OCCUPATIONAL INJURIES, RESPIRATORY HEALTH PROBLEMS AND RELATED FACTORS AMONG REFUSE HANDLERS AT TANGA CITY

Godson Markalio

A Dissertation submitted in partial fulfillment 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

October, 2008

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By

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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 ***"Occupational injuries, respiratory health problems and related factors among refuse handlers in Tanga City"*** in Partial Fulfillment of the Requirements for the Degree of Master of Public Health of the Muhimbili University of Health and Allied Sciences..

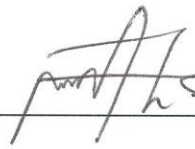
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Dedication

I dedicate this work to the occupational health specialists all over the country whose job makes workers at different level work safely and comfortably.

Abstract

In Tanzania, the health-related underpinnings of solid waste management still need to be addressed. Even the minimal regulatory framework which exists in this country for environmental protection and occupational health and safety is not fully enforced. Waste collection is by labor intensive systems with little, if any, worker protection from direct contact to injuries, respiratory problems and related factors. This study had the aims of exploring occurrence of injuries, respiratory problems and other related factors among refuse collectors and none refuse collectors. The cross-sectional study was carried out where 135 refuse handlers and 113 other workers were involved. Questionnaire was used to collect data on injuries; respiratory problems and use of personal protective equipment (PPE). Data were analyzed using SPSS version 15.0 computer program. Generally, prevalence of injuries and respiratory problems were higher among refuse collectors than in other workers. The proportion of exposure that has faced injuries was 47.4% while for other workers was 25.5%, the difference was statistically significance between the groups (P=0.0001). The group from refuse handlers had higher prevalence of acute respiratory problems such as dry cough (OR) =5.95, 95%, (CI=3.25, 10.88), flue OR=4.90, 95%, (CI=2.77, 8.67) and nasal irritation OR = 4.64, 95%, (CI=1.58, 8.28) while controlling for age and smoking status. With regard to chronic respiratory symptoms for refuse handlers and other workers there were not significantly different. On the use of PPE most respondents know that PPE are important but they don't use because they are not provided which means not available. Regarding hazard prevention measures there were provided for only 20% of facilities studied. From the study findings it is concluded that refuse handlers are highly affected by injuries and acute respiratory symptoms compared to other workers. Moreover there was less use of personal protective equipment among them. In addition the facilities do not provide adequate safety measures. This implies need to enforce laws and regulations to safeguard the health of workers that will involve the right to be training and of being examine periodically on their health problems.

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Abbreviations and acronyms

CBR	Contractors Registration Board
E&OHS	Environmental and Occupational Health and Safety
HBV	Hepatitis B Virus
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HWM	Hospital Waste Management
ILO-SAMAT	International Labour Organization- Southern African Multidisciplinary Advisory Team
MSW	Municipal Solid Waste
MUHAS	Muhimbili University of Health and Allied Sciences
OSHA	Occupational Safety and Health Act.
SPSS	Statistical Package for Social Sciences
PPE	Personal Protective Equipment
TB	Tuberculosis
US EPA	United States Environmental Protection Agency
UTI	Upper Respiratory Infection
WHO	World Health Organization
WHO AFRO	World Health Organization –Regional Office for Africa

Operational definitions

1. **Bruise** Damage to the superficial surface that can not lead into wound and which cannot prevent someone continues working and not necessarily requires treatment.

2. **Injury** means physical damage to the body or a body part that may bleed and make someone unable to continue working and it may require treatment.
3. **Personal Protective Equipment** (PPE) means all equipment (including clothing that provide protection against the weather) which is worn or held to protect against risks to health or safety

4. **Refuse/waste** means unwanted or unusable items, remains, or by-products, or household rubbish.
5. **Refuse/waste handler** means a person handling wastes for the purpose of disposing them in a pre-determined place say a dumping place or container (refuse bin) and scavenging for re-use or sale.
6. **Respiratory health problems** mean symptoms such as chest pain, coughing, shortness of breath, difficult breathing and coughing up sputum.

CHAPTER ONE

1.0 Introduction

1.1 Background information

Occupational injuries continue to be a serious problem affecting workers at different work settings and industries. It is poorly documented in both developed and developing countries. The magnitude of the problem worldwide as documented by the International Labour Organization showed 250 million workers sustain occupational injuries and 330,000 fatalities annually (Anan 1997). In addition, annually, an estimated 160 million new cases of work-related problems occur worldwide, including respiratory and cardiovascular diseases, cancer, hearing loss, musculoskeletal and reproductive disorders, mental and neurological illnesses. Among occupations contributing to the problem is solid waste handling during municipal solid waste management and refuses handling at different industries.

Municipal solid waste is a collection of discarded liquid and solid materials that serves as a breeding ground for bacteria and fungi (Perez *et al*, 2006). The generation of waste, collection, processing, transport and disposal of waste are important stages where human labour together with machines/equipment is involved. The nature and categories of wastes have effects on public health, aesthetic and environment at large (Rushton, 2003). If wastes are not handled with care and adequately they can cause injuries and those handling them or those scavenging in the waste dumps. Hardoy and Satterwaite 2006

noted that waste not managed properly and adequate may pose serious health and environmental risks. The overall goal of municipal waste management is to adequately collect waste and treat them in such a manner to improve and safeguard the public health and welfare, reduce waste generation and increase resource recovery and re-use, and protect environmental qualities.

Since waste is a complex mixture of different materials, some are intrinsically hazardous to health of individuals involved in the collection, transport, transfer and disposal of this waste. Some wastes can cause problems due to its nature of the working environment and the knowledge of refuse (waste) related health effects in other occupations. The handling of municipal solid waste can be expected to result in adverse health outcomes such as respiratory problems as the result of inhaling toxicant and irritant gases emitted by waste decomposition such as methane, hydrogen sulphide, sulphur dioxide, carbon dioxide and many others (Mahar & Thorne 1999).

Some studies among municipal solid waste handlers conducted in Europe and United States suggested that there is an association between job tasks in handling municipal solid waste and various respiratory, dermatologic and gastrointestinal health effects (Rushton, 2005 and Perez, 2006). This was also revealed by the study conducted by Gelin (1985) in United States among refuse collectors who underwent clinical evaluation of skin changes and injuries. It showed that almost 75% had palmer calluses a result of repeated pressure and friction. However those workers who protected their hands with gloves had practically normal skin, with minor or absent calluses. The majority of waste

collectors sustained work-related injuries each year. These may include sprains, abrasions and lacerations, fractures, and eye injuries.

Worldwide, refuse (waste) handlers are exposed to various health problems that originate from refuse or waste substances that they handle. Efforts to handle refuse aseptically differ between countries, the worst scenario being in developing countries, like Tanzania which lack proper enforcement of laws and regulations (Manyele 1996). Most developed countries have the regulations that protect health of refuse handlers for example the efforts by the US Environment Protection Agency (US-EPA) are well documented to date; include register of hazardous, toxic and biomedical wastes, appropriate legislation for managing different kinds of wastes, assessment of medical wastes treatment technologies e.t.c.

Waste collection is by labor intensive systems with little, if any, worker protection from direct contact and injury (Cointreau 2002). Solid waste collectors lift heavier loads, often to higher loading locations and in traffic conditions with significantly more dust and diesel exhaust pollution, than their high income counterparts.

In developing countries, the health-related problems of solid waste management still need to be addressed. Even the minimal regulatory framework which exists in most of these countries for environmental protection and occupational health and safety is not enforced. Large quantities of waste are uncollected.

