Office workers (N = 17)	2.79(0.68)	2.37(0.61)	5.25(1.24)
Total	Petroleum pump attendants (N = 91)*	3.51(0.94)	2.89(0.94)	6.89(1.94)
	Office workers (N = 42)	3.17(0.73)	2.67(0.62)	5.95(1.83)
P value		0.22	0.08	0.01

N = number of participants

SD– Standard Deviation

[1]FVC – Forced vital capacity

[2] FEV1 – Forced expiratory volume in one (1) second

[3] PEF – Peak expiratory flow

*6 petrol pump attendant missing due to unacceptable lung function indices

Table 3 shows that petroleum pump attendants seem to have higher lung function indices than office workers, however the observed difference is statistically significant only for PEF when compare male and female workers.

Table 4: Lung function indices by working period on the particular job

Working on the particular job	Working code	FVC[1] Mean(SD)	FEV1[2] Mean(SD)	PEF[3] Mean(SD)
< 12 months	Petroleum pump attendants (N = 63)	3.49(0.59)	2.98(0.52)	7.41(1.72)
	Office workers (N = 8)	3.49(0.90)	2.97(0.60)	6.23(2.03)
1 -5 years	Petroleum pump attendants (N = 17)	3.52(1.25)	2.57(1.13)	5.59(1.95)
	Office workers (N = 18)	3.35(0.49)	2.78(0.46)	6.21(1.81)
> 5years	Petroleum pump attendants (N = 11)	3.63(1.82)	2.89(2.03)	5.89(1.98)
	Office workers (N = 16)	2.81(0.74)	2.41(0.72)	5.52(1.77)

N = number of participants

SD– Standard Deviation

[1]FVC – Forced vital capacity;

[2] FEV1 – Forced expiratory volume in one (1) second

[3] PEF – Peak expiratory flow

4.2.4 Mean values for the lung function

Table 4 showed that about 70 % of petrol pump attendants have been working for less than 12 months. 1. There was no trend of variable change for forced vital capacity, forced expiratory volume in one second and peak flow volumes for years worked.

2. Significant association between Peak Expiratory Flow values and working duration: One way analysis of variance examining the association between lung function values (parameters) and duration of work. 3. Duration of work was put into three categories; less than a year, 1 – 5 years and above 5 years. The results are presented in the following table:

Table 5: Mean values for FVC, FEV1 and PEF by work period of the study population

Working period on the particular job		FVC	FEVI	PEF
1 year (71)	Mean(SD)	3.5 ±0.6	3.0 ±0.5	7.3 ±1.8
1-5 years (35)	Mean(SD)	3.4 ±0.9	2.7 ±0.8	5.9 ±1.9
>5 years (27)	Mean(SD)	3.1 ±1.3	2.6 ±1.4	5.7 ±1.8
Overall (133)	Mean(SD)	3.4 ±0.9	2.8 ±0.86	6.6 ±2.0
F		1.51	2.54	10.93
P		0.22	0. 08	< 0.01

Results of multiple regression analysis of PEF on Age, Sex, Working duration, Cigarette smoking, height, weight and type of work (1=Pump attendant, and 0=Office workers) show

that age and weight were not influencing Peak Expiratory Flow (PEF) significantly. The final regression model is given by:

PEF = - 0.94 sex – 0.6 wp – 0.91cs + 0.06 ht

That is longer working period (wp) is associated with low Peak Expiratory Flow (PEF) values as shown in the table below:

Table 6: Multiple regression analysis showing relationship between PEF and other variable

Dependent Variable: PEF before work

Variable	B	Std Error	T	P value
(Constant)	2.062	4.529	.455	0.650
Age	-.013	.019	-.671	0.504
Sex	-.944	.362	-2.61	0.010*
Working period	-.604	.194	-3.12	0.002*
Smoking cigarette	-.908	.389	-2.33	0.021*
Height	.062	.025	2.46	0.015*
Weight	-.003	.012	-.261	0.795
Type of work	-1.350	.583	-2.317	0.022*

CHAPTER FIVE

5.0 Discussion

The main objective of this study was to assess respiratory health problems affecting petroleum filling pump attendants in Dar es Salaam so as to improve the working conditions in their working places. The discussion will focus on the following aspects: 1. The proportion of petroleum filling pump attendants with respiratory health problems 2. Symptoms of respiratory health problems among petroleum filling pump attendants 3. The use of personal protective equipment and its importance among petroleum filling pump attendants.

