OCCUPATIONAL INJURIES AND ASSOCIATED FACTORS AMONG SOLID WASTE COLLECTORS IN NAIROBI CITY COUNTY, KENYA

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DECLARATION

This thesis is my original work and has not been presented for conferment of any degree in any University.

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DEDICATION

To the Lord God Almighty be the glory and honour for the gift of life and his amazing grace; and to my husband Victor, daughters Valerie and Lindsey and son Samuel for their unwavering support and encouragement during my studies.

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ABBREVIATIONS AND ACRONYMS

CBOs: Community based Organizations

EOHS: Environmental & Occupational health & safety

HBV: Hepatitis B Virus

HIV: Human Immunodeficiency Virus

HWM: Hospital waste management

ILO: International Labour Organization

MSDs: Musculoskeletal Disorders

MSW: Municipal solid waste worker

OSHA: Occupational safety and health Act

PPE: Personal protective equipment

SW: Solid Waste

SWCs: Solid Waste Collectors

SWM: Solid waste management

USEPA: united States environmental protection agency

URI: Upper respiratory infections

DEFINITION OF OPERATIONAL TERMS

Contusions: is a type of hematoma of tissue whereby capillaries and sometimes veins damaged by trauma, allow blood to seep, hemorrhage or extravasate the surrounding interstitial tissues

Garbologist: a garbologist is a garbage collector

Health Surveillance: is a systematic assessment of fitness for work, and/or of health status that is not directly related to occupation

Hazard: is generally anything that can hurt you or make you ill.

Leptospirosis: is a bacterial disease that affects humans and animals.

Occupational health problems: it refers to as the signs and symptoms as stated by the subject in the study or as observed by the researcher under different problems like musculoskeletal problems, skin problems, eye problems, gastro intestinal problems which are assessed by the researcher.

Occupational health and safety: deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards

Personal protective equipment: refers to equipment worn to reduce one's exposure to serious injuries and illnesses in the work environment. The injuries and illnesses may emanate from contact with the

solid waste and may be inform of mechanical, chemical, electrical, radiological, or other workplace hazards

Permanent employment: Employees without predetermined time limit to employment. They receive benefits like subsidized health care, paid vacations, holidays, sick off, or contributions to retirement plan in addition to their wages.

Occupational injury: Occupational injury is any wound or damage to the body resulting from an event in the work environment and in case from solid waste collection. It includes lacerations, contusions, cut, slash, tear, split, slit etc.

Refuse: Are unwanted waste material such as household garbage, food wastes, waste from yards, and debris from construction sites. Also it includes discarded items like household appliances, furniture, scrap metal, machinery, car parts and abandoned or junk vehicles.

Risk: is an uncertain event or condition that, if it occurs, has an effect on at least one objective

Solid waste: These are abandoned or discarded waste materials which include agricultural refuse, mining residues, demolition waste, municipal garbage, and sewage sludge.

Solid waste/refuse collector: refers to a person who is employed by public or private sectors to collect and dispose solid waste.

Temporary employee: Employees whose working is limited to a certain length of time or until a completion of a specific project.

ABSTRACT

Solid waste collectors are persons employed by either a public or private sector to collect and dispose waste from residential, commercial, industrial or other collection site or for further processing. In developed countries, automated trucks are used that are fitted with hydraulic lift to pick up and dump trash. In developing countries such as Kenya, solid waste handling is usually done manually which exposes the solid waste collectors to occupational injuries. The aim of the study was to assess occupational injuries and associated factors among solid waste collectors in Nairobi City County, Kenya. The study employed the use of cross sectional study design and the study sample constituted 328 solid waste collectors who were clustered into private companies, community based organizations and Nairobi City County environment department employee groups. Systematic random sampling was used to select the study subjects. Data collection for the study was done using a structured questionnaire by trained research assistants. Study findings were analyzed using descriptive statistics of frequency and percentages; inferential statistics using Chi-square to test for associations. Regression analysis was done to isolate the confounding factors. Data was presented and interpreted in tables and charts. The findings show that the common injuries include puncture 264(80.5%); laceration 252(76.8%); contusion 188(57.3%); strain/sprain 111(33.8%); and fracture 28(8.5%). The proportion of solid waste collectors who experienced at least one type of injury within six months prior to the study was 88.1%. The nature of employment i.e. permanent or temporary ($\chi 2=10.179$; df=1; p=0.001); and sources of waste ($\chi 2=15.409$; df=1; p=0.000) were predictor predisposing factors for the occupational injuries. The identified mitigation measures for occupational injuries were on job training ($\chi 2=4.614$; df=1; p=0.032); use of mechanized method for solid waste collection ($\chi 2=11.856$; df=1; p=0.001); and PPEs usage ($\chi 2=7.498$; df=1; p=0.006). The proportion of the various types of occupational injuries was very high among the solid waste collectors, therefore measures including on job training on proper methods of handling solid waste, use of mechanized solid waste collection method and provision and consistent use of PPEs should be enhanced to minimize the injuries.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

According to (Eskezia et al., 2016b) solid waste collection is classified as one of the occupations with the highest risk for injuries and illnesses. Globally, in many cities solid waste collection is done manually and solid waste collectors have been known to be working in a very high risk occupation (Gizaw, et al, 2014). Due to daily exposure to occupational hazards solid waste collectors suffer work related injuries and ailments (Benedicta Ofosuhemaa Asante, 2016). According to International Labor Organization (ILO), every year 270 million occupational injuries and illnesses occur globally with approximately 2.3 million deaths resulting from it (Zewdie et al., 2016). The economic loss related to these accidents and diseases are estimated to be 4% of world gross national product. About 358,000 fatal occupational accidents occur every year. Estimated number of 3,400,000 disabling work related injuries occur (Gizaw et al., 2014). Sub-Saharan Africa countries are the most affected followed closely by Asia (Eskezia et al., 2016). Management of solid waste is riddled with risks at each step from the point of collection, during transportation as well as at disposal or at recycling areas (Endreddy & Sandul, 2015).

A nearly twice higher incidence rate of complaints on musculoskeletal areas among Danish refuse collectors was reported than for the total workforce in Denmark. Refuse collectors in Taiwan reported more than two times higher complaints related to musculoskeletal areas due to injuries of the low back and elbow/wrist than those of their colleagues that worked in the office (AEl-bou-ElWafa et al., 2012). Solid waste can be used to generate income and can be used to sustain livelihood, but in many countries, it is treated as part of unregulated public service and is performed under unfavorable hazardous working conditions (Binion & Gutberlet, 2012). In

many developing countries, solid waste collectors are exposed to occupational injuries due to lifting and carrying heavy waste bags, pulling and pushing the waste bags as they take them to transfer station and the exercise require repeated heavy physical activities (AEl-bou-ElWafa et al., 2012).

Although documentation of accidents that involve solid waste collectors is often done, the nature of work, tasks that are performed and characteristics of solid waste workers management are rarely addressed. The real work conditions are unknown (Camada et al., 2012). In most countries, solid waste collectors are employed being aware of the mitigation measures to applied when they carrying out their daily duties. This means they are employed without requisite training; with low education achievement and majority do not put on personal protective equipment (PPE). Many have never undergone on-job training, no vaccinations before employment, do not have periodic health checks and do not understand the hazardous nature of their work. They receive low pay and live in very poor conditions, which further raises the risk of injury and disease (Alemayehu et al., 2016). According to (Battaglia et al. (2015), interruption of contact pathways in solid waste management can be achieved by improving waste technologies, use of protective clothing and changing working methods.

Like in many cities in the developing countries, it has been observed that solid waste collection in Nairobi City is manual in nature, which exposes the solid waste collectors to many injuries and illnesses. This study therefore, aims to assess the types and extent of occupational injuries and associated factors among solid waste collectors in Nairobi City County.

1.2 Statement of the Problem

Cases of occupational injuries among solid waste collectors are alarming globally and have received little or insufficient attention from all the stakeholders and to date it has not been recognized as a legitimate public health issue (Benedicta et al., 2019). In Nairobi City County, much of the solid waste is collected manually without regard for the safety of the solid waste collectors. Cases of occupational injuries have been observed and reported among the solid waste collectors. The low usage of PPEs during solid waste handling is one of the likely contributing factors to occupational injuries. This gave impetus to the conduct of this study. The study therefore sought to investigate the factors associated with occupational injuries among solid waste collectors in Nairobi City County, Kenya.

1.3 Justification

In most developed countries there is inadequate data on health and accident consequence, and in developing countries it is barely existent (Viegas et al., 2014). The consequences of high population in urban centers on solid waste management is more noticeable in developing countries than in the developed countries (Joshi & Ahmed, 2016). In Kenya, Nairobi is the largest City with a population of 4,397,073 people (Wako Amina, 2019) and as a result, a lot of solid waste is generated daily that require proper disposal. Nairobi city county government has acknowledged that with 2,475 tons of solid waste generated daily, it is unable to manage this huge amount of solid waste (Oyake-Ombis, 2018). Nairobi Metropolitan Services estimates that the generation of solid waste in the city will increase to 1.83 million tons per year by 2030 (Ziraba et al., 2017). Injuries are a common site among SWCs in Nairobi and they reduce SWCs' productivity due to ill-health and absenteeism from work. In Nairobi City, solid waste management remains a critical concern and a major challenge as a result of weak institutional

structures and capacity, weak enforcement of regulatory frameworks, and the control of the sector by criminal cartels (Haregu et al., 2017b). The national burden of occupational diseases and injuries among solid waste collectors remain unknown. The cases are not documented due to lack of an occupational health programmes addressing issues of injuries incurred during solid waste collection. Promotion of healthy work (environments, practices and places) in line with the second WHO Global Strategy for Occupational Health and Safety is low or lacking (Wilson et al., 2012). In observance of World Conventions, guidelines and standards in safe solid waste handling and its management, Nairobi City County, needs data available only through carrying out studies addressing occupational injuries and other related factors affecting solid waste collectors. This study was designed as an attempt to fill that gap. There is therefore need to carry out studies to determine the risk posed to the solid waste collectors in Nairobi City County.

Therefore, this study plays its own role in the identification of the occupational injuries and other related factors, and in the adoption of preventive and control strategies against occupational injuries associated with solid waste management among waste collectors in Nairobi City County.

1.4 Research Questions

1. What are the types and magnitude of occupational injuries among solid waste collectors in Nairobi City County, Kenya?
2. What factors predispose solid waste collectors to occupational injuries in Nairobi City County, Kenya?
3. What are the mitigation measures against occupational injuries among solid waste collectors in Nairobi city county, Kenya?

1.5 Study Objectives

1.5.1 Broad Objective

To establish occupational injuries and associated factors among solid waste collectors in Nairobi City County, Kenya

1.5.2 Specific Objectives

a) To determine the types and magnitude of occupational injuries among solid waste collectors in Nairobi city county, Kenya

b) To establish factors predisposing solid waste collectors to occupational injuries in Nairobi City County, Kenya

c) To identify mitigation measures against occupational injuries among solid waste collectors in Nairobi City County, Kenya

1.6 Null Hypothesis

H_{01}: There is no association between occupational injuries and perceived predisposing factors

H_{02}: There is no association between occupational injuries and perceived mitigation measures

1.7 Significance of the Study

This study generated findings that that can be relied upon by policy makers and other stakeholders to formulate relevant policies, plans and strategies for intervention against the occupational injuries among the solid waste collectors. The health consequences, challenges and prevention strategies of occupational injuries have been identified and described and therefore, expected to contribute to national efforts in search for information based decision making.

The study findings will also help the key decision makers at all level to integrate efforts and intervention strategies to prevent and control occupational injuries among solid waste collectors.

1.8 Scope of the Study

The study included all solid waste collectors in Nairobi City County who are organized and registered with the various solid waste collection agencies including private entities, community based organizations and the Nairobi City County environment department solid waste collection workers. The study included SWC who had been employed for at least six months before the study. The main focus of this study was on occupational injuries among solid waste collectors in Nairobi City County. The study employed the use of cross sectional study design where the data was collected using a questionnaire research instrument.

1.9 Limitation of the Study

The CBOs' records could be obtained only at the sub-county level with the records not being up to date. There was also a high turnover rate of CBOs in Nairobi City County. To address this challenge, the researcher worked with the groups whose records would be obtained and were eligible for recruitment i.e. had been operational for at least six months prior to the study.