In many developing countries, infectious medical wastes and toxic industrial wastes are not segregated from domestic waste, exposing the waste handlers to a wide array of risks. Moreover, in many of these countries, waste pickers commonly find their

livelihood through sorting and recycling of secondary materials. They are highly exposed to occupational health hazards, including contact with human faecal matter, paper that may have become saturated with toxic materials, bottles with chemical residues, metal containers with pesticides residue and solvents, needles and bandages from hospitals, and batteries containing heavy metals. Exhaust fumes from waste collection trucks traveling to and from disposal sites, dust from disposal operations, and open burning of waste all contribute to occupational health problems.

The susceptible group in refuse collection includes people with low occupational skills and low educational and socioeconomic groups The risk is greatest in developing countries where the contact between the solid waste worker and waste is greatest and the level of personal protection is not enforced. This was revealed in the study done by Akter *at al* 2007 whereby the waste disposal practice was found to be quite unsafe, and both clinical and non-clinical wastes were found to be thrown together.

To the researcher's knowledge, there is no information from East African countries regarding the health problems facing refuse handlers on municipal wastes. Hazardous and medical wastes are still handled and disposed together with domestic wastes, thus creating a great health risk to municipal workers, the public and the environment (Array and Seher 2007).

Since Tanga is among cities in Tanzania that has various premises such health facilities, industries, workshops, markets and social centers, it is expected that the practice of handling refuse may be worse because of care is not taken refuse collectors will be handling unsorted refuse. A lot of refuse are mixture of different material from different

facilities that require careful handling municipal wastes. Furthermore, Tanga is one of the Cities included in the national Sustainable Cities Programme to promote environmentally sustainable urban development in Tanzania. Through this project the Tanga City Council has been provided with two skip masters and 30 skip buckets. These facilities have greatly augmented the municipal council's solid waste collection facilities. To implement this project, a good number of refuse handlers were employed to collect refuse around skip buckets and in areas where there is no a skip bucket. Currently, their safety, health and working condition are not well known.

The purpose of this study is to determine the proportion of injuries, respiratory health problems and associated factors pertaining to refuse handling and to recommend possibilities for control measures.

1.2 Problem statement

In Tanzania, the health-related underpinnings of solid waste management still need to be addressed. Even the minimal regulatory framework which exists in this country for environmental protection and occupational health and safety is not fully enforced. Waste collection is by labor intensive systems with little, if any, worker protection from direct contact and injury; waste disposal is in ravines and wetlands near residential neighborhoods, and commonly is burned openly. Solid waste collectors lift heavier loads, often to higher loading locations and in traffic conditions with significantly more dust and diesel exhaust pollution, than their high income counterparts. Waste handlers

work informally at open dumps, typically bare handed. Waste sorting and recycling activities are typically conducted in micro and small scale enterprises, with old equipment and virtually no dust control or worker protection.

✓ The task of collecting these refuse and disposal is done by either municipalities or urban/towns through employing people to do the job. In other places people scavenge these refuse for recycling purposes (to earn living) and the number of scavengers increases daily. This has been pointed out by Medina (2004) in his study that many third world cities have a dynamic informal sector that includes informal refuse collection and scavenging. These activities provide income opportunities for migrants, unemployed, children, women and handicapped individuals. These scavengers are also exposed to the same hazards through scavenging.

The study done by Gonese in Bulawayo Zimbabwe (2001/2) revealed that during that period a total of 97 injuries occurred among cleansing section workers, 67 (73%) occurred in the refuse handling section, including one fatality. Most people employed to handle refuse are among the disadvantaged group. This has been shown by the study conducted in Jeddah city, Saudi Arabia (1) that assessed the health impact of workers employed in land filling which found that most were poor, ignorant and work in any job regardless the hazards that may result from such work. The major four health problems found were respiratory infections and/or allergy, eye infections, gastrointestinal tract (GIT) infections, and musculoskeletal injuries.

The scope of this study was to allow the investigation of injuries and respiratory health problems due to available resources. The study involved employed waste handlers and scavengers at municipal waste dump and other industries at Tanga City.

The findings from this study are expected to be of importance to the municipalities or companies that employ these people so that they may take measure to safeguard their health.

1.3 Research questions:

1. What proportion of refuse handlers who have been injured in the past three months?
2. What is the proportion of refuse handlers with reported respiratory symptoms?
3. What is the level of personal protective equipment among refuse handlers?

1.4 Problem justification

In developing countries particularly Tanzania, refuse handling has not received sufficient attention to protect the handlers from occupational hazards. It is obvious that, hazardous and medical wastes are still handled and disposed together with domestic wastes, thus creating a great health risk to refuse handlers, the public and the environment. Waste collecting, sorting, disposal and treatment are associated with a high risk of occupational injuries and respiratory problems.

Therefore this study will determine the magnitude of injuries and respiratory health problems and, associated factors among waste handlers in Tanga City. It is anticipated that the findings of this study may be important in addressing prevention and control of the health hazards facing waste handlers.

1.5 Objectives

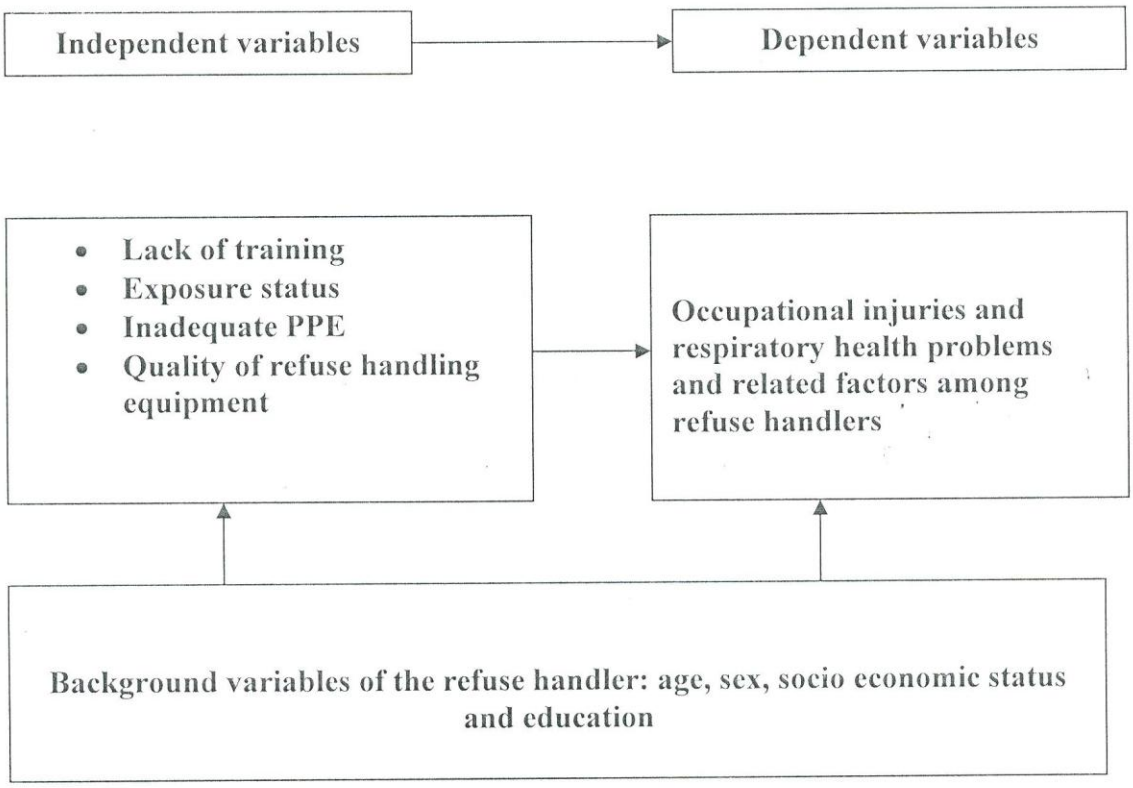
1.5.1 Broad objective

To assess injuries and respiratory health problems and related factors among refuse (waste) handlers in order to address control measures, to minimize the negative impacts on humans and the environment at Tanga City.