The major finding of this study conducted in Dar es Salaam petroleum filling stations is that there is possibility of reduced lung function when working as petroleum filling pump attendant. There is significantly loss of 1.35 litres of Peak Expiratory Flow (Table 6). This implies that workers in the petroleum filling stations have acute respiratory problems due to petroleum exposure. However, this study showed that most of petroleum filling pump attendants reported to have no chronic respiratory symptoms. Due to high air clearance of the petroleum filling stations it might explain the findings since ventilation of the emitted volatile organic compounds from the pumps is simply diluted by the air due to the opening. Our findings might be explained by the young population employed in the field since most of petroleum pump attendants reported to have been working for less than 12 months (69 .2%). The exposure duration is too little to have caused the chronic respiratory problems. Study done in India by Singhal et al (2007) has shown that workers (petroleum filling pump attendants) with less than five years had little chance to develop respiratory health problems (pulmonary dysfunction). Through assessment of Forced Vital Capacity, Forced Expiratory Volume in one second and Peak Expiratory Flow it has been shown that there was significant impairment of lung function with increasing years of work as petroleum filling pump attendant compared to other workers (Chawla et al. 2008).

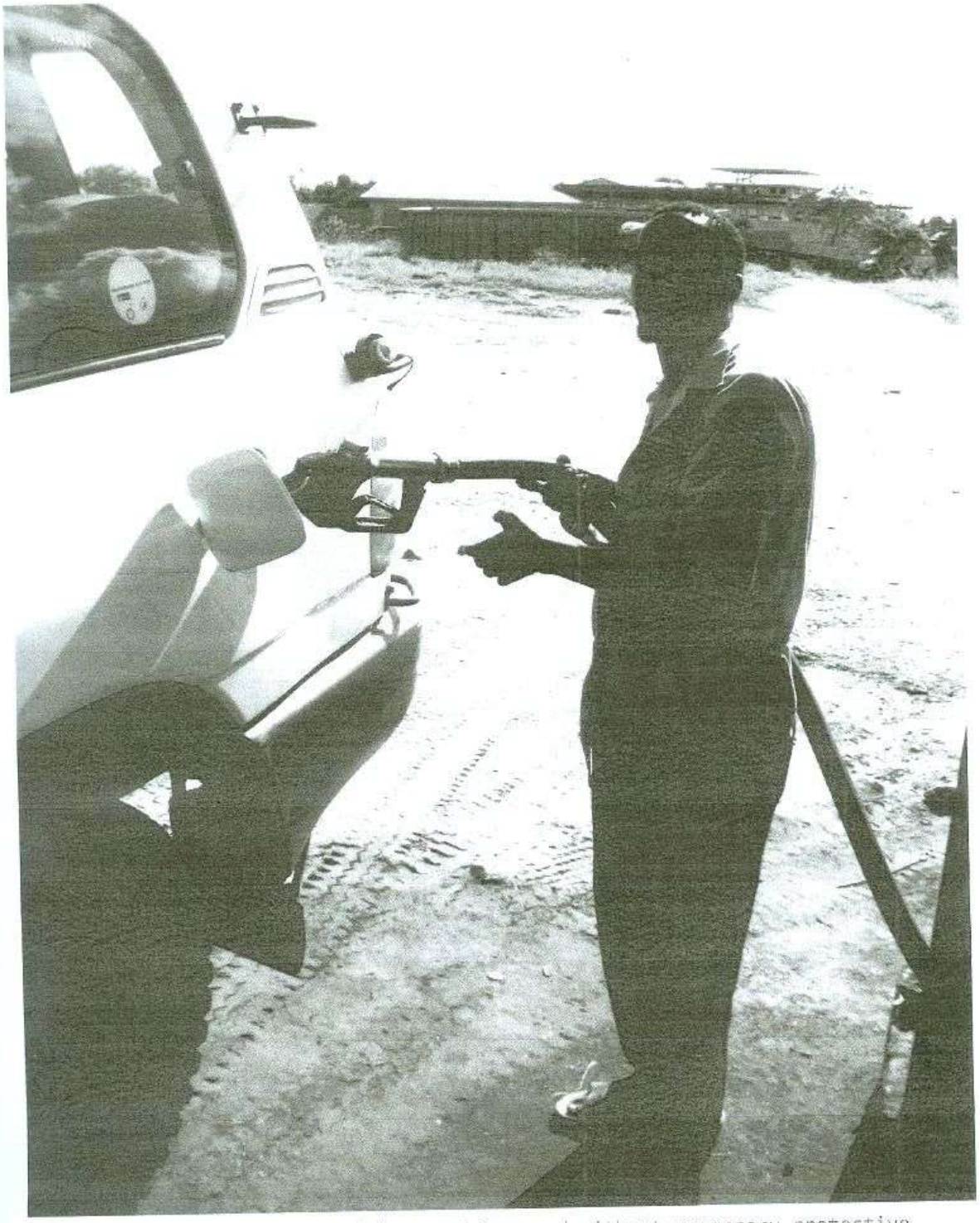
This variation was probably arisen due to fact that some of the petroleum filling pump attendants had the accessibility to information about respiratory health problems (health