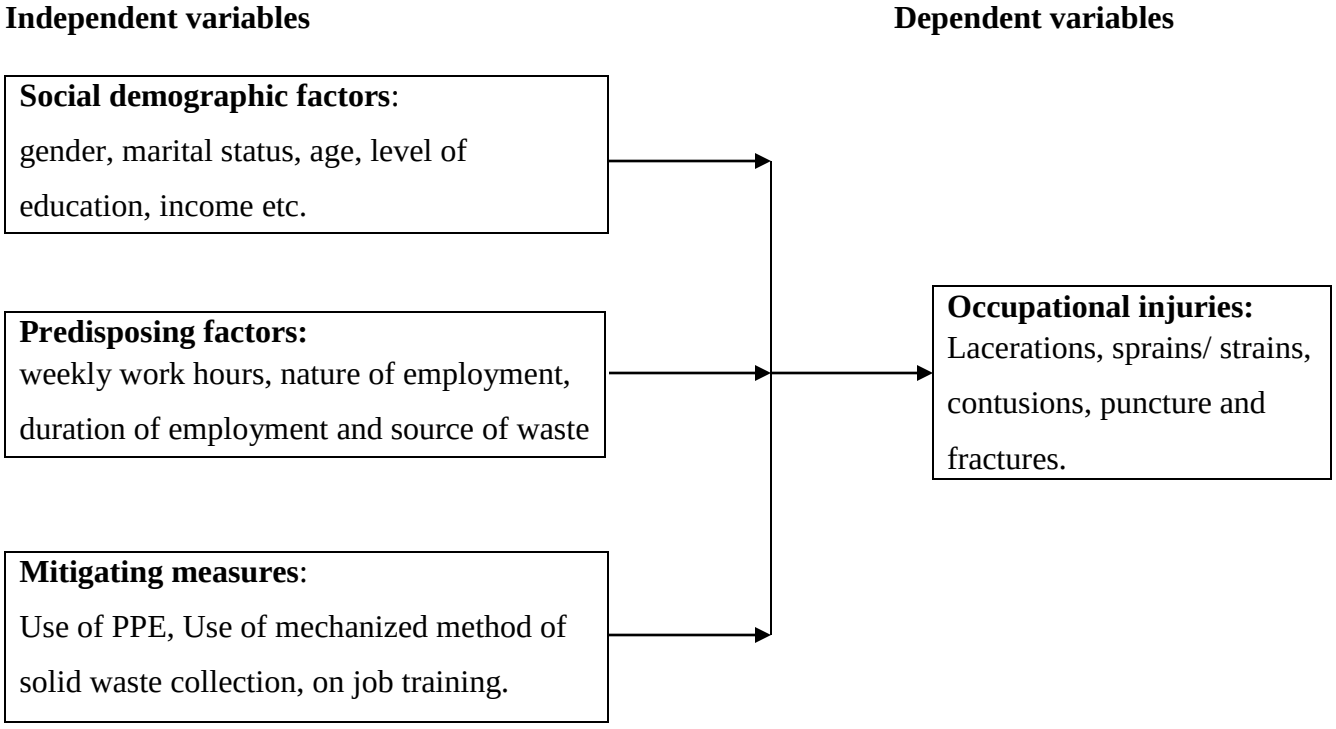
Another challenge was how to differentiate work related injuries from those that SWCs suffered elsewhere. To address this challenge the researcher did a lot of probing by asking SWCs where the injuries occurred and the circumstances surrounding their occurrence, so as to ensure that only injuries that occurred during solid waste handling were reported.

1.10 Conceptual Framework

Methodological approaches towards scientific inquiry characterize a particular discipline. It is important to articulate the pathways by which an intervention is expected to cause the desired outcomes and provides evaluator with specific elements to assess the relationship between occupational injury and factors that affect the presence or absence of occupational injury. It was developed by referring to different literature to bring out the gap in present investigation. The main components of this conceptual framework are:-

- Socio-demographic factors
- Predisposing factors
- Mitigating factors

By observing this core components we can conceptualize how occupational injuries are determined by these core factors.



Source: Investigator (2021)

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature related to occupational injuries among solid waste collectors. It covers the following sub-headings: history of solid waste management, types of occupational injuries, predisposing factors and mitigation measures, solid waste handling in developed countries, solid waste handling in developing countries, solid waste handling in Kenya and challenges faced by solid waste collectors.

2.2 History of Solid Waste Management

Due to the effects of waste on the public and environment throughout history, human progress has always had an intrinsic tie to the management of waste. An insight into civilization of the previous years has been given to us by the Garbologists through the study of garbage. Waste management led to a fall of an American president and has been instrumental in solving crimes. By nature, human beings are careless with trash, and it is an old norm and not a trait of the 20th century. As discovered by Garbologists, people allow waste to fall where it may (Greenall et al., 2015).

As history suggests, there has been a problem of solid waste management since time immemorial. There has always been four ways of dealing with waste in history which includes, dumping, burning, recycling and waste minimization. Just as it will be in future; solid waste management has affected human history in many ways (Mol et al., 2017). The modern industry for waste management has come from far and with recycling and other advances we are poised to go further. In early human history, waste was mainly in form of ash from firewood, vegetable

waste, and bones. The edible matter was used to feed the animals and what remained was decomposed by disposing it in the ground. In early civilization, waste was reused and repaired. The archeologists reveal only tiny amounts of ash, broken tools and pottery, on an excavation of ancient rubbish dumps. Annually about 4 billion metric tons of solid waste (SW) is generated worldwide (Sharma & Chandel, 2017).

2.3 Occupational Injuries among Solid waste Handlers and Associated Risk Factors

There are limited studies that specifically determine the knowledge of waste handlers on occupational health problems (Singhirunnusorn et al., 2017). It is estimated that, worldwide, some two million individuals work informally as solid waste collectors (Cardoso et al., 2019) and the epidemiological studies that have been done have essentially neglected several critical aspects on the human health risks of municipal solid waste handling. It is worthy to note that most studies on municipal waste workers have regrettably negated performing exposure assessments for waste handlers (Ncube, 2017). Epidemiological studies with exposure classification based on field measurement are needed, both to further identify high-risk work conditions for the solid waste collectors and to provide a detailed basis for establishment of occupational exposure limits for mechanical and energetic load particularly in relation to pulling and tilting of containers (Zharlene B. & Sasot, 2019).

Types of injuries encountered by solid waste collectors in garbage collection tasks include the light wound/cut, insect bite, eye irritation, sprain/strain, laceration, contusion and deep wound or cut (Gumasing & Sasot, 2019). Solid waste collectors are vulnerable to occupational injuries due to the inappropriate conditions in which waste is kept, type of waste, the type of truck used in

collection and also collection hours often coincide with peak traffic hours, implying risks of traffic accidents (Pereira et al., 2017). Individual risk factors, such as poor hygiene practices and lack of access to personal protection equipment or the inadequate use of the same, as well as lack of mechanized methods of waste handling has resulted to extreme vulnerability to occupational injuries (Cruvinel et al., 2019).

2.4 Solid Waste Handling in Developed Countries

According to National Waste and Recycling Association (2014), by 1910, in America, nearly 80 percent of the cities had some organized solid waste collection. To begin with, men were involved in collecting solid waste using mule and horse-drawn carts. According to (Kuijer et al., 2010) 1920s, dumping was the most popular method of waste disposal which led to layers of garbage, dirt and ash filling wetlands. There was advent of the automobile, garbage trucks that began to roll on American streets. In advanced nations such as Europe and the USA, automated trucks are used in collection and disposal of waste using hydraulic lifts (Mohammed & Abdul Latif, 2014). It has been estimated that the costs due to work-related injuries amount to US$ 250 billion a year, which is approximately 1.8% of GDP in the US and 2.7–6.0% of GDP in countries like Norway, Sweden, Finland and Denmark. In Finland, there are over 125 000 occupational and commuting injuries annually, based on the obtained claims received by the Finnish Workers' Compensation Center (Härmä et al., 2020).

Due to high technical enterprises, modern landfills are built with environmental protection and safety in mind and with the industry being the most regulated. It is engineered and carefully monitored to minimize odors, control pests and emissions, ground water protection and to serve

as sources of energy generation (Marello & Helwege, 2018a). Over the last century, the composition of waste has changed. Today many people live in apartments and use fire that does not produce cinder and ash. Changes in society, for example, the rise of supermarkets, increased mobility with the automobile, and a steep and fast rise in packaging have inadvertently led to modern living standards that include dedicated waste management systems, particularly in developed countries (Whitmee et al., 2015).

Technologies have been pioneered in the recent decades by the solid waste industries, this includes recognizing today's waste stream being the feedstock for tomorrow's product and recycling. Recycling technology has developed fully in a relatively short time (Whitmee et al., 2015)

2.5 Solid Waste Handling in Developing Countries

Solid waste from municipalities result from economic activity and consumption that include wastes generated from household level, markets, institutions commercial establishments, and industries. It has become an environmental and a public health concern particularly on how the waste is being handled and disposed (Rachiotis et al., 2012). The problem of waste management is more serious in the developing countries, where less than 30% of domestic garbage is treated appropriately (Cruvinel et al., 2019).

Storage of waste collected in developing countries is done in open containers and deposited on the ground. Waste is carried by hand or kept in an open packet to be collected by hand. In high income countries solid waste collectors handle solid waste mostly through sealed plastic bags

and covered dustbins thereby making them have reduced direct contact with the solid waste. In developing countries solid waste handlers have direct contact with the solid waste due to use of open bins and uncovered containers (Guerrero et al, 2013). In developing countries, data on health and accidents related to the occupational problem is nearly non-existent and inadequate in high-income countries, though getting exposed to health risks is not yet considered as a special occupational problem. Solid waste management is a challenge for the cities' authorities particularly in the developing countries because of the huge amount of waste generated each day. The financial burden on the budget of municipalities due to high cost of waste management is enormous (Zohoori & Ghani, 2017).

The primary objective of solid waste management is to ensure that the public is protected and a safe environment is provided to them and it further aims at protecting public health and safety, providing quality and sustainable environment, support economic productivity and employment generation. Therefore, if solid waste management is poorly done, it can be a potential source of infection and diseases so solid waste management has a crucial role to play in sustainable development and wellbeing of human beings (Iyamu et al., 2020). The solid waste worker is deprived socially, economically and environmentally which also involves gender concerns. The working conditions for solid waste collectors such as women sweepers are in most cases very poor; especially due to inadequate or no protective equipment, but they rarely complain about the situation. In several developing countries, studies have shown a relationship between increased respiratory illness and abnormal lung function for waste handlers working at open dumps (Endreddy & Sandul, 2015).

Solid waste management is a documented threat to health and the environment in many countries in sub-Saharan Africa (Muiruri et al., 2020). Until recently, there were little empirical studies on activities of waste collectors, and no known study on their knowledge of occupational safety and health (OS&H) practices. Due to the European Union (2010) admonition that managing waste should not endanger human health, harm the environment, or affect places of special interest, it is prudent to examine the practices and knowledge of OS&H issues among solid waste collectors (Asibey et al., 2019).

2.6 Solid Waste Handling in Kenya

According to the Constitution of Kenya, 2010 (n.d.) In article 42, every person has a right to a clean and healthy environment that include the right to have our environment conserved and protected for the benefit of current generation as wells as future generations. This can be achieved through legislation and other proactive measures; and to ensure obligations relating to the environment are fulfilled, Article 70 guarantees all a clean environment that can be claimed by any citizen in case the right has been infringed.

The Nairobi City County Solid Waste Management Bill (2014) has a provision for a county legal framework for the management of solid waste. Despite having all the legal framework put in place, and despite residents' commitment in paying for the services, complaints have always persisted over presence of heaps of uncollected garbage at residents' doorsteps and along the streets (Mwanthi et al., 2016). According to reports from the City County government, only half of the estimated 3,000 tons of waste generated in Nairobi daily is collected. Approximately 76 per cent of households in Nairobi had regular collection of household waste with the city having

no means of safe waste disposal and about two-thirds of the waste generated in Nairobi City cannot be accounted for (Haregu et al., 2017).

Kenya's status is largely characterized by low coverage of SWC, uncontrolled waste dumping, inefficient public services, unregulated and uncoordinated private sector and lack of key solid waste management infrastructure (K Njoroge et al., 2014).

2.7 Challenges Faced by Solid Waste Collectors

According to (Ziaei et al., 2019) in a study done in Iran it was discovered that about 39% and 36.5% of the solid waste collectors reported high physical and psychological workloads, respectively. A total of 92.5% of solid waste collectors reported musculoskeletal disorders signs and symptoms in at least one body area with the knee and lower back injuries being more common and more severe.

Also in a study done in India, the major occupational health concerns as reported by various groups of solid waste collectors were cuts, muscle and ligament sprain, lacerations and different kinds of allergies. The solid waste collectors encounter these challenges because they are poorly protected from such occupational health hazards (Thakur et al., 2018).

As expected, the sites where solid waste collectors operate are filled with occupational hazards that include: working for many hours; exposures to biological, chemical, mechanical, physical, ergonomic and social agents as well as frequent work accidents (Cruvinel et al., 2018). As informal workers, solid waste handlers are mainly denied access to social benefits such as pensions, unemployment insurance, and health insurance. Physical debilitation, income

imperatives, and lack of education to understand risks associated with solid waste collection make solid waste collectors vulnerable to injury (Marello & Helwege, 2018b).

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter presents information on the research methods employed while conducting the study. It gives a detailed account of the study design and then proceeds to describe the variables of the study, the location of the study, study population and sampling. The chapter further describes data collection instruments and techniques. The study variables are identified and described; the ethical considerations, data management and analysis are also presented.

3.2 Research Design

A cross sectional study design was used in this study. The study design was appropriate because it involves investigating the events as they are found in the environment by giving a cross section of the existing factors associated with occupational injuries among solid waste collectors.

3.3 Study Variables

In this study the independent variables were the socio-demographic data, predisposing factors and mitigation factors and include extent of utilization of personal protective equipment, and working conditions. These independent variables were assessed to determine how they impact the dependent variable which in this case represents the occurrence of occupational injuries.

3.4 Location of Study

The study took place in Nairobi City County that is the largest city in Kenya in terms of population and infrastructural development. The city has experienced a very rapid population growth among urban centers in recent years. The rapid growth is poised to continue due to the increase in the Kenyan population by an average of approximately 2.3% or 1 million persons annually with many people migrating to towns and major cities particularly Nairobi city to look

for employment.

Nairobi City County occupies approximately 684Km^2 with a population of about 4,397,073 (2019 national census) and subdivided into 17 sub counties. Nairobi City County is located on 1°16'S latitude and 36°48'E longitude geographic coordinates. Nairobi is a cosmopolitan city because it is occupied by Kenyans from all walks of life and also the international community. The study was carried out in five of the seventeen administrative sub-counties in Nairobi County i.e. Kasarani, Dagoretti North, Langata, Embakasi central and Starehe sub-counties.

3.5 Study Population

A total of 2246 solid waste collectors in Nairobi City County who are employed by Community Based Organizations (CBOs), private companies and the Nairobi City County Environment department were eligible for the study. The solid waste collectors who had worked for at least six months prior to the study were eligible for recruitment into the study. Records of employees of the private companies and County environment department involved in solid waste collection were obtained from the environment office at Nairobi City County headquarter. In the case of the CBOs, the records of the solid waste collectors were obtained from the sub-county environment department offices given that there were no records of CBOs at the county headquarters.