1.5.2 Specific objectives

1. To assess the proportion of refuse handlers with injuries that happened in the past three months ago.
2. To assess the proportion of refuse handlers with reported respiratory symptoms.
3. To assess the use of personal protective equipment (PPE) and the outcome variables among refuse handlers.
4. To determine the level of hazard prevention within the facilities where refuse handlers work.

1.6 A conceptual framework of health problems among refuse handlers



CHAPTER TWO

2.0 Literature review

Solid waste management (SWM) is a major problem in most developing countries of the world due to its ever growing and endless generation coupled with poor management. In the same vein, medical waste management (MWM) is yet to receive sufficient attention in the overall solid waste management and often times neglected. Though medical waste constitutes a small fraction of the municipal solid waste (MSW), the potential environmental and health hazards could be deleterious if not properly handled, the worst scenario being in developing countries (WHO, 1999). For example a survey of municipal waste management from 91 healthcare facilities in the southern Brazil, by Da Silva *et al* 2004, found that major emphasis was put to sharp waste and inadequate attention was given to the management of other types of medical waste. In Africa, the situation appears to be more critical as reports from around the continent indicate poor municipal waste management practices (Manyele, 2003), described MWM in Tanzania as being poor, further he posited that the general awareness on issues related to medical waste management was generally lacking among generators and handlers.

In Netherlands, most refuse collection is done by use of a closed refuse truck with an automatic lifting device to empty refuse holding containers (Kuijer and Frings, 2004). This technology is important because it minimizes health problems to refuse handlers. In the developing countries, there is a large workforce employed in waste collection,

sorting and disposal. Workers may be exposed to the same potential hazards as the general population, although the amount of exposure and risk may differ.

According to study done by Cointreau 1982, revealed that there are several factors that set municipal solid waste management in developing countries apart from management in industrialized countries. First, the types of materials that compose the majority of the waste are different. In developing countries, there is a much higher proportion of organics, and considerably less plastics. The large amount of organic material makes the waste denser, with greater moisture and smaller particle size (Cointreau 1982). A second difference is that technologies used in industrialized countries are often inappropriate for developing countries. Even garbage trucks are less effective because of the much heavier, wetter, and more corrosive quality of their burden (Cointreau 1982). Other technologies, such as incinerators, are often far too expensive to be applied in poor nations. Third, developing countries' cities are characterized by unplanned, haphazardly constructed, sprawling slums with narrow roads that are inaccessible to collection vehicles (Emily *et al* 2003). Finally, there is often a much smaller stock of environmental and social capital in developing countries. People are unaware or uncaring of cradle-to-grave solid waste management needs, being more concerned with more immediate problems such as disease and hunger.

✓The type of work varies between waste management options with some, such as landfill, incineration, sorting and recycling. The incidence of occupational accidents in waste collection workers has been found to be higher than the general workforce (Elliott et al, 2000). A study of the Norwegian practice of collecting organic waste fortnightly found

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that bin men can suffer breathing problems from exposure to bioaerosols containing endotoxins from bacterial and fungal spores that build up in rubbish (Kari 2003).

Apart from breathing problems, refuse handlers succumb to a number of injuries resulting from refuse. The type of injuries and the causes seem to vary by country, based on studies from Brazil (Gawryszewski and Rodrigues, 2003), Taiwan (Yang *et al,* 2001) and the USA (An and Dorevitch, 2001). For instance, the percentage of fractures among the medical diagnoses of the occupational accidents seems to be higher in Brazil (5%) and the USA (5–7%) than in Denmark (1%).

The percentage of cutting injuries among the causes of the occupational accidents seems to be much higher in Brazil (29–31%). In Taiwan 37% of the refuse collectors had an injury caused by a sharp object in the last 12 months, and the USA (11–31%) than in Denmark (4%). In general, the body parts most often injured were the back, arms, and legs. In the different studies, the injury types mentioned in more than 10% of the cases were strains/sprains, contusion, cutting injury, tenosynovitis, laceration, twisting, and soft part injury. The causes mentioned in more than 10% of the cases were fall or slip injury, struck or injured by goods, vehicles or objects, cutting or perforating objects, and overloading of the body.

According to Anan 2007 the International Labour Organization estimates that worldwide, workers sustain 250 million unintentional occupational injuries and an additional 330,000 fatalities annually.

A typical solid waste management system in a developing country displays an array of problems, including low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control, the breeding of flies and vermin, and the handling and control of informal waste picking or scavenging activities.

These public health, environmental, and management problems are caused by various factors which constrain the development of effective solid waste management systems. They can be categorized into technical, financial, institutional, economic, and social constraints. These factors make occupation in this section tedious and prone to health problems among refuse handlers (Ogawa, 1995). Not only this but also poor servicing of municipal solid waste collection vehicles, poor state of infrastructure and the lack of adequate funding militate against optimization of MSW disposal service (Rotich et al 2005).

In many countries and particularly Tanzania, refuse handling work is predominantly done by women, with a relatively high proportion of older women. They may be employed by private cleaning companies and sent out to clean buildings of various contractors, which may result in dispersed workplaces. An important number of refuse handlers are employed in the informal sector, particularly those in cleaning private homes (Medina 2004) but also in cleaning bars, schools, and other places. Because this group is disadvantaged educationally and socially, they are prone to a wide range of

occupational health hazards because they lack knowledge pertaining to the work health problems and income.

Waste pickers work informally at open dumps, typically living adjacent to the dumpsite in poor housing conditions, with minimal basic infrastructure for clean water and sanitation; and a significant portion of their number are children under 16 years old. Waste sorting and recycling activities are typically conducted in micro and small scale enterprises, with old equipment and virtually no dust control or worker protection.

In Tanzania, there has been little effort put into practice to ensure safety and health of workers and the entire community (Mwombeki, 2005). Occupational diseases and injuries continue to be a serious but poorly documented problem in both developed and developing countries. The study conducted by Contractors Registration Board (CRB) in collaboration with OSHA in 2001 revealed that at least about 50% of the company directors interviewed had knowledge of PPE in construction, while site supervisors, skilled, semi and unskilled workers have little knowledge and consider PPE issue less important. This situation creates vacuum for the company directors to disregard the safety issue to workers, whereby in some cases it has gone sour to the extent of not putting in place measures to prevent accidents, or reporting to relevant authorities in case of occurrence of fatal accidents.

Every facet of solid waste management exposes workers to conditions that may cause injury or illness. Skin problems related to handling refuse were found by Gelin and

Zavon in their 1968 study of Cincinnati solid waste workers. Another report on respiratory effects in the solid waste industry quotes an increase in bronchitis among waste handlers. The largest number of studies on the respiratory health effects of refuse handling has been conducted by Sigsgaard and co-workers (1994) in Denmark. Their initial study followed the workforce of twelve at a newly opened solid waste sorting plant where eight of the workers became ill within eight months with initial symptoms of eye irritation and sore throat. The symptoms progressed to cough among the eight workers, exercise-related dyspnoea in seven, abnormal peak flow readings in seven, and chest tightness at work in four. The problems reportedly disappeared after the plant instituted better occupational hygiene controls.

