PREVALENCE OF WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG HOUSING CONSTRUCTION WORKERS IN MOMBASA COUNTY, KENYA

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Prevalence of Work-Related Musculoskeletal Disorders among Housing Construction Workers in Mombasa County, Kenya

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2018
DECLARATION

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

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DEDICATION

This thesis is dedicated to my loving husband Seth Makula and our children Angela Mwende and Caleb Musembi.
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I would like to thank the Almighty God for His guidance, provision and good health throughout the study period.

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# ACRONYMS AND ABBREVIATIONS

| Acronym | Full Form |
|---------|-----------|
| BMI | Body Mass Index |
| BMUS | Burden of Musculoskeletal diseases in the United States |
| DOSHS | Directorate of Occupational Safety and Health Services |
| ILO | International Labour Organization |
| MSDs | Musculoskeletal Disorders |
| NCA | National Construction Authority |
| NEMA | National Environment Management Authority |
| OSHA | Occupational Safety and Health Act |
| OSH | Occupational Health and safety |
| PPE | Personal Protective Equipment |
| PTD | Prevention Through design |
| SPSS | Statistical Package for Social Sciences |
| WIBA | Work Injury Benefits Act |
| WMSSDs | Work related musculoskeletal disorders |
DEFINITION OF OPERATIONAL TERMS

Administrative controls: changes in the way that work in a job is assigned or scheduled that reduces the magnitude, frequency, or duration of exposure to ergonomic risk factors.

Engineering controls: the physical changes to a job that eliminate or materially reduce the presence of MSD hazards.

Ergonomics: the science of designing the job to fit the worker, not forcing the worker to fit the job.

Ergonomic risk factors: aspects of a job that pose a biomechanical stress to the worker.

Musculoskeletal Disorders (MSD’s): conditions where parts of the musculoskeletal system are injured resulting from the buildup of trauma and are ascertained on the basis of frequent pain and a duration with symptoms persisting for at least three days.

MSD symptoms: physical indications that an employee may be developing an MSD.

Occupier: means the person or persons in actual occupation of a workplace, whether as the owner or not and includes an employer.

Prevalence: a dimensionless unit that gives the frequency of a disorder or the proportion of a population that experiences it, at a specified point in time.
ABSTRACT

The housing construction industry is one of the leading industries worldwide as far as cases of musculoskeletal disorders are concerned due to the strenuous nature of the work. A good understanding of ergonomic risk factors in this industry is paramount in implementing the right preventive measures for musculoskeletal disorders among construction workers. The main objective of this study was to establish the prevalence of work-related musculoskeletal disorders among housing construction workers in Mombasa County, Kenya. The target population was 4,400 housing construction workers drawn from 44 housing construction sites that were registered by the National Construction Authority in the year 2016. Descriptive cross sectional study design was used. Stratified random sampling and simple random sampling were used to draw a random sample of 354 respondents. The inclusion criterion was respondents who were above 18 years of age and had worked in this industry for over three years. A standardized Nordic questionnaire was self-administered to collect data on reported cases of musculoskeletal disorders from the respondents as a result of their daily work activities. An observation checklist was also used to record how construction activities were being performed by workers, postures applied while working, and the number of workers performing a task. Data collected from the questionnaires was cleaned, coded, tabulated and subjected to statistical analysis. Statistical Package for Social Sciences (SPSS) Version 20.0 was used to analyze the data. Summary statistics was used to analyze qualitative data while regression analysis was used to establish relationship between dependent and independent variables. It was established that majority (98.1%) of the workers reported to have had body pain as a result of their daily work activities within the past 12 months. Lower back pain (68%) was the most reported musculoskeletal disorder symptom. Only 2.7% of the respondents had sought medical advice for musculoskeletal disorders experienced within a period of 12 months. From the study, it was established that factors contributing to musculoskeletal disorders were
physical factors, organizational factors and individual factors. Regression analysis established that taking all the independent variables constant at zero, the prevalence of musculoskeletal disorders was 32.1%. Further, it was established that at 95% level of confidence, physical factors, organizational factors and individual factors significantly influenced prevalence of musculoskeletal disorders (p<0.05). Analysis of variance to test the fitness of the regression model gave a significant F value of 154.569 (p = 0.000) hence the null hypothesis was rejected. This study therefore concluded that majority of housing construction workers in Mombasa County were experiencing musculoskeletal disorders and very little had been done to control these disorders. The study recommends safety trainings for all construction workers before deployment, particularly on ergonomics so as to encourage safe work practices, enforcement of the Occupational Safety and Health Act of 2007 by construction site managers and routine site inspections to ensure compliance to the law. Finally, the study recommends awareness creation among housing developers on the importance of implementing engineering controls, administration controls and work-practice controls, in addition to the use of personal protective equipment in preventing musculoskeletal disorders among construction workers in Mombasa County.
CHAPTER ONE