hazards) and the opportunity to practice prevention measures. All petroleum filling pump attendants have attended prior and on job training about selling petroleum, use of petroleum dispensers, customer care and use of personal protective equipment for supervisors. In other study by Balmes (2005) it was shown that biological plausibility of the capacity of occupational exposure to irritating gases, fumes and dust to cause chronic obstructive pulmonary diseases is high. Also epidemiological studies by Mauderly, (1994) have shown that prolonged diesel exhaust exposure can impair lung (pulmonary) function.

However, results of this study have shown that some of petroleum filling pump attendants knew about symptoms of respiratory health problems and they wished prevention awareness to be taught and prevention standards to be practiced by each individual petroleum filling pump attendant at their working areas. The study revealed a big proportion of petroleum filling pump attendants who had no knowledge at all about prevention practices. However, those who had knowledge of prevention standards (petroleum filling station supervisors) were a small proportion among all petroleum filling station pump attendants in Dar es Salaam Municipality.

Use of Personal Protective Equipment among petroleum filling pump attendants:

Petroleum filling pump attendants are required to use personal protective equipment (PPE) which includes masks, gloves, boots and goggles. This study have shown that majority of petroleum filling station pump attendants 78 (80.4 %) are not using personal protective equipment and a small number of petroleum filling station pump attendants19 (19.6 %) knew the importance of personal protective equipment and they use them. In other studies it is said that petrol evaporates more readily in hot than cold countries as a result of this there could be minimization of direct health hazards to petroleum filling pump attendants which could have resulted from inhalation of petroleum vapors (Kesavachandran et al, 2006). In hot climate country like Tanzania it is observed that petroleum filling pump attendants do not wear personal protective equipment due to climate conditions and they are not aware of the risk exposure in the work places. Only supervisors who are responsible for overseeing the oil discharge from petroleum tankers have the habit of using personal protective equipment since



A pump attendant operates without uniform and without necessary protective gears while pumping petrol into a vehicle.

there is heavy discharge of petroleum vapors which poses danger to workers. Due to different reasons such as hot climate some of supervisors do not use personal protective equipment as instructed. Also it is observed in this study that only workers in the Petroleum Depot are under strict instructions and are required to use personal protective equipment while on duty. The study carried out by Kesavachandran (2006), showed that lack of health awareness and lack of protective measures during work among petroleum filling pump attendants may have led to lung function abnormality among them. It is clearly stated in Tanzania Occupational Safety and Health Act 2003 that there should be safe means of access and safe working place. Also UK regulations say that employers have basic duties concerning the provision and use of personal protective equipment (PPE) at work and this document, explains what employers need to do to meet the requirements of the personal protective equipment at Work Regulations (Health and Safety Executive, 1992).

Selection bias might have affected the results, since the population study comprised only petroleum filling pump attendants and office workers who were present during the study. That was due to the fixed short period of study as per University calendar and scarcity of financial resources, most of petroleum filling stations and offices could not be surveyed.