In another study conducted in Karachi Pakistan by Shahida *et al* 2005, out of 8 hospitals visited, 2 (25%) were segregating sharps, pathological waste, chemical, pharmaceutical and pressurized containers at source whereby for handling potentially dangerous waste, two (25%) hospitals provided essential protective gears to its waste handlers.

According to Englehardt *et al* (2003) municipal solid waste collection has recently been found to be among the highest-risk occupations. However, as for other occupational groups, actual total injury rates, including the great majority of injuries not compensated and those compensated by other insurance, are not known. It is assumed that this situation might resemble that of Tanzania as underdeveloped country.

In his study Englehardt 2003 cited out that the injury rate is 50% higher for garbage collectors. Results, though subject to uncertainty in worker numbers and classification

and reporting bias, agreed closely with a survey of 251 MSW collectors, of whom 75% reported being injured (and 70% reported illness) within the past 12 months.

In case of other infections, waste particularly organic solid waste is a rich substrate for microbial growth (Wouters et al 2005). Therefore handling of wastes and biofuel from plants and animal origin are considered to increase the risk of biofuel exposure that leads to a wide range of health effects as reviewed by Douwes et al 2003. In waste (refuse) handling, health effects such as respiratory health problems and gastrointestinal symptoms have been demonstrated (Nersting et al 1991). These are contributed by poor management of refuse handling, for instance, medical waste management evaluation had done at the Vacacai river basin in the State of Rio Grande do Sul, Brazil. A total of 91 healthcare facilities, including hospitals (21), health centers (48) and clinical laboratories (22) were surveyed to provide information about the management, segregation, generation, storage and disposal of medical wastes.

The results about management aspects indicate that practices in most healthcare facilities do not comply with the principles stated in Brazilian legislation. Such information is not different from Tanzania situation. This is because in most health facilities medical wastes are mixed with normal wastes. Moreover, these wastes are disposed in the same way especially in the health facilities which have no disposal means like incinerator. This puts workers in this section under danger because most medical wastes are dangerous to both waste generators and handlers (Manyele 2005).

According to Regina and Saskatoon (2007) to protect workers who are likely to be exposed to infectious materials or organisms, the regulations require the employer to develop and implement a written exposure control plan. The plan must be developed in consultation with the occupational health committee and:

- identify workers who may be at risk of exposure
- describe risks associated with the exposure
- describe infection control measures, (exposure control plans in healthcare and correctional facilities must address how the use of safer needles will be implemented and workers trained on their use)
- set out the procedures to be followed in cases of spills or leaks
- set out the procedures to be followed in cases of accidental exposures
- set out the procedures to be followed where a worker believes that he or she has been exposed
- set out the methods of cleaning, disinfecting or disposing of contaminated material
- describe the training that will be provided to workers
- require the investigation and documentation of exposures
- require the investigation of any associated infection or disease

By adhering to the control plan prepared by the management, it is anticipated that most refuse handlers will be protected against injuries, respiratory problems and other health related problems.

This is because Municipal workers are at risk for a variety of occupational diseases as a result of daily exposure to work-related hazards. The socioeconomic status of waste workers is low and their working conditions are unfavorable. In addition, this population of workers has not been well studied, so the actual risk may be substantially underreported (Mehrdad et al 2008).

CHAPTER THREE

3.0 Research methodology

3.1 Study design

This study was a cross-sectional study where quantitative method of data collection was used.

3.2 Study area

Tanga City is Location at $38^{0}10'$ East and $5^{0}15'$ south and between 0 and 17 meters above sea level. It covers an area of about 600 square km² of which 62 square km² is covered by water bodies. The council has 4 divisions, which are subdivided into 24 wards. Out of these 14 are in urban, 2 are in Peri-urban, and the other 8 are in rural areas. It has also 23 registered villages, 146 sub-wards (Mitaa) and 129 hamlets (Vitongoji). Social Services include health, education, social welfare, rural water supply, and solid waste management, credit facilities for women and youth and cooperative developments. Economic Activities include agriculture, industry, livestock farming, fishing, and mining and business economic reform program. Privatized Industries include Tanga Cement Company Ltd, Amboni Spinning Ltd, Sabuni Detergent Industries Ltd, Unique Steel Rolling Mills, Afri-Text, and Pee Pee Tanzania Ltd. Established Industries include Tanga Fresh, Athi River Lime Factory, and Amani Tea Packers.

3.3 Study population:

The populations of this study included refuse (waste) handlers in the refuse collection points like health facilities, market places, industries and mechanical workshops. It also included scavengers at the municipal dump. This group has been selected as the exposures while the other groups which were included were grass cutters and other attendants that were taken as controls. The risks associate with refuse handling was compared to the control group (grass cutters and other like attendants) which do not handle refuse.

3.4 Sample Size Determination

Sample size was determined using the formula for difference in proportion which was developed by (13) that is:-

$$n = \left(\frac{r+1}{r}\right)\frac{(\overline{p})(1-\overline{p})(Z_{\beta}+Z_{\alpha/2})^{2}}{(p_{1}-p_{2})^{2}}$$

n =Sample size in the exposure and unexposed groups

r=ratio of controls to cases

Z_{β} = Represents the desired power (typically 1.28 for 90% power).

$Z_{\alpha/2}$ = Represents the desired level of statistical significance (typically 1.96).

A measure of variability (similar to standard deviation)

(P_1-P_2) = Effect Size (the difference in proportions)

This study intends to detect Odds Ratio of 2.0 (20%), therefore

- For 90% power, Z_β=1.28
- For 0.05 significance level, Z_α=1.96
- r=1 (equal number of cases and controls)
- The proportion exposed in the control group is 20%
- To get proportion of cases exposed:

$$p_{\exp} = \frac{ORp_{controls\,\exp}}{p_{controls\,\exp}(OR-1)+1}$$

Proportion of cases exposed = $P_{expo=2}(0.2)/0.2(2-1) + 1 = 0.33$

Average proportion exposed = (.33+.20)/2=.265

$$n = \left(\frac{r+1}{r}\right)\frac{(\bar{p})(1-\bar{p})(Z_\beta + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$$

$$n = 2\,\frac{(.265)(1-.265)(1.28+1.96)^2}{(.33-.20)^2} = 242$$

Therefore, n=242 + 10% = 266 (133 exposures, 133 controls)

3.5 Sampling Procedures:

Selection of study participants (refuse handlers-exposures and other workers controls)

Refuse handlers

All refuse handlers from industries, markets, workshops and health facilities in Tanga City were listed to make a sampling frame. The facilities were taken as strata. From each sampling frame, appropriate sample was determined using stratified sampling technique. Through stratified sampling technique, a sampling fraction was determined (sample size divided by the total number of people in the all sampling frames) i.e. 133/361 =0.368. This fraction was later multiplied to a corresponding number of individual in each section (section sampling frame) to obtain the corresponding sub-sample for each section. Since the sample size for exposures was known (133 refuse handlers) then the population (total number of refuse handlers) would be obtained in the site.

Other workers

The same number of controls for this study was obtained from the same place where refuse handlers were obtained. Controls were the other workers in the same section but working in different activities other than handling refuses. Such activities may include office cleansing, office attendants, grass cutters and other minor works such as porters. Below is the illustration on how sample was obtained.