INTRODUCTION

1.1 Background Information

The construction industry is one of the most hazardous workplaces worldwide and the common cause of ill health, disability or even death is musculoskeletal disorders (Schneider, 2001). This industry is also characterized by multiple work activities that take place simultaneously being performed by different workers a few of them skilled while the majority is unskilled casual workers. Work-related Musculoskeletal Disorders (WMSDs) account for the largest number of temporary and permanent disability among the working population in the developed nations (Olson, 1999). Baldwin (2004) noted that MSDs are the leading causes of work absenteeism and lost productivity, accounting for one-third of occupational injuries and illnesses reported to the bureau of labour statistics each year in the United States.

Musculoskeletal disorders represent a group of conditions that affect the muscles, tendons, ligaments, joints, peripheral nerves and supporting blood vessels in the body (Punnett et al., 2004). When a worker suffers MSDs, the signs and symptoms include pain, swelling as tissues become irritated, stiffness and loss of range of motion of surrounding joints and inability to work and function at home (Baldwin, 2004).

Work-related musculoskeletal disorders cause a lot of adverse effects to the entire working population including chronic pain, loss of income and productivity loss to industries, insurance, medical and compensation costs as well as suffering to one’s dependents (Olson, 1999). About 30% of U.S adults are at any time living with musculoskeletal disorders such as joint pain, swelling or limitation of movement (Woollf & Pfleger, 2003). According to BMUS (2008), musculoskeletal disorders are the greatest single cause of lost workdays and medical bed days in the United States across different industries. In the year 2012 alone, the U.S. Bureau of Labor Statistics found
that MSDs accounted for 29% of all illnesses and injuries that required days off work (Gerr et al., 2014). Generally, the mortality rates of MSDs are low that is why they do not receive much attention from most governments (Lubeck, 2003). The impact of MSDs however is more felt in the form of rates of disability, medical costs and reduced quality of life (Lubeck, 2003). For instance, between the years 2004 to 2006, the medical cost related to MSDs in the United States was 576 billion U.S dollars, which is equivalent to 4.5% of gross domestic product (BMUS, 2008).

The housing construction industry is known for its high cases of occupational risks and hazards as well as the associated adverse health effects (Oude et al., 2011). MSDs are a main cause of productivity loss, functional impairments, and permanent disability among housing construction workers worldwide (Boschman et al., 2012). In any population of working construction workers, more than half suffer from occasional or frequent musculoskeletal complaints (Oude et al., 2011). Construction workers worldwide are reported to be more exposed to ergonomic risk factors and they face approximately 16% higher rates of MSDs than workers in other industries (Stattin et al., 2005). Bernard (2010) also noted that work-related musculoskeletal disorders (MSDs) are a major cause of functional impairments and disability among construction workers worldwide due to the strenuousness of the construction activities. Compared to non-construction occupations, construction occupations require greater amounts of strength and involve more stooping, crawling, crouching kneeling, climbing and balancing (Schnieder, 2001).

Musculoskeletal disorders have been a headache to both the developed and developing nations. The Swedish construction work environment for instance is regarded as the safest in the world as far as working conditions and musculoskeletal health is concerned but MSDs still form the biggest percentage of most compensated illnesses among all construction workers in Sweden (Flanagan et al., 2001).
Africa is the poorest continent with socioeconomic constraints reinforcing the higher prevalence of many diseases and disabilities (Lopez et al., 2006). There is increasing literature on the epidemiology of musculoskeletal disorders (MSDs) but these studies are restricted to high-income countries therefore little is known about the epidemiology of MSDs in the rest of the world (Volin, 1997). There is lack of information on the prevalence of MSDs in developing countries (Gilgil et al., 2005). A systematic review into the global prevalence of lower back pain for example by Walker in 2000 identified that out of the 56 included studies, only 8% were conducted in developing countries, with only one study conducted in Africa. The global prevalence of general disability is highest in sub-Saharan Africa with the most frequent cause of disability being musculoskeletal disorders (Murray & Lopez, 1997). African-specific factors such as HIV/AIDS, types of work tasks and poor nutrition may also be an influencing factor to the prevalence of MSDs in the continent (Lopez et al., 2006). Kenya is one of the sub-Saharan countries with no properly documented data on the prevalence of MSDs specifically among construction workers.