This study being cross-sectional comparative study cannot come up with a causal relationship between inhalation of petroleum vapors, exhaust fumes and respiratory health effects to petroleum filling pump attendants, but the statistical analysis performed helped in this evaluation. This study managed to show that being petroleum filling pump attendant is associated to the loss of 1.35 litres in Peak Expiratory Flow rate.

Due to low level of understanding of general health issues of most petroleum filling pump attendants some declined to give correct information despite of being assured that the information collected will be treated with great confidentiality. Also misconception of workers that the study aimed at assessing HIV/AIDS may also have made workers provide incorrect information. The owners of petroleum stations feared to lose workers as well as their

businesses. This caused reluctance among petroleum filling pump attendants to participate in the study for fear of losing their jobs.

Sample size could have been larger if all the conveniently selected pump attendants could agree to participate. A larger sample size would have yielded fairly robust results representation of the study population by increasing statistical power. However the sample size of the 139 yielded fairly robust results, that managed to show being petroleum filling pump attendant in the petroleum filling stations is associated with the loss of lung function by peak expiratory flow rate.

This study was done in three municipals of Dar es Salaam City only, but can be generalized to all petroleum filling stations in Tanzania because the situation of handling petroleum is the same all over the country. But generalization to other countries cannot be guaranteed because every country has its own petroleum business regulation depending on the level of economy of the country.

CHAPTER SIX

6.0 Conclusion and recommendations

6.1 Conclusion

Findings of this study have shown the following:

- Petroleum filling pump attendants have shown a significant loss of 1.35 litres of Peak Expiratory Flow.
- Majority of young people were noted to work for a period of less than 12 months, this implies too little chance to develop respiratory problems.
- The low prevalence of the use of personal protective equipment among petroleum filling pump attendants was established.
- Cigarette smoking was observed more to several petroleum filling pump attendants compared to other workers however, they used to smoke after working hours as it is forbidden to smoke within the premises and they did not know that cigarette smoking can accelerate pulmonary dysfunction.

6.1.2 Recommendations:

1. Awareness and practices about health hazards of petroleum and prevention have not reached all the petroleum filling pump attendants adequately. All stakeholders should advocate health education to petroleum filling pump attendants through adequate information during pre employment and on job training. Ensure regular supervision by department of occupational safety and health personnel.
2. The study recommends the employers (petroleum companies and petroleum filling station owners) to purchase, provide and supervise use of personal protective equipment to all petroleum filling pump attendants and improved procurement of personal protective equipment.

3. Future Research

   The study revealed that there is a need of collaboration between healthcare workers and petroleum business stakeholders for researching about 1) health conditions

affecting petroleum filling pump attendants. 2) working environment such as availability and accessibility of quality of health education in prevention of respiratory health problems. 3) importance of the use of personal protective equipment and general guidelines of training (pre-employment and on job).

REFERENCES

Akintola A, Ojo BA, Emeka P, Coker HAB, Sofola O 2005. Chronic exposure to Petroleum products on some Hematological Biochemical Parameters. Nigerian Quarterly Journal of Hospital Medicine NQJHM Vol. 15 (2) 2005: p p 77-82. Nigeria.

American National Institute of Health (ANIH) 2009. United States.

Austin H, Delzell E, Cole P 1988. Benzene and Leukaemia: a review of the literature and risk assessment. Journal of Epidemiology 127:419.

Balmes JR 2005. Environment and Occupational Medicine: Occupational contribution to burden of Chronic Obstructive Pulmonary Disease. 47 (2): 154 - 160.

Becker C E 1985; Klassen 1990; d'Azevedo P A 1996; Smith L H, 1996; Rabble G K and Wong O 1996; Ross 1996; Rothman, 1996. Leukaemia mortality by cell type in petroleum workers with potential exposure to benzene. Environment Health Perspective 104: 1381-1392.

Beckett M, 2009. An overview on Occupational Exposure of Workplace-related Particles and Respiratory Diseases.

Carere A, Antoccia A, Crebelli R, Degrassi F, Fiore M, Iavarone I, Isacchi G, Lagorio S, Leopardi D, Marcon F, Palitti F, Tanzarella C and Zijno A. (1995). Genetic effects of petroleum fuels: cytogenic monitoring of gasoline station attendants. 322, 1726.