Table 1: Selection of sample size

Place of work	Number of refuse handlers	Sample proportion
Bombo hospital	28	28 times 0.368=10
Bombo hospital contractor	34	34 times 0.368=12
Tanga city	184	184 times 0.368=69
Sikh saw mill	12	12 times 0.368=4
Mgandini market	20	20 times 0.368=7
Makorora market	16	16 times 0.368=6
Chuma market	16	16 times 0.368=6
Ngamiani Health centre	12	12 times 0.368=4
Makorora Health centre	10	10 times 0.368=4
Chumbageni NGO	29 (times 0.368)	29 times 0.368=11
Total	**361**	**133**

3.6 Plan for Data collection

Data were collected from July to August 2008. This period of time was purposely selected according to Muhimbili University of Health and Allied Sciences calendar almanac. Data collection started after obtaining permission from the Tanga Municipal authorities. Selected places were visited one day before actual data collection to make some arrangements with the supervisors/authorities. After identifying the respondent he/she was asked for consent to participate in the study and upon acceptance the research assistant interviewed him/her. The information collected included social

demographic characteristics, people with injuries happened for the past three months, reported respiratory problems and use of personal protective equipment among refuse handlers. Checklist was used to assess the quality of refuse handling equipment and other related factors.

During data collection the principal investigator (PI) supervised the research assistants by inspecting the collected data on the same day and error detected were discussed and corrected accordingly. Also the PI conducted the assessment of refuse handling equipment quality. The data were coded and ready to be entered into computer using EPI Info version 6.

3.7 Data collection Technique

Questionnaire

This method was used to collect information on social demographic characteristics and the refuse handlers with injuries, reported respiratory symptoms, use of PPE and cigarette smoking. This method provides a guard against confusing items. If a respondent has misunderstood a question, the interviewer can clarify, thereby obtaining relevant pertaining to the question asked.

Checklist:

This was used to assess prevention of hazards to refuse handlers at the source and the transport vehicles also the instructions on use of PPE and presence of marking for unusual features such as dangerous part of machinery. It is important to check the quality because most equipment may contribute in contaminating the handlers and cause injuries to them. Checklist was important because it allowed to record points of importance.

3.8 Recruitment, training and Pre-testing.

Three research assistants were selected by looking at their education level and these were graduating Health Officer Students with Diploma from School of Environmental Health-Tanga. Training was done for 2 days and followed by pre-testing of the research tools/instruments with a selected sample of the target population from Pongwe ward. This area is within Tanga City and it was not included in the study areas. The pre - testing was done prior to conducting the main study and necessary adjustments/corrections of questions to the research tools were made accordingly.

3.9 Ethical Consideration

Ethical approval was obtained from the Research and Publication Committee of the Muhimbili University of Health and Allied Sciences (MUHAS). The permission to conduct the study was obtained from the City Medical Officer of Tanga City Council (see the attached annex). The participants were asked for their consent orally after being

informed on the aim and objectives of the study. They were assured that their names would not be used and that the information provided by them would only be used to improve the health of waste handlers. Every respondent reached for interview accepted to participate in the study.

3.10 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 question were coded after completion of data gathering (at the end data collection exercise).

3.10.2 Data analysis

Data were analyzed using SPSS 15.0 computer software for data analysis. Chi-square and Regression analysis tests were used. A result with a value of $p<0.05$ was considered statistically significant.

CHAPTER FOUR

4.0 Results

4.1 Information on Social Demographic of the sample population

This study intended to cover a total of 266 (133 refuse handlers and 133 other workers) but due to some reasons such as absenteeism, respondents interviewed were 248 (93%). The age distribution of the respondents, sex, marital status, employment, smoking status and level of education are shown in the table 2 below. Majority of the study population were from the age groups 19-27 years and 28 – 36 years. The reasons which made these two age groups to involve more in handling refuse could not be established under this study but it was assumed to be caused by socio-economic factors. There were more female employees than men among refuse handler as compared to other workers in the study population.

4.2 Proportion of respondents trained on safe handling of waste

The result shows that, among 135 respondents who were handling refuse, only 5 (3.7%) received training before being employed and 4 (3.0%) got on job training. About 130 (96.3%) did not receive any training. Other workers experienced the similar scenario and suffer more since it was noted only 1 (0.9%) received training on safe working practice.

4.3 Employment status of the respondents

Majority of refuse handlers 69 (51.1%) were employed by the Municipal council, 30 (22.2%) were employed by Contractors, while the remaining 36 (26.7%) were employed by other facilities such as NGO/industry or not employed. It was however noted that some of the respondents were temporarily employed i.e. working for two weeks and get rest for two weeks, then resumes work (see table 2 below). Other workers were also employed by the same facilities but doing other jobs other than handling refuse.

Table 2: Social Demographic characteristics by Exposure status

Characteristic	Refuse handlers (N=135)	Other workers (N=113)	P-value
Age (years)			
<18	5 (3.7%)	5 (4.4%)	
19-27	42 (31.1%)	32 (28.3%)	
28-36	55 (40.7%)	48 (42.5%)	
37-45	15 (11.1%)	19 (16.8%)	
46+	18 (9.6%)	9 (7.3%)	P=0.500
Sex			
Males	52 (38.5%)	101 (89.4%)	P=0.0001
Females	83 (61.5%)	12 (10.6%)	
Marital status			
Married	69 (51.1%)	88 (77.9%)	
Not married	52 (38.5%)	24 (21.2%)	P=0.0001
Widow	14 (10.4%)	1 (0.9%)	
Employment			
Municipal	69 (51.1%)	48 (42.5%)	
Contractor	30 (22.2%)	17 (15.0%)	
NGOs	19 (14.1%)	30 (26.5%)	P=0.0465
Volunteers	17 (12.6%)	18 (15.9%)	
Level of education			
Primary	119 (88.1%)	98 (86.7%)	
Secondary	4 (3.0%)	3 (2.7%)	P=0.8934
No education	12 (8.9%)	12 (9.7%)	
Smoking status			
Current smokers	18(13.3%)	50 (44.2%)	
Ever smokers	23 (17.0%)	62 (54.9%)	P=0.0001
Never smoke	112 (83.0%)	51 (45.1%)	

4.4 Health problems faced by the study population.

Respondents were asked to mention different types of health problems they encountered in the cause of working as refuse handler and other workers. Table 3 below shows the proportions of workers experienced injuries, chest pain, bad smell and bruises.

Table 3: Health problems faced by respondents.