1.2 Statement of the Problem

The construction industry in Kenya plays a major role in the country’s economic growth and employs thousands of people annually. Vision 2030 envisions that more than half of Kenya’s population will be living in urban centers by that time and this call for development of more decent houses in a sustainable manner. There is already a boom in the housing construction sector due to increasing population and improved economy. The building and construction sector in Kenya registered an accelerated growth of 13.1% in 2014 (KNBS, 2015). The number of completed buildings in Mombasa County increased from 1,481 in 2013 to 1,639 in 2014 (KNBS, 2015). The boom in this industry has come along with health and safety challenges. The constitution of Kenya (2010) article 42 states that every person has a right to a clean and safe environment. In order to promote a healthy workforce, the government has enacted laws to protect the health and safety of construction workers including the Occupational Safety and Health Act of
2007 and the National Construction Authority Act of 2011. The construction industry is however still flooded with small scale developers and quacks who do not follow safety laws. There is also understaffing at DOSHS office and inadequate financing which makes inspection of construction sites difficult hence majority of construction workers are exposed to health and safety hazards that have led to injuries and fatalities. In the year 2011 alone, the construction industry accounted for 16% of all fatal accidents (DOSHS, 2011). There is however no data available in Kenya on the number of cases of musculoskeletal disorders in the construction industry. Unless urgent measures are taken, the health and safety of construction workers will continue deteriorating and eventually lead to a decline in economic growth of the country.

1.3 Objectives of the study

1.3.1 Main objective

The main objective of the study was to establish the prevalence of work-related musculoskeletal disorders among housing construction workers in Mombasa County, Kenya.

1.3.2 Specific objectives

1. To evaluate the occupational activities that could lead to musculoskeletal disorder symptoms among housing construction workers in Mombasa County.

2. To determine the presence of musculoskeletal disorder symptoms among workers in the housing construction industry in Mombasa County.

3. To analyze the preventive measures that had been put in place to prevent musculoskeletal disorders among housing construction workers in Mombasa County.
1.4 Research questions

In order to obtain the necessary data, research questions were developed to help this research in understanding the prevalence of MSDs among housing construction workers in Mombasa County. The research questions were;

1. What are the occupational activities that can cause MSD symptoms among workers in the housing construction industry?
2. Which MSDs symptoms do workers in the housing construction industry in Mombasa County report to have experienced?
3. Which measures have been put in place to prevent MSD among housing construction workers in Mombasa County?

1.5 Null hypothesis ($H_0$)

There are no musculoskeletal disorder symptoms (MSDs) among housing construction workers in Mombasa County.

1.6 Justification

Musculoskeletal disorders are a main cause of productivity loss, functional impairments, and permanent disability among housing construction workers worldwide (Boschman et al., 2012). These workers perform strenuous activities such as heavy weight lifting, doing repetitive tasks, standing for long hours and working in awkward postures all of which are predisposing catalytic factors for development of MSDs. There is no properly documented data on MSDs in Kenya and no research has been done particularly in Mombasa county on the prevalence of work related musculoskeletal disorders among housing construction workers hence this study was necessary. This study is beneficial to institutions tasked with the responsibility of ensuring the health and safety of construction workers is taken care of like the Directorate of Occupational Safety and Health Services (DOSHS) and the National Construction Authority (NCA) on the
importance of ensuring routine site inspections. Construction site managers are also encouraged to enforce health and safety laws on their respective sites. Construction workers are also enlightened to seek medical examinations regularly in order to identify and treat cases of musculoskeletal disorders.