Records kept at the department of environment at the County offices, indicated that there were forty five (45) eligible registered private companies with a total of 726 solid waste collectors (see Appendix III). Nairobi County had a total of 288 eligible solid waste collectors employed by the county government. The total number of registered and eligible CBOs in the County at the time of the study was 206 employing a total of 1232 eligible SWCs. The total number of eligible solid

waste collectors in Nairobi City County therefore at the time of the study was 2246 spread across private companies; community based organizations (CBOs); and the Nairobi City County environment department employees.

3.6 Sampling

3.6.1 Sampling Techniques and Procedure

Nairobi City County was purposively sampled as the study area because it is the largest city in east and central Africa and with huge amount of solid waste generated daily by the residents. Simple random sampling was employed to select five sub-counties out of the seventeen sub-counties in Nairobi City County. This represents approximately 30% of all the sub-counties in Nairobi. The sampled sub-counties include Starehe, Dagoretti North, Kasarani, Langata and Embakasi Central (see Appendix IV and V).

Finally systematic random sampling was used to select the study subjects from the records of solid waste collectors kept by each of the three groups (private companies; CBOs and Nairobi City County government employees) from the sampled sub-counties (see appendices IV and V). To select the first respondent as the starting point the n^{th} was computed for the various strata (groups) as follows:

$$\frac{\text{Number of solid waste collectors}}{\text{Sample size}}$$

After getting the n^{th}, the starting point respondent was then selected randomly from the first n^{th} number of respondents for each of the three strata.

3.6.2 Sample Size Determination

Fishers' et al., 1999, statistical formula was employed to calculate the sample size with a correction for the target population less than 10,000

$$N = \frac{z\text{^}2 \times p \times (1 - p)}{d\text{^}2}$$

Where z = 1.96 (standard normal deviate for alpha level of 0.05)

p = 0.5 (because there is no known prevalence of injuries among solid waste collectors in Nairobi City County, 50% prevalence or 0.5 was used to compute the sample size)

$$N = \frac{1.96 \times 1.96 \times 0.5 \times (1 - 0.5)}{0.05 \times 0.05}$$

n = 384

To adjust the sample size when the target is less than 10,000 in Nairobi City County,

$$nf = \frac{n\ .}{1 + (n/N)}$$

Where:

nf= the desired sample size (when the population is less than 10,000).

N= the estimated population size = 2246

n = 384

$$nf = \frac{384}{1+(384/2246)}$$

Desired sample size = 328

Therefore, a total of 328 solid waste collectors in Nairobi City County were recruited for the study. Proportionate computation of the sample size for the three groups (strata) is as follows:

Private companies $\frac{726*328}{2246} = 106$

Nairobi City County Environment department $\frac{288*328}{2246} = 42$

Community based organization $\frac{1238*328}{2246} = 180$

3.7 Inclusion and Exclusion Criteria

3.7.1 Inclusion

Solid waste collectors working with registered private companies, CBOs and County environment department were included in the study as study subjects. SWCs were also expected to have worked for at least six months prior to the study to be eligible for recruitment as study subjects because this duration enabled them to have a proper understanding of the challenges in the work environment.

3.7.2 Exclusion

Solid waste collectors who had not consented were excluded from the study.

3.8 Construction and Research Instruments

The study employed the use of a structured questionnaire as the research tool. The tool was used to gather information from the solid waste collectors about the occupational injuries suffered (see appendix IV); predisposing factors; and mitigation measures against the injuries.

3.9 Data Collection Quality Control

3.9.1 Pre-testing

A total of 34 solid waste collectors who represented at least 10% of the study sample size were used to pre-test the interview schedule research instrument prior to the study period. The pretesting was carried on respondents who were different from the study participants. According to

Mugenda and Mugenda (1999), a sample size of 10 to 50% of the study sample size is recommended for pretesting. Pretesting was done in Roysambu sub-county because the location was presumed to have similar characteristics as the study areas. Using a different sub-county from the sampled sub-counties is recommended to avoid re-selecting the respondents during the actual study. Analysis was then done to ascertain the quality of data collected and inconsistencies, gaps and overlaps were rectified before the actual study was conducted.

3.9.2 Validity

Validity of the questionnaire research instrument was meant to show that the tool had the ability to measure what it was supposed to measure. Pre-testing was done to appraise the study instrument and check its feasibility for collecting the correct data. This was meant to enhance validity by making sure that questions in the study instrument were clear and generated the right responses.

3.9.3 Reliability

Reliability shows the precision and accuracy of the measuring instrument. Reliability of the questionnaire was done by carrying out pre-test to ensure the questionnaire consistently measured what it was supposed to measure. In addition, research assistants were trained to enable them ensure consistency of data during data collection.

3.10 Data Collection Techniques

Data was collected using interviewing technique because it was considered appropriate for obtaining relevant data from the study participants. When using interviewing technique the researcher is usually in control of the information being sought from the study participants. It

was easy to seek for clarification from the SWCs through further probing whenever the answers given were not clear or satisfactory.

3.11 Data Analysis

The collected data was entered into SPSS Version 21.0 statistical software for analysis after coding. Descriptive statistical analysis was done using frequencies and percentages, Chi square test was employed to test for associations between predictor and outcome variables (use of personal protective equipment, work environment versus the injuries and related health problems incurred).

Logistic regression test was carried out to determine the true significant predictors of occupational injuries. In all cases $p<0.05$ was used as a cut off for statistical significance. The analyzed data was presented and interpreted in tables, bar graphs and pie charts.

3.12 Logistical and Ethical Considerations

The proposal was approved by Kenyatta University graduate school. Ethical clearance was obtained from Kenyatta University Ethical Review Committee. The research permit to conduct the study was obtained from the National Commission for Science, Technology and Innovation (NACOSTI). Informed consent was sought from the study subjects after a brief introduction of the intent of the study. Confidentiality was enhanced by omitting respondent's names from the interview schedules**.** The computer used for data entry was password protected and accessed only by the investigator.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents analyzed data from responses from SWCs obtainable using questionnaire research instrument. The results are presented with respect to the objectives of the study.

4.2 Socio-Demographic Characteristics of the Study

Socio-demographic characteristics of the solid waste collectors who were respondents in the study are presented in Table 4.1. Majority of the respondents were males 301(91.8%) with the proportion of females being 27(8.2%). Majority of the respondents 183(55.8%) were aged above 30 years old. The age of respondents ranged from 18 to 57 years, with the mean age being 34.63 years (Table 4.2).

The study established that, majority of the respondents had at most primary school level of education 237(72.3%). Majority of the respondents 189(57.6%) had work experience of at most 3 years. The study also shows that 220(67.1%) of the respondents were slum dwellers and only 108(32.9%) were non-slum dwellers. Majority of the respondents 141(43.0%) earn Kshs 0-10000 with the least 74(22.6%) earning above Kshs. 20000 (Table 4.1). The mean monthly income of the respondents was Kshs 16769.51 with the minimum income earned being Kshs 3000 and maximum being Kshs 50000 respectively (Table 4.2).

Majority of the respondents 258(78.7%) worked for more than 30 hours per week with only 70(21.3%) working for at most 30 hours per week (Table 4.1). The mean weekly work hours was 50.90 hours with the minimum work hours being 10 hours and the maximum work hours being 90 hours (Table 4.2).

Majority of the respondents 201(61.3%) were married with the rest 127(38.7%) being single (never been married, separated, widowed) (Table 4.1). The mean duration of employment as a SWC was 6.95 years with the minimum being 1 year and maximum being 31 years (Table 4.2).

Table 4.1: Socio-demographic characteristics of solid waste collectors

Characteristic	Solid waste collectors organization type			
	Private Company (n=106)	Nairobi County Environment Department (n=42)	Community Based Organization (CBO) (n=180)	Total (n=328) (n=100%)
Gender				
Male	102	26	173	301(91.8)
Female	4	16	7	27(8.2)
Age				
≤30	56	0	89	145(44.24)
>30	50	42	91	183(55.8)
Marital Status				
Married	59	30	112	201(61.3)
Single	47	12	68	127(38.7)
Highest Level of Education				
≤ Primary level	68	35	134	237(72.3)
≥ Secondary level	38	7	46	91(27.7)
Income				
Kshs. 0-10000	58	10	73	141(43.0)
Kshs 10001-20000	33	6	74	113(34.5)
Kshs >20000	15	26	33	74(22.6)
Residence				
Slum	76	16	128	220(67.1)
Non-slum	30	26	52	108(32.9)
Years of experience				
≤3	51	10	128	189(57.6)
>3	55	32	52	139(42.4)
Weekly work hours				
≤30	26	10	34	70(21.3)
>30	80	32	146	258(78.7)

Table 4.2 Descriptive statistics for continuous variables

Descriptive Statistics

Variables	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Respondents' age	328	18	57	34.63	9.405	.544	.135	-.719	.268
Respondents' monthly income (KES)	328	3000.00	50000.00	16769..51	11498.64	1.696	.135	1.941	.268
Respondents' duration of employment (years)	328	1	31	7.29	8.473	1.679	.135	1.504	.268
Respondents' weekly work hours	328	10	90	48.43	20.199	-.279	.135	-.806	.268
Valid N (Listwise)	328								

4.3 Types and Magnitude of Occupational Injuries

4.3.1 Respondents who Suffered Occupational Injuries Six Months Prior to the Study

Figure 4.1 shows that 289(88.1%) of the solid waste collectors suffered occupational injuries and only 39(11.9%) had not suffered any occupational injuries.

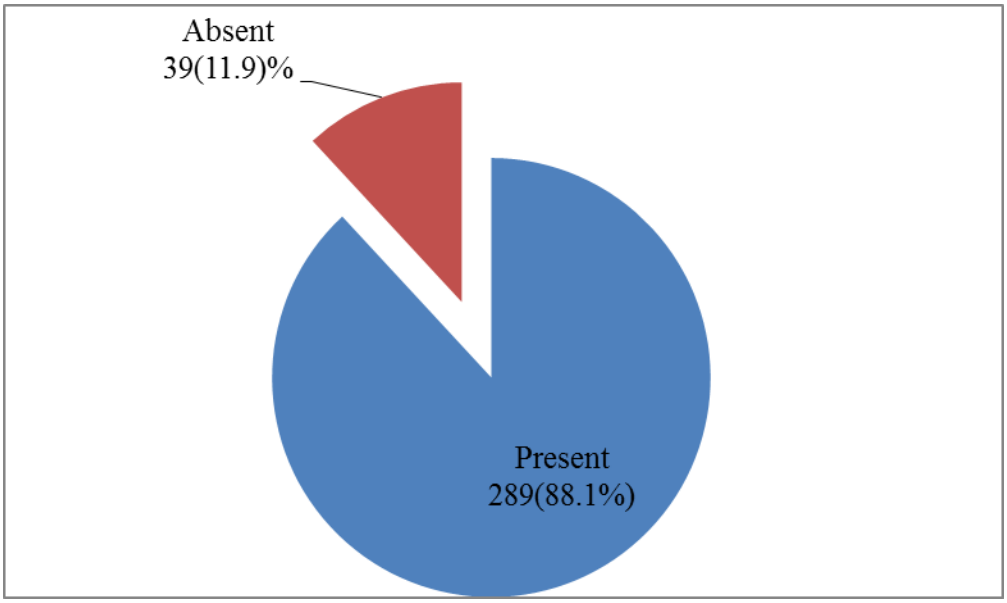


Figure 4.1: Proportion of respondents who had experienced occupational injuries six months prior to the study

4.3.2. Types and Magnitude of the Various Types of Occupational Injuries

Figure 4.2 shows the various types and magnitude of occupational injuries suffered by the respondents six months prior the study. The types and magnitude of occupational injuries suffered by SWC were as follows: fracture injury 28(8.5%); sprain or strain injury 111(33.8%); contusion injury 188(57.3%); laceration injury 252(76.8%); and puncture injury 264(80.5%) respectively. It can be deduced that puncture injuries were the most prevalent and fracture injuries the least prevalent among the solid waste collectors.

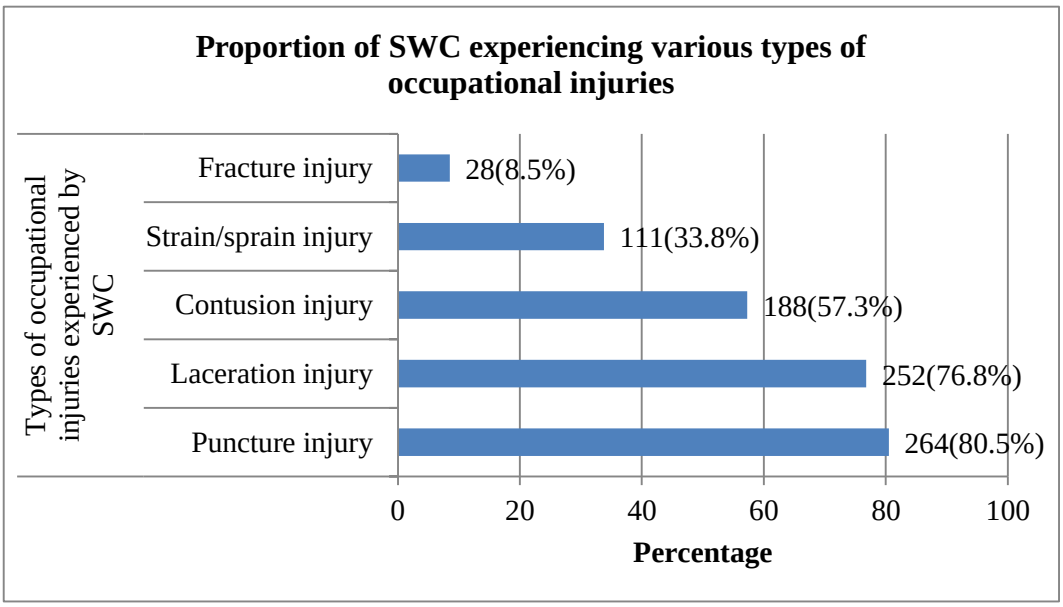


Figure 4.2: Types and magnitude of occupational injuries experienced by SWC six months prior to the study.