Health problem	Refuse handlers (N=135)	Other workers (N=113)	P-value
Injuries			
Yes	64 (47.4%)	14 (12.4%)	
No	71 (52.6%)	99 (87.6%)	P=0.0001
Chest pain			
Yes	8 (5.9%)	15 (13.3%)	
No	127 (94.1%)	98 (86.7%)	P=0.0474
Bruise			
Yes	71 (52.6%)	24 (21.2%	
No	64 (47.4%)	89 (78.8%)	P=0.0004
Bad smell			
Yes	72 (53.3%)	29 (25.7%)	
No	63 (46.7%)	84 (74.3%)	P=0.0001

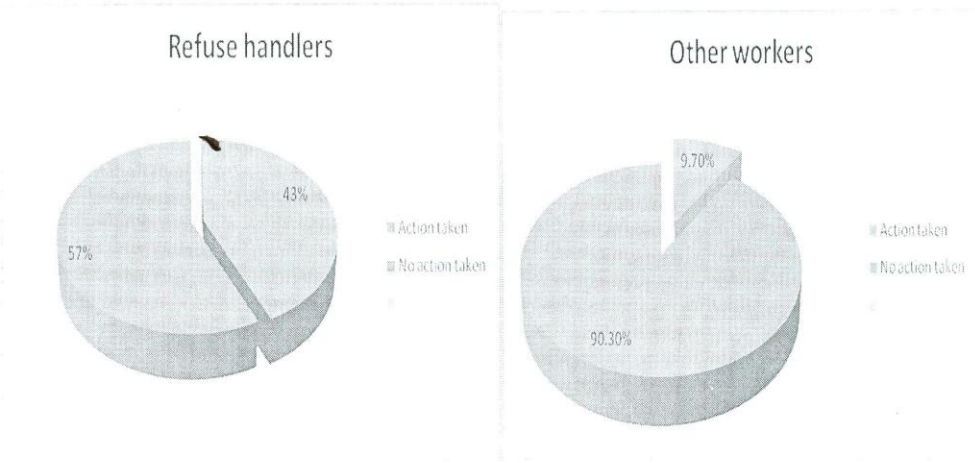
It was observed that 64 (47.4%) of the refuse handlers reported injuries as one of health problem while the corresponding other workers were 14 (12.4%), the difference between the two groups were statistically significant.

Less refuse handlers 8 (5.9%) reported chest pain compared to other workers 15 (13.3%) and the difference is statistically significant. The regression analysis conducted to identify factors that associated to chest pain among study population showed that by being not exposed there is high risk of developing chest pain than being a refuse handlers with OR =2.3 (95%CI, 1.01 -5.408), P=0.041) while controlling for smoking and age.

Refuse handlers reported more bruises (52.6%) as compared to other workers who reported few bruises (21.2%) and the differences is statistical significance between the groups P=0.0001).

Bad smell was also among health problems mentioned by the respondents as it affects them psychologically. Refuse handlers significantly suffer more from bad smell as compared to other workers (p=0.0001).

Figure 1: Action taken in case of injuries



Regarding the action taken, in the refuse handlers 56 (43.0%) and 11 (9.7%) of other workers respectively said that action is taken in case of injuries. Actions taken were either treated, given an off duty or given light duty. While about 77 (57.0%) of refuse handlers and 102 (90.3%) of the other workers said that no action taken in case of injuries. The Chi-square test showed statistical significance on the two variables (P=0.0001).

4.5 Proportion of refuse handlers with reported respiratory symptoms.

(a) Acute respiratory symptoms by exposure status.

Refuse handlers and other workers were asked whether they experienced acute respiratory symptoms during or after the day's work. It was noted that more workers in

refuse handling 89 (65.9%) experience acute respiratory problems compared to other workers 40 (35.4%). The difference is statistically significant (P=0.0017).

Table 4: Acute respiratory symptoms among study population

Responses	Refuse handlers (N=135)	Other workers (N=133)	Significance test
Problems			
Experience	89 (65.9%)	40 (35.4%)	
Not experience	46 (34.1%)	73 (64.6%)	X^2=22.27, P=0.0017
Nasal irritation			
Yes	84(62.2%)	29 (25.7%)	
No	51(37.8%)	84 (74.3%)	X^2=33.01, P=0.001
Coughing			
Yes	85 (63.0%)	26 (23.0%)	
No	50 (37.0%)	87 (77.0%)	X^2=39.55, P=0.001
Flu			
Yes	99 (73.3%)	36 (31.9%)	
No	36 (26.7%)	77 (68.1%)	X^2=42.49, P=0.001
Asthma			
Yes	18 (13.3%)	7 (6.2%)	
No	117 (86.7%)	106 (93.8%)	X^2=3.44, P=0.063

Table 4 above shows that more refuse handlers suffer much of acute respiratory problems than the other workers. The group from refuse handlers had higher prevalence of acute respiratory problems such as dry cough (odds ratio (OR) =5.95, 95%

Confidence interval (CI) 3.25, 10.88), flue OR=4.90, 95%CI=2.77, 8.67) and nasal irritation OR = 4.64, 95%CI 1.58, 8.28), controlling for age and smoking status.

(b) Chronic respiratory symptoms

Respondents were asked to give their history of coughing. This aimed at identifying those who cough in the morning when awake, day and night and if they cough for long time with sputum associated with coughing. Below table 5 represents the results of respondents.

Table 5: Chronic respiratory symptoms by exposure status

Respiratory symptoms	Refuse handlers (N=135)	Other workers(N=113)	Significance test
Coughing in the morning			
Yes	26 (19.3%)	14 (12.4%)	X^2=2.29, P=0.130
No	107 (80.7%)	99 (87.6%)	
Coughing in day or night			
Yes	36 (26.7%)	14 (12.4%)	X^2=7.76, P=0.005
No	99 (73.3%)	99 (87.6%)	
Coughing 4-6 times/day/4 days			
Yes	6 (4.4%)	5 (4.4%)	X^2=0.00, P=0.99
No	129 (95.6%)	108 (95.6%)	
Coughed for 3 months			
Yes	4 (3.0%)	4 (3.5%)	X^2=0.07, P=0.79
No	131 (97.0%)	109 (96.5%)	
Coughing sputum day&night			
Yes	8 (5.9%)	2 (1.8%)	X^2=2.73, P=0.098
No	127 (94.1%)	111 (98.2%)	
Chronic bronchitis			
Yes	6 (4.4%)	5 (4.4%)	X^2=0.00, P=0.97
No	127 (95.6%	108 (95.6%)	

With regard to chronic respiratory symptoms of respondents it was noted that there was statistical significance difference for coughing day and night in the group handling refuse than other workers (P=0.005) while in coughing 4-6 six times a day in four days a week was not statistically significant for both groups p=0.99, and coughing for three

months or chronic bronchitis was not statistical different for refuse handlers and other workers (P=0.79).

(c) Shortness of breath and wheezing among study population

Respondents were asked to give their history of shortness of breath and wheezing. The aim was to see if there is an association between handling refuse and the chronic respiratory symptoms. The results are given in the table 6 below:

Table 6: Shortness of breath and wheezing among study population

Symptoms	Refuse handlers (N=135)	Other workers (N=113)	Significance level
Shortness of breath			
Yes	6 (4.4%)	16 (14.2%)	X^2=7.15, P=0.007
No	129 (95.6%)	97 (85.8%)	
Wheezing			
Yes	7 (5.2%)	5 (4.4%)	
No	128 (94.8%)	108 (95.6%)	X^2=0.000, P=0.78

With regard to shortness of breath, there is a statistical significance difference between refuse handlers and other workers (P=0.007) while in wheezing, there is no statistical difference between refuse handlers and other workers (P=0.78). Regression analysis showed that those who are exposed to refuse have higher chance of developing shortness of breath compared to other workers OR=11.36 (95%CI):2.551 to 50.5900) P=0.001. On the gender status, it was observed that females have more chances of developing

shortness of breath compared to males with OR: 10.28 (95%CI: 2.452 to 43.071) P=0.001.

4.5 Use of personal protective equipment (PPE) among refuse handlers.

(a) Personal protective equipment (PPE)

The respondents were asked if they use personal protective equipment and the importance of using them. The aim was to know the general understanding of the refuse handlers with regard to PPE use. Below is the table which summarizes the results.