1.7 Scope of the study

This study was done in Mombasa County on housing construction sites that were registered with the National Construction Authority at the time of data collection (2016). The target population was 4,400 housing construction workers. Respondents selected for the study were those who were above 18 years of age and had worked in the construction industry for more than 3 years. The main focus was on work related musculoskeletal disorders as a result of construction activities. Mombasa County was selected for the study because it has one of the highest construction activities in the country in the recent past as a result of its tourist attraction due to its coastal location and also due to devolved government (NCA, 2016).

1.8 Limitations of the study

This study was based on self-reported cases of MSDs symptoms among housing construction workers. Self-reported cases may be under-estimated or over-estimated. Additionally, majority of the respondents in this study were casual workers who had been allocated specific work load to complete each day so they could only participate in the study during lunch breaks which made the study more expensive as it took a longer time than initially planned. Most of the casual workers also did not report to the same construction site consistently so some issued questionnaires could not be traced back hence the response rate was 74.6% and not a hundred percent.
1.9 Ethical consideration

This research was conducted after approval by Jomo Kenyatta University of Agriculture and Technology and also by the Ethics Review Committee (Appendix 1). Respondents were additionally issued with a consent form to sign (Appendix 2) before filling in the questionnaires and it was explained to them that participation was purely voluntary, the questionnaires were anonymous and that they were free to terminate the exercise at any time without any consequences.

1.10 Conceptual framework

The conceptual framework in Figure 1.1 shows the relationship between physical factors, exposure history and work procedures that can lead to presence of MSDs. Ergonomic risk factors such as heavy weight lifting, repetitive motions, working in awkward postures, number of years worked in the construction industry and lack of PPEs have a predisposing catalytic impact to development of MSDs.
Independent variables

- Physical factors
  - Heavy weights lifting,
  - Repetitive motions,
  - Awkward postures and exposure to Vibration

- Organizational factors
  - Use of PPEs, working hours, wages, planning of work, Job rotation

- Individual factors
  - Age, gender, lifestyle, experience in the industry

Dependent variable

Figure 1.1: Conceptual framework showing independent factors causing MSDs
CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The construction industry is one of the leading industries as far as musculoskeletal ill-health is concerned (Ammendolia et al., 2009). This industry is characterized by several interdependent activities taking place at the same time that pose different safety and health challenges to the workers on site. Musculoskeletal disorders are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs (Armstrong et al., 1993). Work-related MSDs are conditions in which the work environment and performance of work contribute significantly to the condition and/or the condition is made worse or persists longer due to work conditions (DHHS, 1997). MSDs are given different definitions including Cumulative Traumatic Disorders (CTD), Occupational Overuse Syndrome (OOS) or Repetitive Strain Injuries (RSI). These disorders are not typically the result of a distinctive, singular event, but are more gradual in their development (Bakker et al., 2009).

Although the causes of any particular case of a MSD are exceedingly difficult to identify with complete accuracy, certain risk factors are typically discussed in the field of ergonomic studies (Baldwin, 2004). A risk factor itself is not necessarily a causation factor for any particular MSD. Many times, it is not simply the presence of a risk factor, but the degree to which the risk factor is expressed that may lead to MSD (Olson, 1999). Work-related Musculoskeletal Disorders (WMSDs) are the leading causes of work absenteeism and lost productivity, accounting for one-third of occupational injuries and illnesses reported to the bureau of labour statistics each year (Baldwin, 2004). Also WMSDs account for the largest number of temporary and permanent disability among the working population (Olson, 1999).
Some of the common factors contributing to development of MSDs symptoms among housing construction workers include physical factors (work activities) that include heavy weights/force, repetitive motions, working in awkward postures and exposure to vibrations. Other contributing factors are exposure history of an individual (the length of time worked) and organizational factors (work procedures) like long working hours, lack of job rotation and big workloads.

2.2 Factors that can cause MSDs

2.2.1 Physical factors causing MSDs

Physical risk factors are a subset of work-related risk factors including the environment and biomechanical risk factors, such as posture, force, repetition, direct external pressure (stress per contact), vibration and cold (DHHS, 1997).

Many construction work tasks are physically very strenuous and the incidence of work-related musculoskeletal disorders (WMSDs) among construction workers is considerably higher than those in most other occupations (Arndt et al., 2004). The housing construction industry is labour intensive and involves heavy weight lifting, repetitive motions, working in awkward postures for long hours factors that cause musculoskeletal disorders. Existing literature show that there is a strong evidence that low back disorders are associated with lifting, high exertion and awkward back postures (Punnett et al., 1991; Marras et al., 1993).