4.4 Distribution of Occupational Injuries Based on Socio-demographic Characteristics

This section discusses the distribution of occupational injuries based on socio-demographic characteristics: age; gender; marital status; place of residence; level of education; and monthly income.

4.4.1 Distribution of Strain or Sprain Injury Based on Socio-demographic Characteristics

The study indicates that the total number of respondents who experienced strain or sprain injuries were 111(33.8%). Most of the respondents were aged >30 years and experienced a higher proportion of strain or sprain injury 58(31.7%) than those aged ≤30 years 44(30.3%); female respondents experienced a higher proportion of strain or sprain injury 13(37%) than the male respondents 98(30.6%). Respondents who had single marital status experienced a higher proportion of strain or sprain injury 44(34.6%) than the married 58(28.9%); respondents who were non-slum dwellers experienced a higher proportion of strain or sprain injury 38(35.2%) than the slum dwellers 64(29.1 %). Respondents who had attained at most primary level of education experienced more strain or sprain injury 75(31.6%) than those who had attained at least secondary level of education 27(29.7%); and respondents who earned Kshs 10001-20000 experienced the highest proportion of strain or sprain injury 39(34.5%) with those earning Kshs > 20000 experiencing the least proportion of strain or sprain injury 18(24.3%) (Table 4.3).

There was no statistical significant difference between strain or sprain injury and all the socio-demographic characteristics as follows: age ($\chi2=0.069$; df=1; p=0.793); sex ($\chi2=0.484$; df=1; p=0.486); marital status ($\chi2=1.218$; df=1; p=0.270); place of residence ($\chi2=1.256$; df=1; p=0.262); level of education ($\chi2=0.120$; df=1; p=0.729); and monthly income ($\chi2=2.244$; df=1;

p=0.326) (Table 4.3). That means anyone regardless of age, sex, marital status, place of residence, level of education and monthly income was vulnerable to strain or sprain injuries.

Table 4.3: Distribution of strain or sprain injury based on socio-demographic characteristics

Socio-demographic characteristics		Status of strain or sprain		χ2-value
		Present n(%)	Absent n(%)	
Age (years)	≤30 years	44(30.3%)	101(69.7%)	χ2=0.069; df=1; p=0.793
	>30 years	58(31.7%)	125(68.3%)	
Gender	Male	92(30.6%)	209(69.4%)	χ2=0.484; df=1; p=0.486
	Female	10(37%)	17(63%)	
Marital status	Married	58(28.9%)	143(71.1%)	χ2=1.218; df=1; p=0.270
	Single	44(34.6%)	83(65.4%)	
Place of residence	Slum	64(29.1%)	156(70.9%)	χ2=1.222; df=1; p=0.262
	Non-slum	38(35.2%)	70(64.8%)	
Level of education	At most primary	75(31.6%)	162(68.4%)	χ2=0.120; df=1; p=0.729
	At least secondary	27(29.7%)	64(70.3%)	
Monthly income (KES)	0-10000	45(31.9%)	96(68.1%)	χ2=2.244; df=2; p=0.326
	10001-20000	39(34.5%)	74(65.5%)	
	≥20000	18(24.3%)	56(75.7%)	

Significant at p<0.05

4.4.2 Distribution of Puncture Injury Based on Socio-Demographic Characteristics

With regard to puncture injury a total of 257(78.4%) respondents experienced puncture injury, with respondents aged ≤30 years experiencing a higher proportion of puncture injury 120(82.8%) than those aged >30 years 137(74.9%); male respondents had a higher proportion of puncture injury 240(79.7%) than the female respondents 17(63%); respondents who were married had a proportionately higher puncture injury 161(80.1%) than the single 96(37.4%). Slum dwellers experienced a higher proportion of puncture injury 177(80.5%) than non-slum dwellers 80(74.1%). Respondents who had attained at most primary level of education experienced

proportionately higher puncture injury 194(81.9%) than those with at least secondary level of education 63(69.2%); both respondents who earned Kshs 0-10000 had the highest proportion of puncture injury 119 (84.4%), whereas those who earned Kshs >20000 had the least proportion of occupational injuries 47(67.1%). Table 4.4.

There was statistical significant difference between puncture injury and the following socio-demographic characteristics: sex ($\chi2$=4.094; df=1; p=0.043); level of education ($\chi2$=6.180; df=1; p=0.013); and monthly income ($\chi2$=15.091; df=2; p=0.001). There was no statistical significant difference between puncture injury and the following socio-demographic characteristics: age ($\chi2$=1.419; df=1; p=0.234); marital status ($\chi2$=0.933; df=1; p=0.334); and place of residence ($\chi2$=1.222; df=1; p=0.269) (Table 4.4). This shows that male respondents, respondents with low level of education, and those living in slum areas were more vulnerable to puncture injuries.

Table 4.4: Distribution of puncture injury based on socio-demographic characteristics

Socio-demographic characteristics		**Status of puncture injury**		**$\chi2$-value**
		Present n(%)	**Absent n(%)**	
Age (years)	≤30 years	120(82.8%)	25(17.2%)	$\chi2$=2.973; df=1; p=0.085
	>30 years	137(74.9%)	46(25.1%)	
Gender	Male	240(79.7%)	61(20.3%)	$\chi2$=4.109; df=1; p=0.043
	Female	17(63%)	10(37%)	
Marital status	Married	161(80.1%)	40(19.9%)	$\chi2$=0.933; df=1; p=0.332
	Single	96(37.4%)	31(24.4%)	
Place of residence	Slum	177(80.5%)	43(19.5%)	$\chi2$=1.738; df=1; p=0.187
	Non-slum	80(74.1%)	28(25.9%)	
Level of education	At most primary	194(81.9%)	43(18.1%)	$\chi2$=6.180; df=1; p=0.013
	At least secondary	63(69.2%)	28(30.8%)	
Monthly income (Kshs)	0-10000	119(84.4%)	22(15.6%)	$\chi2$=15.099; df=2; p=0.001
	10001-20000	92(81.4%)	21(16.6%)	
	≥20000	46(62.2%)	28(37.8%)	

4.4.3 Distribution of Contusion Injury Based on Socio-demographic Characteristics

The study further indicates that the total number of respondents who experienced contusion was 184(56.1%) (Figure 4.2) with those aged ≤30 years experiencing a higher proportion of contusion injury 90(62.1%) than those aged >30 years 94(51.4%); male respondents had higher proportion of contusion injury 171(56.8%) than the female respondents 13(48.1%); respondents with single marital status had a proportionately higher contusion injury 73(57.5%) than the married 111(55.2%). Slum dwellers experienced more contusion injury 126(57.3%) than non-slum dwellers 58(53.7%); respondents who had attained at most primary level of education experienced proportionately higher contusion injury 143(60.3%) than those with at least secondary level of education 41(45.1%); and respondents who earned Kshs 0-10000 had the highest proportion of contusion injury 93(66%), with those who earned Kshs >20000 experiencing the least proportion of contusion injuries 25(33.8%) (Table 4.5).

There was a statistical significant difference between contusion injury and the following socio-demographic characteristics: level of education ($\chi 2=6.236$; df=1; p=0.013); and monthly income ($\chi 2=20.771$; df=2; p=0.001). There was no statistical significant difference between contusion injury and the following socio-demographic characteristics: age ($\chi 2=3.763$; df=1; p=0.052); sex; ($\chi 2=0.755$; df=1; p=0.385); marital status ($\chi 2=0.161$; df=1; p=0.688); and place of residence ($\chi 2=0.375$; df=1; p=0.540) (Table 4.5). This shows that respondents who were more learned and those who earned more salaries were less vulnerable to contusion injuries.

Table 4.5: Distribution of contusion injury based on socio-demographic characteristics

Socio-demographic characteristics		Status of contusion injury		χ2-value
		Present n(%)	Absent n(%)	
Age(years)	≤30 years	90(62.1%)	55(37.9%)	χ2=3.763; df=1; p=0.052
	>30 years	94(51.4%)	89(48.6%)	
Gender	Male	171(56.8%)	130(43.2%)	χ2=0.755; df=1; p=0.385
	Female	13(48.1%)	14(51.9%)	
Marital status	Married	111(55.2%)	90(44.8%)	χ2=0.161; df1; p=0.688
	Single	73(57.5%)	54(42.5%)	
Place of residence	Slum	126(57.3%)	94(42.7%)	χ2=0.375; df=1; p=0.540
	Non-slum	58(53.7%)	50(46.3%)	
Level of education	At most primary	143(60.3%)	94(39.7%)	χ2=6.236; df=1; p=0.013
	At least secondary	41(45.1%)	50(54.9%)	
Monthly income (Kshs)	0-10000	93(66%)	48(34%)	χ2=20.771; df=2; p=0.001
	10001-20000	66(58.4%)	47(41.6%)	
	≥20000	25(33.8%)	49(66.2%)	

Significant at p<0.05

4.4.4 Distribution of Laceration Injury Based on Socio-demographic Characteristics

Table 4.5 shows the distribution of laceration injury based on socio-demographic characteristics. The study revealed that a total of 246(75%) respondents experienced laceration injury and the respondents aged ≤30 years experienced a higher proportion of laceration injury 113(77.9%) than those aged >30 years 133(72.7%); male respondents had higher proportion of laceration injury 229(76.1%) than the female respondents 17(63%); respondents who were married had a proportionately higher laceration injury 151(75.1%) than the single 95(74.8%). Slum dwellers experienced a higher proportion of laceration injury 172(78.2%) than non-slums dwellers 74(68.5%); respondents with at least secondary level of education experienced a proportionately higher laceration injury 69(75.8%) than those with at most primary level of education 177(74.7%); and respondents who earned Kshs 0-10000 had the highest proportion of laceration injury 116(82.3%), with those who earned Kshs >20000 (50(67.6%) having the least).

There was a statistical significant difference between laceration injury and monthly income and monthly income ($\chi2$=7.219; df=2; p=0.027) (Table 4.6.

There was no statistical significant difference between laceration injury and the following socio-demographic characteristic: age ($\chi2$=1.191; df=1; p=0.275); sex ($\chi2$=2.274; df=1; p=0.132); marital status ($\chi2$=0.004; df=1; p=0.948); place of residence ($\chi2$=3.306; df=1; p=0.058); and level of education ($\chi2$=0.046; df=1; p=0.831). This shows that the more the salary the less vulnerable one becomes.

Table 4.6: Distribution of laceration injury based on socio-demographic characteristics

Socio-demographic characteristics		**Status of laceration injury**		**$\chi2$-value**
		Present n(%)	**Absent n(%)**	
Age	≤30 years	113(77.9%)	32(22.1%)	$\chi2$=1.191; df=1; p=0.275
	>30 years	133(72.7%)	50(27.3%)	
Gender	Male	229(76.1%)	72(23.9%)	$\chi2$=2.274; df=1; p=0.132
	Female	17(63%)	10(37%)	
Marital status	Married	151(75.1%)	50(24.9%)	$\chi2$=0.004; df=1; p=0.948
	Single	95(74.8%)	32(25.2%)	
Place of residence	Slum	172(78.2%)	48(21.8%)	$\chi2$=3.608; df=1; p=0.058
	Single	74(68.5%)	34(31.5%)	
Level of education	At most primary	177(74.7%)	60(25.3%)	$\chi2$=0.046; df=1; p=0.831
	At least secondary	69(75.8%)	22(24.2%)	
Monthly income (Kshs)	0-10000	116(84.4%)	22(15.6%)	$\chi2$=7.219; df=2; p=0.027
	10001-20000	880(70.8%)	33(29.2%)	
	≥20000	50(67.6%)	24(32.4%)	

Significant at p<0.05

4.4.5 Distribution of Fracture Injury Based on Socio-demographic Characteristics

A total of 28(8.5%) respondents experienced fracture injury with those respondents aged >30 years experiencing a higher proportion of fracture injury 16(8.7%) than those aged ≤30 12(8.3%); male respondents had higher proportion of fracture injury 27(9%) than the female

respondents 1(3.7%); respondents who were single had a proportionately higher fracture injury 17(13.4%) than the married 11(5.5%). Non- slum dwellers experienced a higher proportion of fracture injury 12(11.1%) than the slum dwellers 16(7.3%); respondents with at most primary level of education experienced a proportionately higher fracture injury 22(9.3%) than those with at least secondary level of education 6(6.6%); and respondents who earned Kshs 10001-20000 had the highest proportion of fracture injury 13(11.5%), with those who earned Kshs >20000 (3(4.1%)) experiencing the least proportion of fracture injury. There was a statistical significant difference between fracture injury and the following socio-demographic characteristics: marital status ($\chi 2$=6.242; df=1; p=0.012) (Table 4.7).

There was no statistical significant difference between fracture injury and the following socio-demographic characteristics: age ($\chi 2$=0.023; df=2; p=0.880); sex (Fisher's exact test p = 0.492); level of education ($\chi 2$=0.609; df=1; p=0.435); place of residence ($\chi 2$=1.367; df=1; p=0.743); and monthly income (Fisher's exact test =3.129; p=0.190) (Table 4.7).

Table 4.7: Distribution of fracture injury based on socio-demographic characteristics

Socio-demographic characteristics		Status of fracture injury		Significance
		Present n(%)	**Absent n(%)**	
Age (years)	≤30 years	12(8.3%)	133(91.7%)	$\chi2$=0.023; df=1; p=0.880
	>30 years	16(8.7%)	167(91.3%)	
Gender	Male	27(9%)	274(91%)	Fishers exact p=0.429
	Female	1(3.7%)	26(91.3%)	
Marital status	Married	11(5.5%)	190(94.5%)	$\chi2$=6.242; df=1; p=0.012
	Single	17(13.4%)	110(86.6%)	
Place of residence	Slum	16(7.3%)	204(92.7%)	$\chi2$=1.367; df=1; p=0.242
	Non-slum	12(11.1%)	96(88.9%)	
Level of education	At most primary	22(9.3%)	215(90.7%)	$\chi2$=0.609; df=1; p=0.435
	At least secondary	6(6.6%)	85(93.4%)	
Monthly income (Kshs)	0-10000	12(8.5%)	129(91.5%)	Fishers exact=3.129; p=0.190
	10001-20000	13(11.9%)	100(88.5%)	
	≥20000	3(4.1%)	71(95.9%)	

Significant at p<0.05

4.5 Factors Predisposing Solid Waste Collectors to Occupational Injuries

This section discusses on the factors predisposing solid waste collectors to occupational injuries. They include: weekly work hours; nature of employment; duration of employment; and source of solid waste.