Table 7: Use of personal protective equipment

Responses	Refuse handlers (N=135)	Other workers(N=113)	Significance test
PPE use			
Use PPE	13 (9.6%)	10 (8.8%)	
Not using	122 (90.4%)	103 (90.7%)	X^2=0.04, P=0.833
Why not using PPE			
Not available	95 (68.1%)	68 (40.6%)	
Unpleasant	7 (5.1%)	20 (79.0%)	
Too hot (weather)	33 (24.4%)	25 (35.3%)	X^2=9.96 P=0.0069

The table 7 above shows that PPE use among refuse handlers and other workers was not statistically significant (P=0.833). On the issue of why not using PPE, it was found that the reasons given by refuse handlers and other workers differ significantly that most

refuse handlers and other workers (68.1% and 40.6% respectively) said that protective equipments are not available, 24.4% of refuse handlers and 35.3% of other workers said that weather was a limiting factor and 5.1% of refuse handlers and 79.0% of other workers said that PPE are unpleasant to use (P=0.0069).

4.6. Hazards prevention

In the places where refuse handling was taking place, possibility of hazards using checklists were determined. Among the areas which were assessed using checklist include presence of instruction covering unusual hazards or complicated features, training given to users of equipment, record keeping and use of equipment in accordance with manufacturer's instructions. Other areas assessed include presence of clear warning notices or marks to wear PPE, regular inspection of equipment and record keeping. Below is the table 8 which shows the result.

Table 8: Hazard prevention through safety measures in refuse handling equipment.

N=10

Instruction covering unusual features	**Number of facility**	**Percent (%)**
Present	3	30
Absent	7	70
Training equipment use, precaution and risks		
Trained	2	20
Not trained	8	80
Use of equipment according to manufacturers instruction		
Instruction used	3	30
No instruction used	7	70
Warning notices or markings to wear PPE		
Present	2	20
Absent	8	80
Inspection of equipment at regular interval		
Inspected	2	20
Not inspected	8	80
Inspection recorded		
Yes	2	20
No	8	80
All dangerous Machinery adequately guarded		
Guarded	1	10
Not guarded	2	20
Not applicable	7	70

The findings indicate that the level of hazard prevention among the surveyed facilities was very low. This is because the level of practice found during this study ranges from 10-30%

CHAPTER FIVE

5.0 Discussion

The response rate of this study was 93% which included 135 (54%) refuse handlers and 113 (46%) other workers as controls. The main aim of the study was to assess the proportion of refuse handlers with reported injuries and respiratory problems and associated factors causing the problems. Checklists were used to determine hazard prevention among refuse handlers and refuse handling equipment.

5.1 Proportion of refuse handlers with injuries which happened in the past three months

This study found that the proportion of injuries is higher among the refuse handlers compared to the other workers. The proportion of refuse handlers sustained injuries in the course of work were 64 (47.4%) out of 135 while other workers reported 14 (25.5) out of 113.

The duration of injuries was observed to be the same in all groups where the significance difference could not be observed. The causes of injuries were reported to be metal sheets, nails, metal scraps, syringes woods and bones. Syringes can transmit several diseases from hospitals and nails can result into tetanus etc. These results are pertinent to the findings of the study conducted in Bulawayo where the occupational injury register indicated that during the study period, 62 workers sustained 67 injuries, including one that was fatal. Of these 67 injuries, 27 (40%) involved workers who sustained cuts inside

a box-type refuse removal truck, and 11 (16%) involved workers who had sprained ankles and wrists as a result of improper lifting (Gonese et al 2002). The difference in the proportion that sustained injuries between Bulawayo and Tanga might be influenced by duration of the study, methodology and sample size. Bulawayo study was retrospective, descriptive cross-sectional survey done for about period of one year and Tanga City study was cross-sectional descriptive study done for about three months.

In another study conducted by Huren et al 1999 in Florida USA revealed that waste collectors (refuse handlers) had a higher risk of injury than other workers in municipal solid waste industry. This is the same as what this study found where the refuse handlers reported more injuries as compared to other workers. Furthermore, this study suggested that whilst injury rates for all Florida industrial workers decreased, the injury rates of municipal solid waste workers almost doubled from 1993 to 199. This was contributed by the fact that refuse collection is a job which requires repeated heavy physical activity such as lifting, carrying, pulling, and pushing, hence has high risk of injuries (Yang et al 2001)

The other health problems which were explored concurrent with the injuries include coughing and chest pains. Other workers reported more chest pain as compared to refuse handlers. Probably chest pain among other workers could have been influenced by the type of work which they performs that included grass cutting, pushing trolleys, washing clothes and watering flower gardens. Normally those who work in grass cutting are doing this task alongside the road or in the open spaces which are not protected hence being as controls, they are also exposed to the hazards. Those who push trolleys have no

gears and also the trolleys can also cause injuries and those watering gardens are watering around town gardens which are also not protected.

This study found that majority of people employed in this field does not get any train before starting job and on job training. Only 3 (3.7%) received training before work and 4 (3.0%) trained during work. Training is important to people who handle refuse because it enables them to take care when encountering environmental features that can cause hazards. It was noted that most workers employed neither as refuse handlers did not have neither prior training nor on job training. The similar situation was reported by Medina (2007) who reported refuse handlers as disadvantaged and vulnerable group compared to other occupations. In our study the few who received training on safe handling of refuse were from Bombo Hospital where there is improved waste collection station established by the GTZ supporting program. The other facilities visited were found to recruit workers who were desperate looking for job without training them.

Training to workers handling refuse is a pre-requisite requirement and failure to do so is contrary to the Environmental and Occupational Health and Safety regulations of Tanzania. This was also pointed out by Manyele (2003) that knowledge gap in occupational health is among the challenges facing the Environmental and Occupational Health and Safety (E&OHS) in Tanzania. His analysis shows that the Tanzania's position in the international E&OHS platform (that is, ILO-SAMAT, WHO/ILO Joint effort, WHO-AFRO, etc.) is very weak, namely due to lack of awareness, high level of illiteracy, weakness in the enforcement of environmental laws, and lack of environmental departments in small and large-scale enterprises.

5.2 Proportion of refuse handlers reported acute respiratory problems

Nasal irritation, Coughing, Flu and Asthma during the work shift and after work shift were elicited as a measure of acute respiratory symptoms. More refuse handlers reported nasal irritation than other workers 62.2% and 25.7% respectively. Coughing was significantly reported more among refuse handlers than other workers (63.0%) and (23.0%) respectively with P=0.0001. The findings might be due to the fact that refuse handling encompasses odour and various gases such as sulphur dioxide (SO_2), methane (CH_4), hydrogen sulphide (H_2S) and carbon monoxide (CO_2) in addition to other dusts and ashes.

Most of emissions from waste have effects on respiratory system as from trachea, bronchiole to the alveolar (gas exchange zone). Asthma was reported more by refuse handlers than other workers (13.3% versus 6.2%), though that difference is not statistically significant (P=0.06). Health workers effect might explain the phenomenon since those with allergic to refuse dust and fumes might not opt for the job or have left the job. In comparing these results with other studies done elsewhere, they showed several respiratory symptoms being significantly elevated among refuse collectors relative to other workers, diarrhea at work, headache (without cold), nasal irritation (without cold) cough with phlegm (without cold), and phlegm were all elevated compared to a small control group (Mahar & Thorne, 1999). Heldal *et al* 2003 in their study reported that exposure to bioaerosols during waste handling induces upper respiratory inflammation dominated by a neutrophil infiltration and activation. It was not

possible to establish the factors that may contribute to respiratory problems among refuse handlers because they handle un-separated wastes from different sources.