A study done by the Danish government showed that the one year prevalence of symptoms from the lower back was 42% and from the neck/shoulder was 40% (Brenner & Ahern, 2000). The study compared questionnaire data from two Dutch periodic occupational health surveys carried out in the general working population and the construction industry. Greater percentages of workers in the construction industry complained about the physical demands of the job or of backache than in the general working population. They attributed this to the “average” job in the construction
industry being physically very strenuous compared to most other occupations in the general survey. They also found that groups of employees with the same occupation from the two data sets differed systematically but the rank order of eight occupations was similar in both data sets. They, therefore, attributed some of the actual differences to geographical differences between the two surveys (Brenner & Ahern, 2000).

A study done in Canada found the construction industry as the industry with the fourth highest rate of lost-time claims (Sturner et al., 1997). The study showed that overexertion was the most common cause of injury, accounting for 24.5% of injuries, while the most frequent class of injury was sprains and strains, accounting for 42.3% of injuries. Similar results for construction workers were found when examining a surveillance database of injuries treated at an urban hospital emergency department in the USA (Stocks et al., 2010).

While studying construction workers who had had acute musculoskeletal injuries in the USA in 2012, it was reported that almost half had on-going symptoms two months later while 40% had symptoms 12 months after the injury (Lenderink et al., 2012). Those who reported chronic symptoms also reported that their quality of life was substantially affected. Also only a minority of those injured had their jobs accommodated to their symptoms. in the same study found that symptoms that persisted more than two months varied according to body part affected. Knee, leg, groin and hip injuries were most likely to last beyond two months followed by shoulder, neck and low back problems; while foot and ankle injuries and upper extremity injuries recovered the most rapidly (Lenderink et al., 2012).

In construction activities, the back is the body part most frequently injured and the major cause of injury is overexertion (Latza et al., 2000). Low back pain caused by musculoskeletal disorders has been estimated to afflict one third of construction workers at some time during their employment period (Holmstrom & Ahlborg, 2005). Van et al. (2009) showed that back pain is a major cause of morbidity and lost production work in
the USA with carpenters being at high risk. Cook et al. (1996) found a clear association in construction workers between the prevalence of low back pain and a history of low back pain and stiffness of the shoulder.

Construction is in the top four high-risk occupations in the USA for carpal tunnel syndrome (Von et al., 1992). Solomon et al. (2007) showed that the levels of disability of construction workers receiving disability pensions due to musculoskeletal disorders were greater than for other occupations since they were likely to be affected in four body regions; low back, neck/shoulder, hip and knee; whereas the other occupations were likely to be affected in only two or three regions.

Another cause of musculoskeletal disorders among construction workers is high repetition. These workers handle heavy weight at high frequencies making their conditions worse. Force is the amount of effort our bodies must do to lift objects, to use tools, or to move. More force equals more muscular effort, and consequently, a longer time is needed to recover between tasks. Since in repetitive work, as a rule, there is not sufficient time for recovery, the more forceful movements develop fatigue much faster. Exerting force in certain hand positions is particularly hazardous. The housing construction industry features a variety of work activities majority of which require coordinated efforts which are fast and repetitive thus causing workers to develop MSDs (Sturner et al., 1997). Working in the wrong postures as common among construction workers predisposes them to musculoskeletal health complains (Holmstrom & Ahlborg, 2005).

Information from the US Department of Labor Employment and Training Administration Database on Job Demands (DOL/ETA) shows that, compared to non-construction occupations, construction occupations require greater amounts of strength and involve more stooping, crawling, crouching kneeling, climbing and balancing (Schnieder, 2001). In particular, climbing is very fatiguing and could result in muscle strain, potentially resulting in a loss of balance that could lead to a fall and serious injury
There is a gradual increase in the number of musculoskeletal disorders reported to the Danish Labour Inspection Service is increasing every year as a result of working in awkward postures (Cohen et al., 1997).