4.5.1 Frequency of Predisposing Factors for Occupational Injuries

Majority of the respondents 258(78.7%) worked for > 30 hours per week; SWCs on temporary employment were the most prevalent 245(74.7%); majority of the respondents 189(57.6%) had been in employment for ≤ 3 years; and majority of the respondents collected solid waste from different sources (mixed waste) 322(98.2%) with the least proportion 2(0.6%) collecting solid waste from homes only (Figure 4.3).

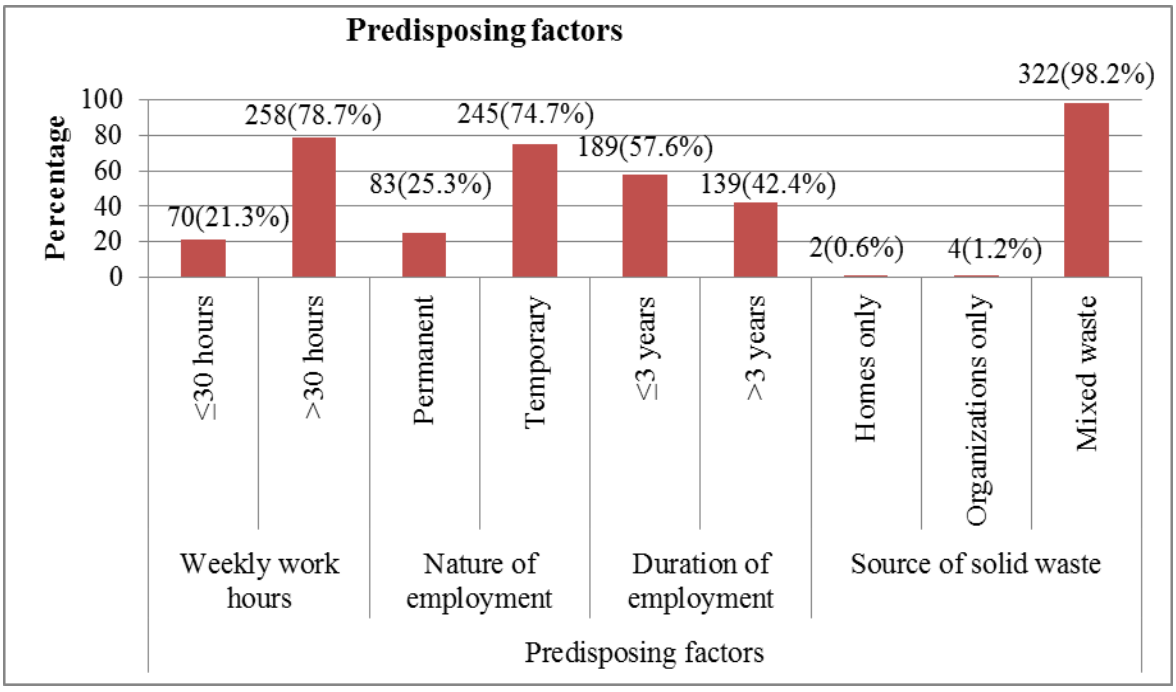


Figure 4.3: Percentage frequency of predisposing factors' categories

4.5.2 Association between Occupational Injuries and Predisposing Factors

Solid waste collectors who worked for >30 hours experienced a higher proportion of occupational injuries 229(88.8%) than those who worked for ≤30 hours 60(85.7%); those who were on temporary employment had higher proportion of occupational injuries 224(91.4%) than SWCs on permanent employment 65(78.3%); solid waste collectors who had worked for ≤3years had experienced a proportionately higher occupational injuries 168(88.9%) than those who had worked for >3years 121(87.1%). SWCs who collected mixed solid waste experienced the highest proportion of occupational injuries 285(88.5%) with the least being among those who collected solid waste from institutions 1(25%) (Table 4.8).

There was statistical significant difference between occupational injuries and the following predisposing factors: nature of employment ($\chi 2$=10.179; df=1; p=0.001); and source of waste (Fisher's exact test=8.308; p=0.20). There was no statistical significant difference between

occupational injuries and the following predisposing factors; weekly work hours ($\chi2$=0.487; df=1; p=0.485); duration of employment ($\chi2$=0.258; df=1; p=0.611).

Table 4.8: Association between occupational injuries and predisposing factors

Predisposing factors		**Status of occupational injuries**		**$\chi2$-value**
		Present n(%)	**Absent n(%)**	
Weekly work hours	≤30 hours	60(85.7%)	10(14.3%)	$\chi2$=0.487; df=1; p=0.485
	>30 hours	229(88.8%)	29(11.2%)	
Nature of employment	Permanent	65(78.3%)	18(21.7%)	$\chi2$=10.179; df=1; p=0.001
	Temporary	224(91.4%)	21(8.6%)	
Duration of employment	≤30 years	168(88.9%)	21(11.1%)	$\chi2$=0.258; df=1; p=0.611
	>30 years	121(87.1%)	18(21.7%)	
Sources of waste	House to house	1(50.0%)	1(50%)	Fishers' exact=8.308;df=2; p=0.020
	Institutions	1(25%)	3(75.0%)	
	Mixed waste	285(88.5%)	87(11.5%)	

Significant at p<0.05

4.6 Mitigation Measures against Occupational Injuries

This section discusses the mitigation measures against occupational injuries among solid waste collectors. The mitigation measures include on job training; full usage of PPEs; and method of waste collection.

4.6.1 Frequency of Mitigation Measures against Occupational Injuries

Figure 4.4 shows the frequency distribution of the various categories of mitigation measures against occupational injuries. Majority of the SWCs 281(85.7%) never received any training on safe methods of solid waste handling; SWCs who never used mechanical method of solid waste collection were the majority 313(95.4%); and on the status of usage of PPEs, majority of the SWCs never used any kind of PPEs 208(63.4%) six months prior to the study.

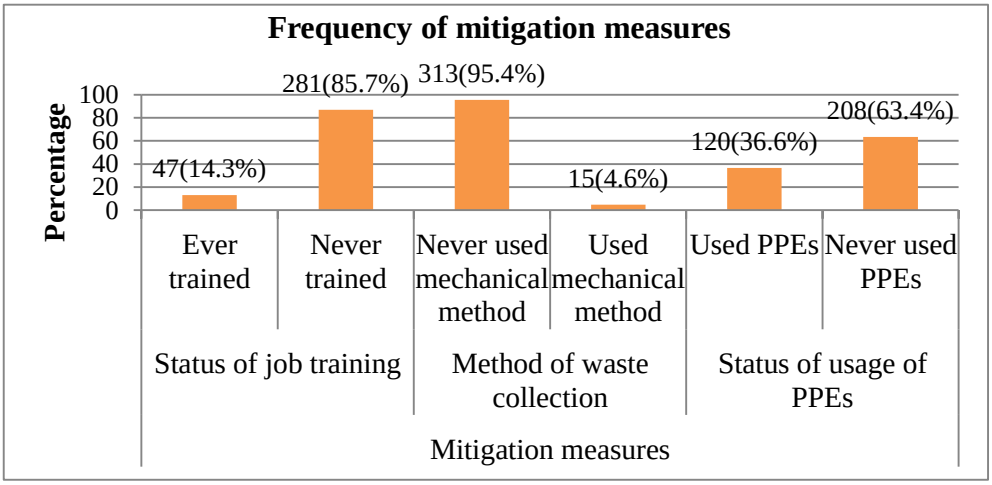


Figure 4.4: percentage frequency of mitigation measures

4.6.2 The Association between Mitigation Measures and Occupational Injuries

Table 4.8 shows the association between occupational injuries and mitigation measures. SWCs who have never trained on safe solid waste collection methods had a higher proportion of occupational injuries 252(89.7%) than those who have ever trained 37(78.7%); SWCs who never used mechanical method of solid waste collection had a higher proportion of occupational injuries 280(89.5%) than those who had ever used mechanical method of solid waste collection 9(60%); and SWCs who never used PPEs had a higher proportion of occupational injuries 191(91.8%) than those who have ever used PPEs 98(81.7%).

There was a statistical significant difference between occupational injuries and all the mitigation measures as follows: status of usage of mechanical method of solid waste collection ($\chi2=11.856$; df=1; p=0.001); status of job training ($\chi2=4.614$; df=1; p=0.032); and status of usage of PPEs ($\chi2=7.498$; df=1; p=1.006). Therefore all the mitigation measures are predictor of occupational injuries.

Table 4.9: The association between mitigation measures and occupational injuries

Mitigation measures		Status of occupational injuries		χ2-value
		Present n(%)	Absent n(%)	
Job training	Ever trained	37(78.7%)	10(21.3%)	χ2=4.614; df=1; p=0.032
	Never trained	252(89.7%)	29(10.3%)	
Waste collection methods	Manual	280(89.7%)	33(10.5%)	χ2=11.856; df=1; p=0.001
	Mechanical	9(60%)	6(40%)	
PPEs usage	Ever used	98(81.7%)	22(18.3%)	χ2=7.498; df=1; p=0.006
	Never used	191(91.8%)	17(8.2%)	

Significant at p<0.05

4.7 Logistic Regression Model

A binary logistic regression model was done to identify the predictor variables that were independently associated with the various types of occupational injuries (outcome variables).

The regression model shows that with regard to the distribution of puncture injury among socio-demographic characteristics there was association between puncture injury and gender (OR=0.5; p=0.048); level of education (OR=0.6; p=0.017); puncture injury and monthly income (OR=1.8; P=0.001) (Table 4.9). These results are in agreement with the bivariate Chi-square test (Table 4.3).

The regression model shows an association between contusion injury and the level of education (OR=0.9; P=0.014); contusion injury and monthly income (OR=1.9; P=0.000) (Table 4.10). The results agree with the results of bivariate Chi-square test as shown in Table 4.3. Bivariate test findings (Table 4.4) agree with the regression model that there is an association between fracture injury and marital status (OR=0.4; P=0.020).

The regression model analysis for predisposing factors (Table 4.10) agrees with bivariate test findings (table 4.7) that there was an association between occupational injuries and nature of employment (OR=1.4; p=0.009). Binary regression model (Table 4.10) agrees with bivariate Chi-square test findings (Table 4.8) with regard to association between occupational injuries and all mitigation measures as follows: use of mechanized methods for solid waste handling (OR=0.8; p=0.011), usage of PPEs (OR=1.9; p=0.035) and job training (OR=1.5; p=0.041).

Table 4.10: Regression model for distribution of occupational injuries among socio-demographic factors

Variable		**B**	**df**	**Sig.**	**OR(95% C.I)**
Logistic regression for occupational injuries based on socio-demographic characteristics					
Puncture injury	Gender	-.900	1	.048	0.5(0.1 to 2.0)
	Education level	-.701	1	.017	0.6(0.1 to 1.6)
	Monthly Income	.598	1	.001	1.8(1.3 to 2.6)
Contusion injury	Education level	-.630	1	.014	0.9(0.1 to 1.1)
	Monthly Income	.632	1	.000	1.9(1.4 to 2.5)
Fracture injury	Marital status	-.953	1	.020	0.4(0.2 to 0.9)
Logistic regression for predisposing factors for occupational injuries among SWCs					
Occupational injuries	Nature of employment(1)	.947	1	.009	1.4(0.9 to 1.8)
Logistic regression for mitigation measures against occupational injuries among SWCs					
Occupational injuries	Status of Job training(1)	.786	1	.041	1.5(0.9 to 2.2)
	Use of mechanical method(1)	-1.867	1	.011	0.8(0.4 to 1.5)
	Status of PPEs usage(1)	.754	1	.035	1.5(0.9 to 2.1)

4.8 Summary of the Study Findings

Several findings can be deduced from the binary logistic regression model (Table 4.10). With respect to gender, the female SWCs had proportionately higher puncture injuries than the male; level of education is a negative predictor of occurrence of puncture injury with SWCs who were more educated having proportionately lower puncture injuries. SWCs who earned more had higher proportion of puncture injuries than those who earned less.

The level of education is a negative predictor of occurrence of contusion injury with SWCs who were more educated having proportionately lower contusion injuries. SWCs who earned more had higher proportion of contusion injuries than those who earned less. With regard to fracture injury, the married experienced a higher proportion of fracture injuries than the single (separated/divorced/widowed/never married).

With respect to predisposing factors for occupational injuries, SWCs on temporary employment had higher proportion of occupational injuries than those who were on permanent employment. With regard to mitigation measures, not undergoing training is a positive predictor of occupational injuries with SWCs who were trained experiencing less occupational injuries than those who were not trained. Respondents who used mechanical method of solid waste handling experienced a lower proportion of occupational injuries than those who did not. SWCs that used PPEs experienced a lower proportion of occupational injuries than those who did not use PPEs.

CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1. Discussion

The study results, conclusions and recommendations are presented in this chapter. It provides information on the various types and magnitude of occupational injuries experienced by solid waste collectors in Nairobi City in their daily work, the distribution of the injuries, factors predisposing the solid waste collectors to injuries and the mitigation measures against occupation injuries. There are three categories of solid waste collectors who engage in waste collection in Nairobi City County. They include solid waste collectors employed and working under the County government environment department, those organized as CBOs and those employed by private companies that are sub-contracted to collect solid waste on behalf of the county government of Nairobi.