Another study done by Ranjan et al 2004 in Delhi reported that landfill workers had significantly higher prevalence of both upper and lower respiratory symptoms. Moreover their results demonstrated higher prevalence of respiratory symptoms, inflammation of the airways, lung function decrement and a wide range of general health problems in MSW disposal workers. The findings are also consistent to the findings of the study done by Yang et al 2001 which reported that household waste collection presents a risk for the development of chronic respiratory symptoms (cough, phlegm, wheezing, and chronic bronchitis).This situation of exposures could be contributed by the way workers handle refuse since most never use PPE though in some instances some use self improvised PPE such rolling piece of clothes around mouth and nose or wearing discarded plastic bag in the hand instead of hand gloves, which do not prevent them adequately.

Other findings which reported similar results were from the study conducted by Cointreau (2006) documented that more of the waste pickers interviewed reported that they experienced higher disease levels since becoming waste pickers, than they had before in flu were 48% and 86% respectively for prior to and during employment, headache was 3% after 23% respectively. Also a comparative study reported by Nath (1991) among waste pickers working at Calcutta's Dhapa dump in the 1980's showed that waste pickers reported higher prevalence of respiratory diseases compared to farmers (pickers: 71% vs. farmers: 34%).

The smoking status of the respondents was assessed, current smoking being who still smoking and former were smoking are those who used to smoke more than one cigarette a day but have stopped smoking in more than twelve months prior to survey. There were more smokers among other workers than in refuse handlers for both current and former smokers (P=0.0001). Since smoking was found to be higher among other workers, their effect was not detected when included in the logistic regression model. Cigarette smoking being a confounding factor for respiratory problems was considered in assessing the association related to the problem.

5.3 Use of personal protective equipment (PPE) among refuse handlers

This study find out that high proportion of refuse handlers knows that problems arising from handling refuse can be avoided though they are unable to avoid them. Among the ways listed by respondents include use of PPE, avoid carelessness and avoid not coming in bare bodily contact with the refuse when handling them. In some studies done elsewhere it was reported that solid waste workers in high-income countries routinely wear gloves and boots and handle only the bags or containers where solid wastes are stored. On the other hand, solid waste workers and waste pickers in developing countries touch the waste they collect or sort them without wearing adequate protective gears.

When the results on the use of PPE among refuse handlers compared with other workers, it was found to not be statistically significant (P=0.833) though refuse handlers know much than other workers. This might be due to nature of job and the long working

experience of refuse handlers. In assessing the importance of using personal protective equipment (PPE) it was found that most respondents know the importance as they mentioned them. The important points given out by the respondents include PPE protect against health problems such as injuries, protect against microbes and prevent accidents. However, refuse handlers know better the ways to avoid occupational problems than other workers. There was a statistical significant difference between refuse handlers and other workers in the use of PPE.

Gonese *et al* 2002 in his study, 72(84%) of workers reported the consistent use of personal protective equipment (PPE) would protect them from injuries. About provision of PPE, the large proportion 77 (57%) of interviewed respondents in refuse handlers and only 4 (3.5%) in other workers said that they should be provided by the employers. Those who said none should provide were 48 (35.6%) in refuse handlers and 77 (68.2%) in other workers. During this study it was noted that most refuse handlers were handling refuse bare handed, no feet protection and with their normal clothes. Most respondents said that they don't use PPE because they are not available, which means the employers do not supply PPE to them. Few said that due to weather condition PPE cause disturbances hence they don't use even when supplied to them. It is clearly stated in Tanzania OH& safety Act 2003 that there should be safe means of access and safe working place and UK regulation say that employers have basic duties concerning the provision and use of personal protective equipment (PPE) at work and this document, explains what employer need to do to meet the requirements of the Personal Protective Equipment at Work Regulations 1992 (Health and Safety Executive, 1992).

5.4 Prevention of hazards among refuse handlers

The ten facilities where refuse handlers operated were studied by observations. The facilities were Bombo hospital (Bombo hospital waste management section and contractor section), Tanga City Council, Sikh Saw mill, Mgandini Market, and Makorora market. Others were Chuma market, Ngamiani Health Centre, Makorora Health Centre and Chumbageni NGO.

Prevention of hazard to the workers was found to be very low because most of the facilities surveyed to assess hazard prevention measures, found that 7 out of 10 facilities have no instructional warning measures to prevent hazard related to the use of facilities by refuse handlers. Instruction covering unusual hazards or complicated features is the prerequisite for safety. Training on the correct use, risks and precautions was noted be 2 out of 10 facilities.

On the issues of recording keeping, use of equipment according to manufacturer's instructions and presence of warning marks, only 2 out of 10 facilities found to practice record keeping. These finding show that the hazard prevention among waste collectors is not given priority. This is contrary to what reported by Frings 2005 in his study where he commented that the socioeconomic status of both types of waste collectors is low, and their working conditions are unfavorable. In the occupational setting, however, many preventative measures have been proposed and implemented in order to reduce the risk of accidents and occupational disease. Such measures involve increasing safety and

reducing the risk of musculoskeletal, fatigue, respiratory, gastrointestinal, and hearing complaints. The effectiveness of most of these measures, however, has yet to be investigated. In Tanzania, there is less enforcement of laws and regulation on occupational health and safety.

5.5 Generalization of the findings

1. **Limitation of selection bias:** Respondents were selected from facilities which in one way or another are connected to municipal council. Due to scarcity of resource particularly time most industries could not be surveyed. Therefore the situation that persists within the industries could not be established.
2. **Cross-sectional study:** This study being a cross sectional study in design can not come up with the causal relationship even though this study being of its kind in Tanzania and especially in Tanga city has managed to show the magnitude of problems facing refuse handlers in a limited resource setup.
3. **One Municipal:** This study was done to one municipal, but the findings can be generalized to all Tanzania municipalities because the situation of handling refuse is the same all over. But generalization to other countries cannot be guaranteed because every country has its own system of handling refuse depend on the level of mechanized used and economy of the country.

5.6 Conclusion and recommendations

5.6.1 Conclusion

Findings of this study enable the author to conclude the following:

- Workers responsible for refuse handling were more susceptible to injuries and respiratory health problems than other population.
- The low prevalence of the use of PP among refuse handlers noted.
- More refuse handlers noted to be affected by acute respiratory symptoms compared to other workers.
- Cigarette smoking was noted to fewer refuse handlers compared to other workers.
- Little enforcement of the occupational health and safety regulation among facilities responsible for waste handling.
- Prevention of hazard to the workers by facilities was found to be very low.

5.6.2 Recommendations:

Responsible authorities such as Municipal Councils, Tanzania Occupational Health Institute and Ministry of Health and Social Welfare should do the following:

- Prepare guidelines which indicate training needs of a person employed as refuse handler and make sure that the training are done before and while on job.

- Employers (Municipal Councils, contractors, facilities e.t.c) purchase, provide and supervise use of personal protective equipment (PPE) and replace them when they are old or expired.
- Employers (Municipal Councils, contractors, facilities e.t.c) to put in place written instructions and warning marks that should remind the refuse handler of what should not be done so as to safeguard their health.
- Employers (Municipal Councils, contractors, facilities e.t.c) to regularly examine the refuse handlers for any chronic health effects and be treated promptly.
- Retro and prospective studies to identify health effects outcome effects of the people handling refuse for the long period of time.

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