### 2.2.2 Individual factors and MSDs

Studies carried out in developed nations like in the U.S cite that some individual risk factors like high body mass index, history of past body pain and general lifestyle influence the occurrence of musculoskeletal disorders (DHHS, 1997). Individual risk factors such as age, gender, smoking, physical activity, strength, anthropometry and previous WMSD and degenerative joint diseases can also impact the likelihood for occurrence of a WMSD (McCauley, 2011). The aged both male and female are more prone to musculoskeletal disorders as compared to the youth as a result of joint immobility and degeneration.

Physical activity also plays a role in development of musculoskeletal disorders. In construction workers, more frequent leisure time was related to healthy lower backs and severe low-back pain was related to less leisure time activity (Holmström et al., 1992). On the other hand, some standard treatment regimes have found that musculoskeletal symptoms are often relieved by physical activity. National Institute for Occupational Safety and Health stated that people with high aerobic capacity may be fit for jobs that require high oxygen uptake, but will not necessarily be fit for jobs that require high static and dynamic strengths and vice versa (DHHS, 1997).

Substantial epidemiologic evidence exists for a strong relationship between back injury and weak back strength in different job tasks. Chaffin et al. (1977) found a substantial increase in back injury rates in persons performing jobs requiring strength that was greater or equal to their isometric strength-test values and the risk was three times greater in weaker individuals. The housing construction industry is highly labour intensive and heavily manual. Most workers are forced to lift/carry weights heavier than
their body weights hence causing MSDs. The Kenya OSHA (2007) makes it an offence for any employer to make his employees carry weights that pose bodily injury due to their weight.

Body mass index has also been identified in studies as a potential risk factor for development of MSDs particularly CTS and lumbar disc herniation with obese people twice as much likely to develop MSDs compared to slender individuals (Vessey et al., 1990). The strenuous nature of construction activities implies that obese people cannot find employment here.

2.2.3 Psychosocial and organizational factors

Psychosocial and organizational factors are aspects of how the work is organized, supervised and carried out (Hagberg et al., 1995). The construction industry is in most cases coordinated by different sub-contracted service providers who make the organization of work difficult thus exposing workers to psychosocial risk factors that in return contribute to development of MSDs. Although organizational and psychosocial factors may be identical, psychosocial factors include the worker emotional perception. Psychosocial risk factors are related with work content for example the work load, the task monotony, work control and clarity. Housing construction workers are given large workloads so as to meet the strict deadlines of the developers. The organizational characteristics for example, include vertical or horizontal organizational structure, interpersonal relationships at work; relations with supervisor and workers and financial/economic aspects for example salary/wages and social like prestige and status in society (DHHS, 1997). When the psychological perceptions of the work are negative, there may be negative reactions of physiological and psychological stress. These reactions can lead to physical problems, such as muscle tension. On the other hand, workers may have an inappropriate behavior at work, such as the use of incorrect working methods, the use of excessive force to perform a task or the omission of the rest.
periods required to reduce fatigue. Any these conditions can trigger WMSDs (Hagberg et al., 1995).

Poor work procedures and poor planning coupled with strict deadliness for construction workers is a contributing factor to development of MSDs (Schneider, 2001). The housing construction industry is labour intensive and incorporates parallel activities at the same time which exposes workers to multiple risk factors. Most contractors have strict deadlines to meet and as a result construction workers are at times exposed to long working hours, lack of job rotation and working without proper PPEs all of which contribute to development of MSDs among housing construction workers.

Organizational measures are mostly adopted in tasks whose exposure level cannot be lowered due to the characteristics of the job or through physical measures (Sato et al., 2009). If well-coordinated, organizational measures can play a major role to reduce the cases of reported MSDs among workers. Best practices like job rotation have been found to reduce the cases of MSDs among production workers in highly repetitive jobs with heavy loads (Mathiassen, 2006). This has been shown to help in cost reduction and promotion of health of workers (Keir et al., 2011). The prevention and health promotion for workers occurs through switching between different tasks with different levels of exposure and biomechanical applications, which in theory reduce the cumulative and or average exposure that should in turn promote the reduction of musculoskeletal and cognitive overloads (Keir et al., 2011).