5.1.1 Socio-demographic Characteristics

Majority of solid waste collectors in Nairobi City County were low academic achievers having attained only primary school level of education 237(72.3%). This is in agreement with a study done in India that the SWC have low literacy level (Khaiwal, et, al 2016). Also majority 183(55.8%) were relatively older, aged >30 years old. The study findings agree with a study conducted in Mansoura Egypt which showed that majority of the solid waste handlers were aged ≥40 years (Abou-ElWafa et al., 2012). Also another study carried out in South Korea indicated that majority of the solid waste collectors were older workers with 50 years or older (Choi, 2009; Jeong et al., 2016). The findings from this study indicates that the male gender is the most dominant 301(91.8%) which is contrary to a study done in Amhara in Ethiopia that indicates that majority of the solid waste collectors were female (75.2%) (Eskezia et al., 2016). However, a

study done in India agrees with this study that the males were the majority solid waste collectors and had low education level at most primary level (Endreddy & Sandul, 2015a).

The study revealed that most solid waste collectors were low income earners with the majority earning Kshs 0–10000 (43%). This is because they are unskilled and are low academy achievers hence attracting low pay which agrees with a study done in India where majority of the solid waste collectors were unskilled and therefore their earnings were classified as low and average (Endreddy & Sandul, 2015a). Majority of the solid waste collectors live in the slum 220(67.1%) and are already married and majority had worked for at least three years and also the majority worked for more than 30 hours per week.

5.1.2 Respondents Types and Magnitude of Occupational Injuries

The study indicated that there was a high prevalence of occurrence of occupational injuries among the solid waste collectors with 88.1% of the solid waste collectors having experienced injuries in the last six months prior to the study. This can be attributed to the manual loading of the solid waste, lack of training on safe handling of solid waste particularly on job training, limited use of personal protective devices and long working hours. According to Alemayehu et al. (2016) a study conducted in Ethiopia, indicated that absence of appropriate training for solid waste collectors before employment would have resulted in improper waste management practices hence raising health risks among solid waste handlers. This therefore agrees with the findings from this study.

The puncture injuries were the most common injuries experienced by the solid waste collectors. It was noted that majority of the solid waste collectors handle waste with their bare hands hence exposing them to puncture injuries.

This study agrees with a study carried out in Addis Ababa by Bogale et al. (2014) and another carried in out in Mansoura, Egypt by AEl-bou-ElWafa et al. (2012) that indicated that the absence of safety training, especially on job training, limited use of personal protective devices while handling solid waste are the major contributors to occurrence of occupational injuries.

5.1.3 Distribution of Occupational Injuries among the Solid Waste Collectors

The study also reveals that males were the most affected 91.8% by occupational injuries. Moreover, there is increased load situation for males because they carry and empty heavy bags that are unstable and have a high variability of weight. The study disagrees with a study carried out in Addis Ababa that showed that majority of respondents experiencing injuries were females (Bogale et al., 2014). The study also agrees with the study done in Korea where males were the most injured (Jeong, 2017). The high magnitude of occupational injuries would also be attributed to lack of knowledge on the dangers of work related problems (Caniato, et al, 2015). Also in developing countries health intervention and occupational safety is mostly equaled with supply of PPEs which is considered to be a less effective measures than the others due to the demand that it must be applied correctly and consistently and has been inadequate and insufficiently supplied (Bunn et al., 2011).

A study done in Greece showed that although PPEs are recommended strongly, they are not regularly used (Athanasiou et al., 2010). Also solid waste collectors generally known to work

late into night or very early in the morning, and due to poor visibility more injuries are encountered (Jayakrishnan et al., 2013).

5.1.4 Status of Predisposing Factors

The study revealed that SWCs who worked for >30 hours per week were the most affected (86.3%); also those who were on temporary employment were the most affected by the occupational injuries 95.4%. This concur with a study done in Ethiopia that indicated that those solid waste collectors who worked for long hours experienced more injuries (Bogale et al., 2014). Furthermore, the study also reveals that most of the affected respondents (59.1%) had worked for ≤3 years and also those who collected mixed waste (98.2%).

As is the case with developing countries, solid waste collectors in Kenya come from less privileged population and reside in unhygienic environment which is a contributing factor to the poor state of work conditions. Solid waste collection including the disposal mechanisms are usually informal and low paying. Because of the low level of education, solid waste handlers are often unaware of the associated risks and also lack proper medical treatment. The study agrees with a study carried out in Egypt that solid waste collection is a job done mainly by poor people and by people of low education status (Mostafa et al., 2015).

5.1.5 Mitigating Measures against Occupational Injuries

The study reveals that most respondents were never trained on waste handling 86.9% before and during the working period. This however agrees with a study carried out in Ethiopia which shows that refuse handlers lack relevant information, training and appropriate tools in order to perform their work in the most healthful and safe manner (Bogale et al., 2014).

95.4% used manual methods when handling the waste this also agrees with the study done in Ghana that use of un automated vehicles made solid waste collectors to be more vulnerable to injuries(Akormedi, et, al 2017) and 63.4% never used the personal protective equipment. Most of the respondents complained that the personal protective equipment was never provided and therefore forcing them to work without. The lack of PPEs increased the risk of waste collectors being exposed to the injuries (Endreddy et al., 2015).

5.2 Conclusion

These conclusions can be drawn from the study findings:

I. SWCs suffered the following occupational injuries: puncture 78.4%; laceration 75%; contusion 56.1%; strain and sprain 31.1%; and fracture 8.5% respectively.

II. The study found out that nature of employment was the only significant predisposing factor for occupational injuries with SWCs on temporary employment experiencing more occupational injuries than those on permanent employment.

III. The study found out that job training; use of mechanized method of solid waste collection; and use of PPEs were positive predictor mitigation measures against occupational injuries.

5.3 Recommendations for Policy

Since the current OSHA regulations do not specifically address solid waste collectors since we do not have comprehensive policy for solid waste collectors relating to health and safety issues, The study recommends that Nairobi City County, CBOs and private companies engaged in solid waste handling should:,

I. Make effort to sensitize SWCs about the various types and magnitude of occupational injuries affecting them.

II. Make effort to reduce the weekly work hours and improve remuneration of SWCs on temporary employment so as to reduce magnitude of the various types of occupational injuries.

III. Ensure regular training of SWCs on proper ways of waste handling; provision of mechanized methods of solid waste collection; and supply of adequate PPEs and monitor their usage.

5.4 Recommendations for Further Research

Very few studies have been done on solid waste collection. We recommend that research can be done on the following areas:

1. The effectiveness of implementing occupational safety and health act (OSHA) among solid waste collectors in Nairobi, Kenya
2. Access, uptake and delivery of quality medical care and treatment for solid waste collectors and how to enhance it.

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APPENDICES

Appendix I: Consent to Participate in Research

Title of Study: *Occupational injuries and associated factors among solid waste collectors in Nairobi City County, Kenya*

Introduction

My name is _**Jane Kanario Kaluu**. I am a *graduate student* at Kenyatta University, school of Public Health. I am *working with my faculty advisors, Dr. Justus O.S. Osero and Dr. Peterson Warutere* in the School of Public Health. I intend to carry out research, which I hereby invite you to participate part in.

You are invited to be part of this study because the organization you work for as a solid waste collector has been sampled to take part in the study. Also using the approved standard procedures for sampling you were identified as one of the study subjects

Purpose

The purpose for conducting this study is to find out the challenges facing solid waste collectors in Nairobi City County in the course of executing their duties. The study will look at the types of injuries experienced, the magnitude and distribution of these injuries as well as the working conditions that favour the occurrence of these injuries. The study seeks to determine the measures that are necessary to protect the solid waste collectors against the injuries.

The total number of study subjects who will participate in the study will be 328 who will be sampled from registered solid waste collection organizations operating in Nairobi City County.

Procedures

If you agree to be part of the study, you will be required to answer questions during an interview on the types, magnitude and distribution of injuries among solid waste collectors and also on the use of protective equipment. You will also be expected to advice on the measures that can be taken to address the challenges faced by solid waste collectors in Nairobi City County. I will need 30 minutes of your time for the interview which will be carried out at your place of work at your convenient time.

Before you begin the main part of the study...

You will need to confirm that you have been working as a solid waste collector for at least six months prior to the study for you to be eligible as a study participant.

Study time: Study participation is expected to take *approximately 30 minutes*.

Study location: All data collection procedures shall take place at your place of work**.**

Benefits

There is no expected direct gain for you in participating in the study. However, information gained from conducting the study is expected to help the solid waste collection companies, Nairobi City County environment department and other stakeholders to tackle the challenges facing solid waste collectors while performing their duties.

Risks/Discomforts

Some of the questions are likely to make you feel uncomfortable or even upset, but have the liberty to refuse to respond to such questions or to leave the group at will.

Breach of confidentiality: As is the case with all research, there is likelihood that confidentiality could be breached; however, all precautions will be taken to reduce or even eradicate this risk.

Confidentiality

The study data shall be handled with utmost confidentially as possible. If the study results are published or presented, the names and any personal information for identification will be excluded.

Risks to confidentiality will be prevented by excluding your name anywhere in the study and the interview schedules will be kept in a lockable cabinet and they will be destroyed as soon as the data has been retrieved and analyzed.

Treatment and compensation for injury

It is imperative that you promptly alert the researcher *[**Jane Kanario Kaluu**]*, if feel that you have been harmed by participating in this study. You can inform the researcher in person or call her at *[0721749159, or send letter to postal address, P.O Box 67944-00200, Nairobi]*.

Rights

Participation in research is completely voluntary. You are at liberty to refuse to take part in the study or to even withdraw altogether any point during the study without consequences.

Questions

If you have any concerns or questions about the study, you can contact Jane Kanario Kaluu__ [lead investigator name(s)] at 0721749159_ [phone number(s)] or janekanario@yahoo.com [email address] or Kenyatta University Ethics Review Committee Tel: 8710901/12 or ercku2008@gmail.com

****

CONSENT

You are provided with a copy of this consent form for your custody.

If you wish to take part in this study, please sign and date below.

_____

Participant's Name *(please print)* Date

_____

Participant's Signature Date

_____

Person Obtaining Consent Date

Appendix II: Research Interview Schedule

Occupational injuries and related health problems among solid waste collectors in Nairobi county Kenya

SOCIO-DEMOGRAPHIC CHARACTERISTICS

1. Name of participant: …….…….

2. Age of participant (in completed years): ……

3. Sex

Male [ ] 1

Female [ ] 2

4. Place of residence

Slum [ ] 1

Non-slum [ ] 2

5. Highest level of education attained

No formal schooling [ ] 1

Primary school level [ ] 2

Secondary school [ ] 3

6. Personal monthly income (KES): ……

DURATION OF EXPOSURE:

7. How long have you worked in this profession?.....

8. Total number of hours of work in a week?.....

JOB RELATED FACTORS:

9. Nature of Employment.

Permanent [ ] 1

Temporary [ ] 2

10. Have you ever been trained on solid waste handling?

No [ ] 1

Yes [ ] 2

11. From which places do you collect solid waste?

House to House only [ ] 1

Institutions only [ ] 2

Mixed waste [ ] 3

Any other Places (Specify) _____ 6

12. Method of solid waste collection?

Manually [ ] 1

Mechanical method [ ] 2

Both manual and mechanical [ ] 3

13. Do you use personal protective equipment during solid waste collection?

No [ ] 1

Yes [ ] 2

IF NO SKIP Q. NO 14

14. If yes, which protective equipment are you using?

Gloves [ ] 1

Gum Boots [ ] 2

Uniform [ ] 3

Goggles [ ] 4

Mask [ ] 5

All of the above [ ] 6

Any other (Specify_____) 7

None of above [ ] 8

15. If no, why are you not using protective equipment?

Not aware of risk [ ] 1

To save the time [ ] 2

To save the discomfort [ ] 3

Do not care [ ] 4

Protective equipment not provided [ ] 5

Any other (please specify)_____) 6

MORBIDITIES:

16. Have you had any injury in past six months?

Yes [ ] 1

No [ ] 2

IF NO SKIP TO Q.18

17. If yes, what type of the injuries have you ever experienced in the past six months?

Strain [ ] 1

Puncture [ ] 2

Contusion/bruise [ ] 3

Cut/laceration injury [ ] 4

Fracture [ ] 5

Sprain [ ] 6

Any other (please specify)_____ 7

None [ ] 8

18. According to you what would be the main reasons for injuries and deaths among waste collectors?

Lack of visibility around truck [ ] 1

Insufficient training [ ] 2

Non-observance safety procedures [ ] 3

Nature of work [ ] 4

Improper disposal of waste by residents [ ] 5

Lack of proper personal protective equipment [ ] 6

Careless passing of other vehicle [ ] 7

Weather [ ] 8

Incentive to work quickly [ ] 9

Lack of provision of temporary job change due to illness [ ] 10

Any other (please specify)_____ 11

Appendix III: Distribution of Solid Waste Collectors in Registered Private Companies in Nairobi City County

Table 5.1: Total number of solid waste collectors in registered private companies

S/N.	NAME OF PRIVATE COMPANIES	NUMBER OF SOLID WASTE COLLECTORS
1	Boulevard Bins Ltd	12
2	Nairobi Garbage Collectors and Consultants	16
3	Zoa Taka Ltd	13
4	Simple Garbage Collectors Ltd	13
5	Garbage Dot Com Ltd	17
6	Allybins Garbage Management	17
7	Moivan Waste Services	20
8	December Waste Services	17
9	Leinad Enterprises	18
10	Tamia Limited	20
11	Safi Environment Company Ltd	15
12	Evabo Enterprises	19
13	Dawac Garbage Collectors	10
14	New Light Communication	18
15	Junky Bins	17
16	Vijana Kwa Mazingira	16
17	Green Leaf Services Ltd	18
18	Smart City Cleaners Ltd	10
19	Dial-a-Home Limited	19
20	Sabiti Cleaning Services	18
21	One Way Cleaning	13
22	Masters Management Services Ltd	15
23	Bins Nairobi Services	16
24	Dos Bins Enterprises	12
25	Heritage Garbage Collectors	15
26	Usafi refuse Handlers	12
27	Three Bins Services	15
28	Parapet Cleaning Services	18
29	Colnet Limited	19
30	High-Tech Waste Management Consultants	12
31	Boredo Suppliers	30
32	Flash Services	15
33	Black Bin Agency	18