Chawla A, Lavania AK 2008. Air Pollution and Fuel Vapors induced changes in lung Functions: Are Fuel Handlers Safe? India.

Chilcott R P 2008. Chemical hazard information, hazard identification, incident Management and Toxicological overview. Health Protection Agency (HPA). United Kingdom.

Chilcott R P 2007. Exposure to Benzene. Workers Safety and Health. Health ProtectionAgency. United Kingdom.

Edward J W and Priestly B G 1993. Sister-chromatid exchanges in lymphocytes of petroleum retailers. British Journal of Industrial Medicine, 50 (2): 144- 54. United Kingdom.

Expert panel report (EPR) updates 2002. Guidelines for the Diagnosis and Management of Asthma. NIH Publication No. 02 5074. Bethesda, MD: U.S.

Department of Health and Human Services; National Institute of Health; National Heart, Lung; and Blood Institute; National Asthma Education and Prevention Program. United States.

Grandjean P and Andersen O 1991. Lung cancer in filling station attendants Odense, Denmark.

Guidance for Petrol Filling Station – Dispensing Control Measures. 2009. United Kingdom.

Hadnagy W and Seemayer NH (1998). Cytotoxic and genotoxic effects of extract of particulate emission from gasoline-powered engine. Environ. Mol. Mutagen. 12: 385-396.

Health and Safety Executive (HSE). 1992. Guidelines to the Personal Protective Equipment at Work Regulations. United Kingdom.

International Agency for Research on Cancer (IARC) 1989. Monographs on the Evaluation of the Carcinogenic Risks to Humans. Vol. 45. Occupational Exposures inPetroleum Refining: Crude Oil and Major Petroleum Fuels. Lyon, France.

Jaffe and Badman 1994. Air pollutants: Automotive exhaust chemicals.

Keshava and Ong 1999. Overview on exposure to hazardous substances.

Kesavachandran G; Ratsogi S K; Anand M; Mathur N and Dhawan A. 2006. ' Lung Function Abnormality among petrol pump workers of Lucknow'. India.

Koren HS 1995. Association between Criteria Air Pollutants and Asthma. 103 Suppl. 6: 235-42. United States.

Management of Health and Safety Regulations (MHSR) 1999. Petrol Filling Stations Dispensing Control Measures. United Kingdom.

Martino-Roth MG (2002).Genotoxic evaluation through micronucleus in workers of car and battery repair garage. Mutation Res. 25: 495-500. Brazil.

Mauderly J L 1994. Environment Health Perspectives, vol. 102, pg 165 – 171.

The National Institute for Occupational Safety and Health (NIOSH) 2008. United States.

The Occupational Safety and Health Administration (OSHA) 2008. United States.

Occupational Safety and Health Agency Act 2003. Tanzania.

Okoro A M, Ani E J, Ibu J O and Akpogomeh B A 2006. Effect of Petroleum Products Inhalation on some Haematological Indices of Fuel Attendants in Calabar Metropolis, Nigeria. Journal of Physiological Sciences 21 (1-2): 71-75. Nigeria.

Orriols G , 2006. Surveillance on Incidence of Occupational Respiratory Diseases. Catalonia, Spain.

Santos-Mello R, Cavalcante B 1992. Cytotoxic studies on gas station attendants. Mutation Res. 280: 285-290. Brazil.

Singhal M; Halid F; Singhal S and Tandon OP 2006. Pulmonary Functions in petrol pump workers: A preliminary study 51 93): 244 – 248. Delhi, India.

Smith T J, Hammand S K, Wond O (1993). Health effect of gasoline exposure 1: Exposure assessment for US Distributers workers. Environment health perspectives 101: 13021. United States.

Uzma N, Salar BM, Kumar BS, Aziz N, David M A, Reddy VD 2008. Impact of organic solvents and environmental pollutants on the physiological function in petrol filling workers. International Journal of Environment. 5 (3): 139-46. India.

Vigotti MA 1999. Short term effects of exposure to urban air pollution on human health in Europe. The Air Pollution and Health: A European Approach (APHEA) Project. Epidemiology Prev. 1999. 23(4): 408-15.