Job rotation has thus been adopted in repetitive, static, or monotonous activities, aiming to relieve the effects of muscle and cognitive overload, monotony, absenteeism, and stress (Rissen et al., 2002). Construction activities are highly repetitive, static and physically demanding hence job rotation if practiced can help in reducing cases of musculoskeletal disorders. A cross-sectional study done among supermarket workers found a 40% reduction in complaints of neck pain and a 20% reduction in complaints of pain in the shoulder for those who carried out job rotation (Hinnen et al., 1992).
In 1997, the Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH) released a review of evidence for work-related musculoskeletal disorders. According to DHHS (1997), examples of work conditions that may lead to development of musculoskeletal disorders include routine lifting of heavy objects, daily exposure to whole body vibration, routine overhead work, work with the neck in chronic flexion position, or performing repetitive forceful tasks (Boschman et al., 2012). There is sufficient evidence that organizational factors play a big role in management of musculoskeletal disorders (DHHS, 1997).

Construction workers are also faced with the challenge of lack of standardized wages especially in Kenya. This is because their jobs are highly casual in nature and there is normally no written agreement of terms and conditions of service. As a result, many casual workers move from one construction site to another frequently in search of better wages. This makes it even more difficult to know their health status because they rarely visit a medical facility for suspected cases of musculoskeletal disorders due to lack of enough money.

Personal Protective Equipment (PPE) for construction workers like helmets, safety shoes, gloves and overalls if well used can be beneficial in reducing exposure to ergonomic risk factors. OSHA, (2007) requires employers to provide their employees with proper PPE and the employees are required to use the provided PPE so as to minimize expose to health and safety hazards while at work.

2.3 Legislations governing the construction industry in Kenya

In Kenya, various laws have been passed that promote the health and safety of workers. These include the OSHA, (2007) and subsequent regulations, WIBA, (2007), the constitution of Kenya (2010) and the NCA, (2011).
2.3.1 Occupational safety and health act (OSHA, 2007)

The purpose of OSHA 2007 is to protect the safety, health and welfare of people at work, and to protect those not at work from risks to their safety and health arising from, or in connection with, the activities of people at work.

Section 76 provides that every employer shall take necessary steps to ensure that workstations, equipment and work tasks are adapted to fit the employee and the employee’s ability including protection against mental strain. An employer shall not require or permit any of his employees to engage in the manual handling or transportation of a load which by reason of its weight is likely to cause the employee to suffer bodily injury.

Sections 55 – 60 provide for the safety requirements of all machinery equipment used in workplaces. All machinery and equipment whether fixed or mobile shall only be used for work which they are designed for and be operated by a competent person. Every dangerous part of the machinery equipment shall be securely fenced and every machine intended to be driven by mechanical power shall be provided with an efficient starting and stopping appliance which shall be readily and conveniently operated by the machine operator. All portable tools and equipment shall be securely guarded and shall not be used in areas with flammable vapor or substances unless they are intrinsically safe for such environments. All materials used as safeguards for machinery equipment shall be of substantial construction, constantly maintained and kept in the right positions within the machinery equipment.

Section 101 of the Act requires that every employer shall provide and maintain for the use of employees in any workplace where employees are employed in any process involving exposure to any injurious, wet processes or offensive substance, adequate, effective and suitable protective clothing and appliances. Section 93 also requires employers to provide and maintain for use of a person employed, adequate and suitable
accommodation for clothing not worn during working hours. Section 10 (1)(c) of the Act provides that every employee shall, while at workplace at all times wear or use any protective equipment or clothing provided by the employer for any purpose of preventing risks to his safety and health.

Section 10 (2) of the Act states that an employee who contravenes commits an offense and shall on conviction be liable to fine or imprisonment or both.

Section 89 (4) of the Act provides that in every workplace where any vibration which is transmitted to the human body through solid structures, is harmful to health or otherwise dangerous, all practicable control, preventive and protective measures shall be taken by employer to secure the safety and health of any such person who may be exposed to the vibration.

2.3.2 Work injury benefits act (WIBA, 2007)

The purpose of WIBA 2007 is to promote compensation to employees for work-related injuries and diseases contracted in the course of their employment, and for connected purposes. Section 5 of WIBA, (2007) states that an employee is entitled to compensation if he/she contracts a disease specified in the second schedule that arose out of and in the course of the employee’s employment or contracts any other disease that arose out of and in the course of the employee’s employment. Section 3 of the same act on the right to compensation states that an employer is liable to pay compensation in accordance with the provisions of this Act to an employee injured while at work.