34	Environmental & combustion Consultant Ltd	18
35	Brown Bins Enterprises	18
36	Usafi Refuse Handlers	19
37	Reliable Refuse Disposal	18
38	Hy-tech Bins	19
39	Ngei Dev't Youth Group	11
40	Jambo Bins	16
41	Smartlink Services Ltd	13
42	Multiple Waste Paper Collectors	13
43	Recycle and Reuse Enterprises Ltd	15
44	Jewaka Garbage Collectors Company	15
45	Prime Bins Ltd	18
Total		**726**

***Key: Selected** –represents the total eligible solid waste collection companies in Nairobi City County.

Appendix IV: Total Number of Solid Waste Collectors in each Sub County for the three Groups

Table 5.2: Distribution of solid waste collectors for all sub counties in Nairobi County

S/N	Name of Sub county	Number of CBOs in the Sub county	Total Number of CBOs solid waste collectors per sub-county	No. of SWC working for Environment department per sub-county	No. of private companies per sub-county	No. of private companies SWC per sub-county	Sampled sub counties
1	Kasarani	16	98	19	3	53	✓
2	Embakasi North	15	88	12	2	29	
3	Westlands	8	50	17	2	32	
4	Dagoretti North	16	101	27	4	56	✓
5	Ruaraka	11	56	13	3	47	
6	Mathare	12	77	18	2	36	
7	Langata	7	36	12	3	42	✓
8	Kibra	17	97	15	2	38	
9	Roysambu	13	81	14	3	45	
10	Embakasi Central	15	95	18	3	59	✓
11	Embakasi West	12	68	19	2	43	
12	Embakasi South	14	90	15	2	34	
13	Starehe	6	40	30	3	41	✓
14	Embakasi East	10	52	14	3	45	
15	Kamukunji	8	54	21	3	39	
16	Makadara	9	60	12	2	36	
17	Dagoretti south	15	89	11	3	51	
Total		**206**	**1232**	**288**	**45**	**726**	

Appendix V: Number of sampled solid waste collectors per each sampled sub-county

Table 5.3: Proportionate distribution of sample size for each sampled sub-county

S/NO	Sampled sub-counties	SWC sample size for CBOs per sampled sub-counties	SWC sample size for Nairobi City County environment Department per sampled sub-counties	SWC sample size for private companies per sampled sub-counties
1	Kasarani	48	7	22
2	Dagoretti North	49	11	24
3	Embakasi Central	46	7	25
4	Langata	18	5	18
5	Starehe	19	12	17
	Total	**180**	**42**	**106**

Appendix VI: Identification of the Various Types of Occupational Injuries

1. Strain Injury

A strain is an injury that occurs to a muscle or tendon, and often results from by overuse, tearing, force, or stretching. A tendon is a mass of tissue that joins muscles to bones. Strains are often experienced in the lower back and in the back of the thigh. Signs and symptoms of strains include: pain; swelling; muscle spasms; inability to move the affected muscle.

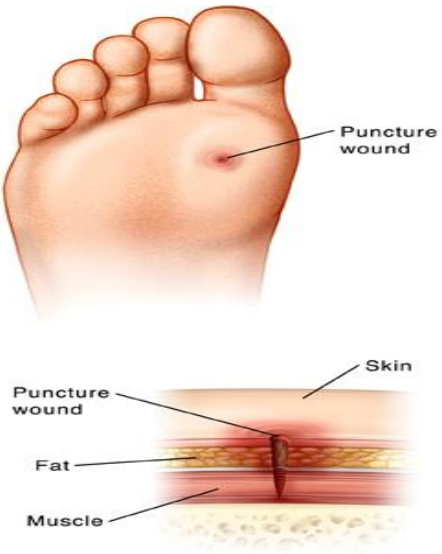
There are two kinds of strain injuries i.e. acute and chronic.

- Acute strain is usually caused by the pulling or straining of a muscle and sometimes may cause a tear. It can also result from a sudden or unusual stretch of a muscle. Acute strains occur due to the lifting a heavy object, slipping on ice throwing jumping or running lifting in an awkward position.
- A chronic strain emanates from prolonged and repetitive muscle movement. This usually occur at the job lace or when performing sports activities.

2. Puncture injury

A puncture wound is a wound that occurs when the skin is pierced by an object therefore creating a small hole. A puncture wound is caused by a pointed object that pierces the skin like when one steps on a nail resulting to a small entry hole. Depending on the sources some punctures occur on the surface of skin while others are very deep. Usually, wounds from puncture injury close fairly fast without any form of intervention and may not result to excessive bleeding. Puncture wounds are common causes by wood splinters, glass, pins and nails. Puncture injuries may also result from objects like knives and scissors. A puncture wound can potentially be caused by any sharp object.

The main signs and symptoms of a puncture wound are usually mild bleeding and pain at the site of the injury. The injury may appear red, swell and have pus or watery discharge if infected and not noticed or treated well.



2. Contusion injury

A contusion is caused by leakage of blood by an injured blood vessel or capillary into the surrounding area. Contusions as a type of hematoma, refers to any collection of blood outside of a blood vessel. Contusion is a medical term that refers to a common bruise. A bruise can also occur on a bone, and is referred to as a bone contusion. A hard fall, high-impact sports injury or car accident can all cause bone contusions.

.

4. Laceration injury

Laceration is a wound that occurs when the skin or a flesh is deeply torn by an object causing an irregular wound. It is also referred to as a cut. Lacerations may be as a result of an injury caused

by high impact injury exerted force or from a blunt object, or by a sharp object and can occur on any part of the body. In most instances, there is minimal tissue injury, and rarely do infections occur. However, severe lacerations can be found throughout the skin and spread into subcutaneous tissues, as well as internal organs, underlying muscle, or bone. Massive bleeding and a lot of pain often accompany lacerations.

Split laceration: It's a type of wound that occurs when a body part is crushed between two blunt objects. Example is when the head or the face receives a blow from a blunt object resulting to the skin and a tissue tearing from compression. This type of lacerations commonly appear on the hands, head, legs and face.

Over-stretching: This type of a wound occurs from a single force to the skin at an angle and pushes and/or pulls the skin therefore causing a stretch and then a break of the skin.

Grinding compression: This type of wound occurs when the skin is hit by a blunt object at an angle and with a sweeping motion therefore causing a wound. The individual's skin is peeled like a potato. The epidermis and the top skin layer peel away.

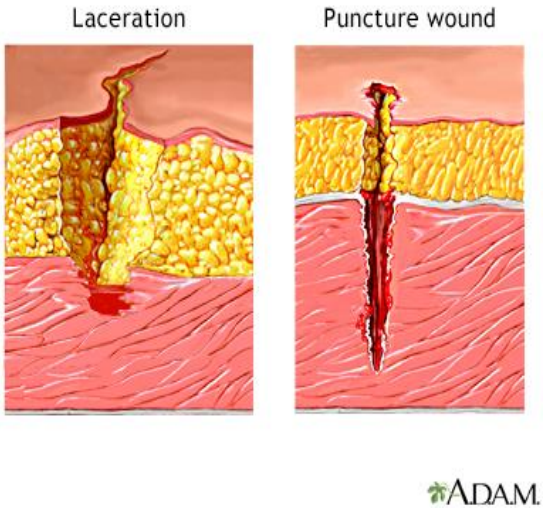
Cut laceration: It is actually the most prevalent type of laceration and occurs as a result of a sharp object such as a knife, scissors or a blade coming into contact with a skin causing it to break and possibly the underlying tissue.

Causes

Lacerations occur depending on the force angle depth at which the object hits the skin. Some lacerations can lead to serious bleeding depending on how deep the tissue is injured.

Symptoms

Laceration is characterized by mild or serious and mild breaking of epidermis; this can range from tearing of first layer of the skin to deep gashes. Bleeding can occur depending on the depth and severity of the laceration at different levels. If the laceration is mild it may lead to mild pain accompanied by brief bleeding. Deeper lacerations will lead to more intense pain and greater bleeding.



5. Fracture injury

Bone fracture, broken bone, and bone crack refer to the same thing. The damage to the bone makes it no longer intact. As a medical condition, a bone fracture is caused by a partial or complete break in the continuity of the bone. In more serious and severe cases, the bone may be broken into several pieces. A bone fracture may result from t of high impact force, or a minimal trauma injury emanating from certain medical conditions that weaken the bones, such as osteoporosis, bone cancer, osteopenia, or osteogenesis imperfecta, where the fracture is then properly termed a pathologic fracture.

The symptoms of a fracture are pain on the injured part that makes the injured area to hurt especially when weight is put on it. The injured person may be unable to move the injured part normally, the fractured area may be tender to touch , may look distorted, swell ,look bent, out of place, have bruises or discolored and possibly loss of feeling (numbness or abnormal sensations).

Common types of fractures include:

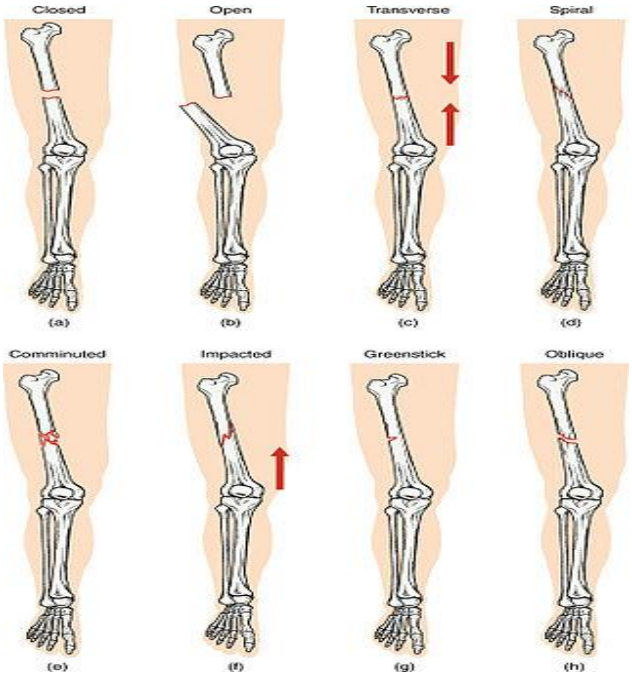
i. **Stable fracture:** The ends of the bone are broken and line up and are almost out of place.
ii. **Open, compound fracture:** The skin breaks during fracture after being pierced by a bone or by a hard hit that breaks the skin. The bone can be visible in the wound or not.
iii. **Transverse fracture**: a fracture of this nature has a horizontal fracture line.
iv. **Oblique fracture:** The fracture pattern is angled.
v. **Comminuted fracture:** The fracture is broken into three or more pieces of bone.

Cause

The fractures are commonly caused by:

- **Trauma:** a fall, tackle during sports, or a motor vehicle accident, can all cause fractures.

- **Osteoporosis:** Is a disorder that weakens bones and cause them to be more likely to break.
- **Overuse:** Muscles can tire and more force is usually placed on bone by repetitive motion. This can lead to stress fractures. Athletes suffer most from stress fractures.



6. Sprain injury

A sprain is a stretching or tearing of ligaments — the tough bands of fibrous tissue that connect two bones together in your joints. Sprains may also occur in the following circumstances: ankle; knee; wrist; thumb.

Signs and symptoms of sprain injury include: pain; swelling; bruising; limited ability to move the affected joint; at the time of injury, you may hear or feel a "pop" in the joint.

Factors predispose one to sprains and strains are as follows:

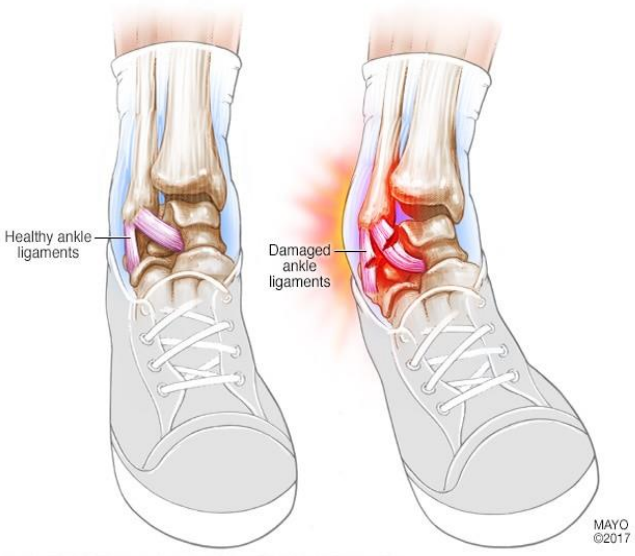
i. **Poor conditioning**: Absence of conditioning can cause your muscles to weaken and have a higher probability of sustaining an injury.

ii. **Fatigue:** when muscles tire they become less likely to give good support to the joints. When a person is tired, he/she is also has a higher likely of succumbing to the forces that overextend a muscle or stress a joint.

iii. **Improper warm-up:** when warming up is improper just before vigorous physical activity, the muscles loosen and increase joint range of motion, hence make the muscles to be less tight and more prone to trauma and tears.

iv. **Environmental conditions:** Uneven and slippery surfaces can cause an individual to be more prone to injury.

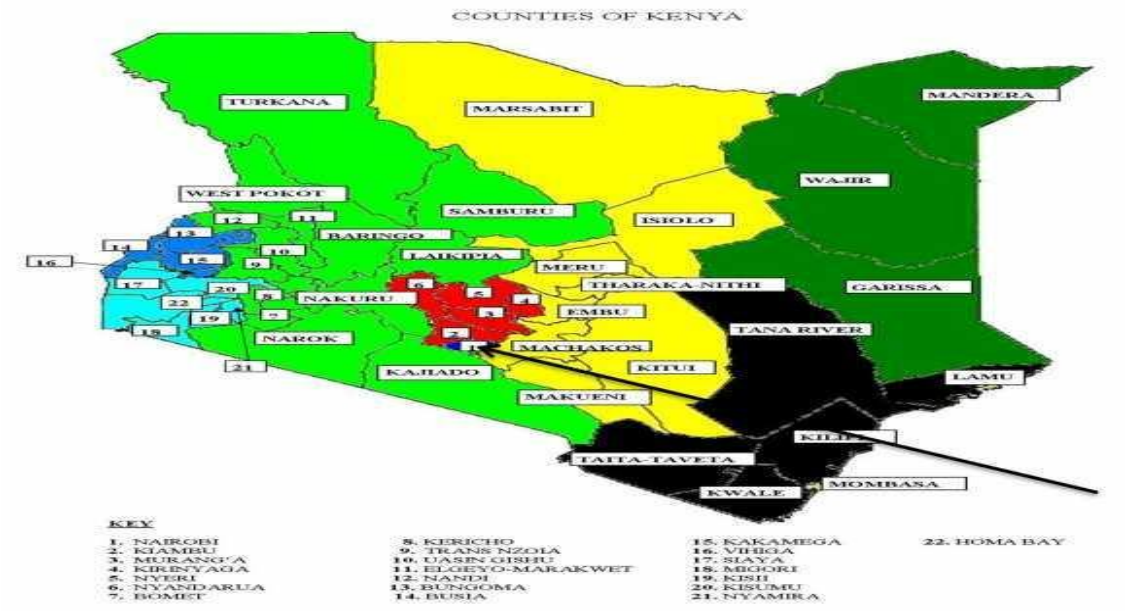
v. **Poor equipment:** Ill-fitting and/or footwear that is maintained poorly or other equipment for sporting can also increase the risk of a sprain.




Fibula
Tibia
(shin bone)
Anterior
tibiofibular
ligament
Medial ligament
Torn
calcaneofibular
ligament
Torn
anterior
talofibular
ligament

Appendix VII: Map of Kenya Showing the Location of Nairobi City County and Nairobi

Figure 5.1 Maps of Kenya and Nairobi County



Appendix VIII: Letters of Approval to Conduct the Study

Letter of Approval from National Commission for Science, Technology and Innovation (NACOSTI)

CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.
2. Government Officer will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) hard copies and one (1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

REPUBLIC OF KENYA

National Commission for Science, Technology and Innovation

RESEACH CLEARANCE PERMIT

Serial No.A 11503

CONDITIONS: see back page

THIS IS TO CERTIFY THAT:
MS. JANE KANARIO KALUU
of KENYATTA UNIVERSITY, 67944-200
Nairobi,has been permitted to conduct research in *Nairobi County*

on the topic: *OCCUPATIONAL INJURIES AND ASSOCIATED FACTORS AMONG SOLID WASTE COLLECTORS IN NAIROBI CITY COUNTY, KENYA*

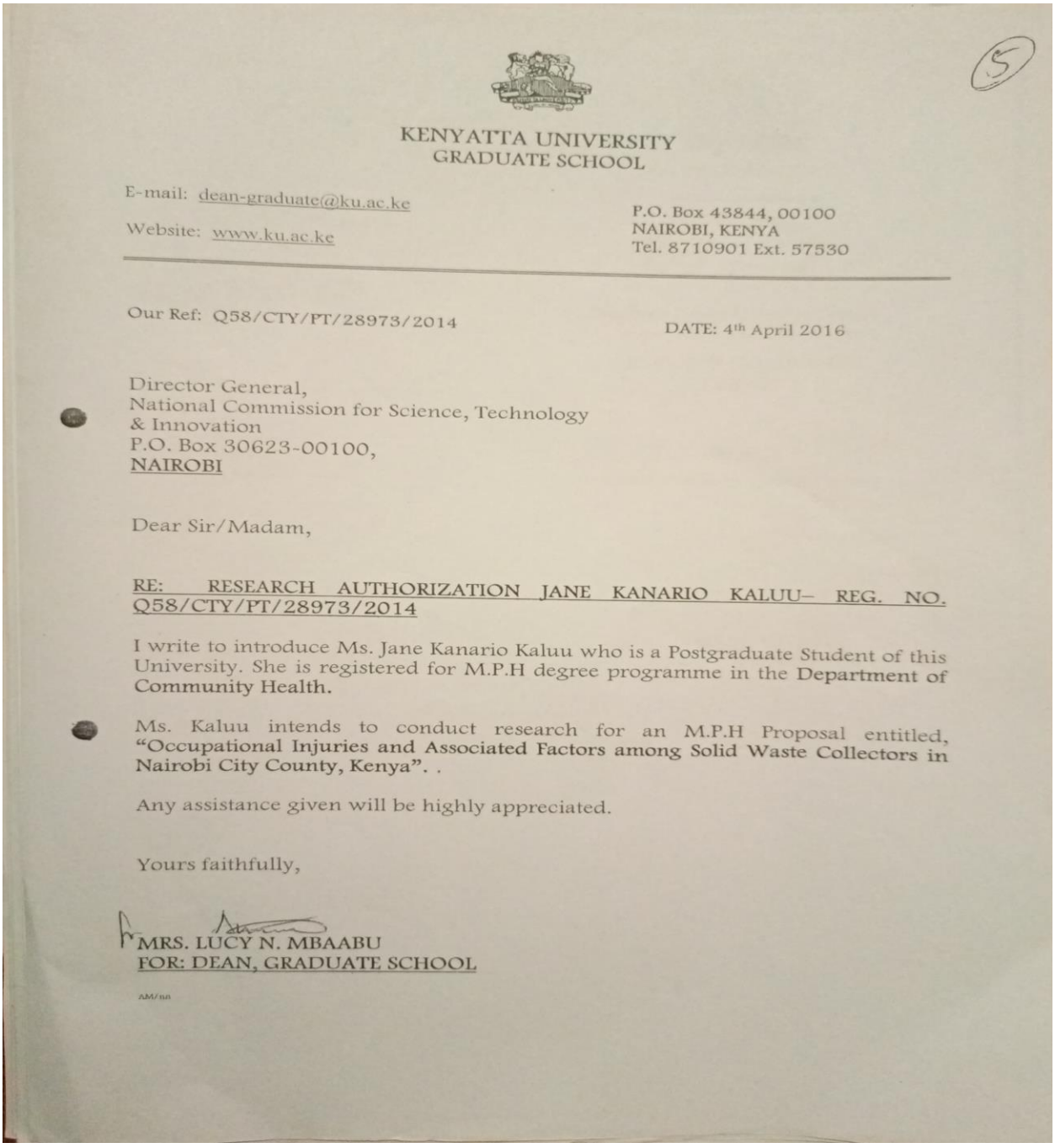
for the period ending:
28th October,2017

.....
Applicant's Signature

Permit No' : NACOSTI/P/16/38848/14287
Date Of Issue : 28th October,2016
Fee Recieved :ksh 1000

.....
Director General
National Commission for Science, Technology & Innovation

Letter of Approval from Graduate School - Kenyatta University



KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: Q58/CTY/PT/28973/2014

DATE: 4th April 2016

Director General,
National Commission for Science, Technology
& Innovation
P.O. Box 30623-00100,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION JANE KANARIO KALUU– REG. NO. Q58/CTY/PT/28973/2014

I write to introduce Ms. Jane Kanario Kaluu who is a Postgraduate Student of this University. She is registered for M.P.H degree programme in the Department of Community Health.

Ms. Kaluu intends to conduct research for an M.P.H Proposal entitled, "Occupational Injuries and Associated Factors among Solid Waste Collectors in Nairobi City County, Kenya". .

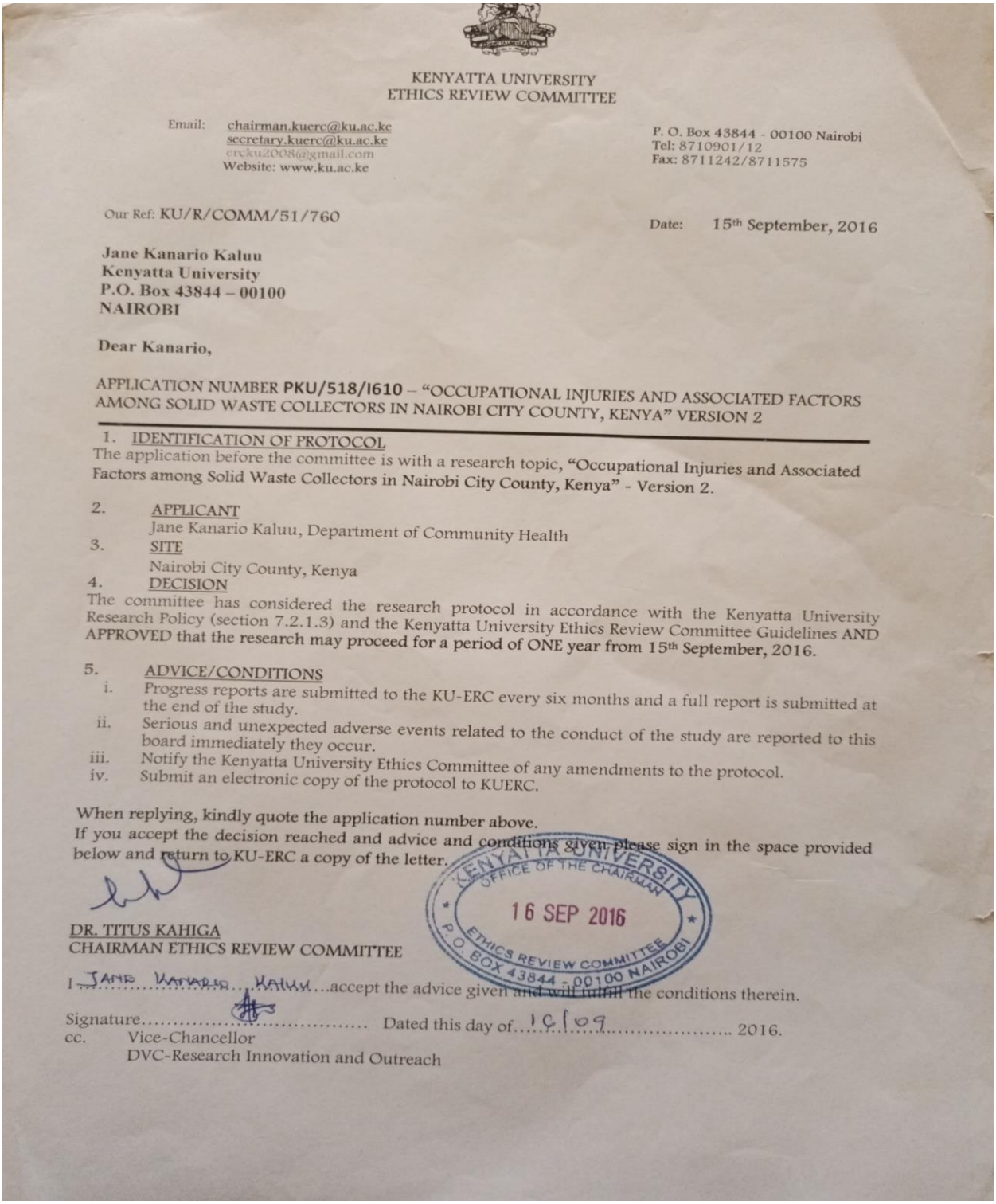
Any assistance given will be highly appreciated.

Yours faithfully,

MRS. LUCY N. MBAABU
FOR: DEAN, GRADUATE SCHOOL

AM/nn

Letter of Approval from Ethics Review Committee - Kenyatta University



KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTEE

Email: chairman.kuerc@ku.ac.ke
secretary.kuerc@ku.ac.ke
ercku2008@gmail.com
Website: www.ku.ac.ke

P. O. Box 43844 - 00100 Nairobi
Tel: 8710901/12
Fax: 8711242/8711575

Our Ref: KU/R/COMM/51/760

Date: 15th September, 2016

Jane Kanario Kaluu
Kenyatta University
P.O. Box 43844 – 00100
NAIROBI

Dear Kanario,

APPLICATION NUMBER **PKU/518/I610** – "OCCUPATIONAL INJURIES AND ASSOCIATED FACTORS AMONG SOLID WASTE COLLECTORS IN NAIROBI CITY COUNTY, KENYA" VERSION 2

1. IDENTIFICATION OF PROTOCOL
The application before the committee is with a research topic, "Occupational Injuries and Associated Factors among Solid Waste Collectors in Nairobi City County, Kenya" - Version 2.

2. APPLICANT
Jane Kanario Kaluu, Department of Community Health

3. SITE
Nairobi City County, Kenya

4. DECISION
The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines AND **APPROVED that the research may proceed for a period of ONE year from 15th September, 2016.**

5. ADVICE/CONDITIONS
i. Progress reports are submitted to the KU-ERC every six months and a full report is submitted at the end of the study.
ii. Serious and unexpected adverse events related to the conduct of the study are reported to this board immediately they occur.
iii. Notify the Kenyatta University Ethics Committee of any amendments to the protocol.
iv. Submit an electronic copy of the protocol to KUERC.

When replying, kindly quote the application number above.
If you accept the decision reached and advice and conditions given please sign in the space provided below and return to KU-ERC a copy of the letter.

KENYATTA UNIVERSITY OFFICE OF THE CHAIRMAN 16 SEP 2016 ETHICS REVIEW COMMITTEE P.O. BOX 43844 - 00100 NAIROBI

DR. TITUS KAHIGA
CHAIRMAN ETHICS REVIEW COMMITTEE

I JANE KANARIO KALUU ...accept the advice given and will fulfill the conditions therein.

Signature..... Dated this day of 16/09/..... 2016.

cc. Vice-Chancellor
DVC-Research Innovation and Outreach