2.3.3 National Construction authority act (NCA, 2011)

The national construction authority act is mandated to promote safety in construction operations by ensuring that only qualified persons are registered and licensed to do construction work. Section 3 of the act states that a person shall not carry on the business of a contractor unless the person is registered by the board under the act. Any person
who contravenes this act commits an offence and shall be liable on conviction to a fine not exceeding one million Kenya shillings, or to imprisonment for a term not exceeding three years or to both.

2.3.4 The Kenyan constitution, 2010

Article 41 of the constitution states that every worker has the right to fair remuneration and a right to reasonable working conditions. Article 42 states that every person has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and to have obligations relating to the environment fulfilled under Article 70 (Kenya constitution, 2010).

2.4 Control of MSDs in the construction industry

There are various methods of preventing ergonomic risk factors in construction sites. They include engineering controls, administrative and workplace controls and use of personal protective equipment. Figure 2.1 illustrates these controls in order of their effectiveness.
2.4.1 Engineering controls

Engineering controls are the physical changes to a job that eliminate or materially reduce the presence of MSD hazards. They include modifying, or redesigning tools, equipment, materials, Processes, facilities and workstations (NIOSH, 1997). Engineering controls are usually the most effective long-term approach to reducing WMSD risk factors as they eliminate the risk factors present in specific construction task. Manufacturers can also employ such controls to modify the size or design of materials. In the U.K for example, a focus group feedback showed that kerbs were redesigned by reducing their size, using a lighter concrete and adding handholds which lead to reduction of MSDs.
(Bust et al., 2005). Engineering controls also include using mechanical devices to hold a heavy tool in place while it is in use as this reduces the physical burden placed on the worker ((Bust et al., 2005).

2.4.2 Administrative controls

Administrative controls are changes in the way that work in a job is assigned or scheduled that reduces the magnitude, frequency, or duration of exposure to ergonomic risk factors (DHHS, 1997). Stretch exercises for example can be used to reduce injury and increase performance (Choi & Rajendran, 2014). Site exercise programs have been suggested and implemented as preventive measures against upper extremity MSDs in developed countries (McGorry & Courtney, 2006). Holmström & Ahlborg (2005) evaluated the effects of morning warm-up exercise (a 10-minute exercise every morning at the building site) on musculoskeletal fitness in construction workers. They found a significant increase of thoracic and lower back mobility, increase of hamstring and thigh muscle stretch-ability in the morning warm-up exercise group. Ludewig & Borstad (2003) studied the effects of a home exercise program (five shoulder stretching exercise with two stretches for 30 seconds, each repetition) on shoulder pain and functional status in construction workers. Participants who performed the stretching and strengthening exercises showed significantly greater improvements in shoulder function and satisfaction. OSHA (2007) recommends that when working in strenuous activities, employees should take short and frequent breaks to stretch their muscles. For construction companies, stretching sessions and pre-job safety/ergonomics planning (for example toolbox safety talks) may be implemented as part of a comprehensive ergonomics program to control WMSDs.

2.4.3 Personal protective equipment (PPE)

Personal protective equipment is the least effective means of preventing health and safety hazards at a workplace (NIOSH, 1997). Controlling a hazard at its source is the
best way to protect employees. When engineering, work practice and administrative controls are not feasible or do not provide sufficient protection, employers must provide personal protective equipment (PPE) to their employees and ensure its use (OSHA, 2004). PPE is equipment worn to minimize exposure to a variety of hazards and examples include helmets, gloves, safety boots, eye protection, protective hearing devices, respirators and full body suits.

2.5 Tools and equipment used in housing construction sites

Proper tools and equipment are essential for the effective operation in any construction site. Equipping the construction workers with the correct tools and equipment plays an essential role in achieving timely and good quality results. Construction tools are often classified as hand tools and power tools. Hand tools include all non-powered tools, such as hammers and pliers. Each type of tool presents some unique safety problems. According to ILO, (2011), the primary hazard from hand tools is being struck by the tool or by a piece of the material being worked on. Some of the major problems are caused by using the wrong tool for the job or a tool that has not been properly maintained. The size of the tool is important also as some women and men with relatively small hands have difficulty with large tools. Dull tools can make the work much harder, require more force and result in more injuries. Cutting material at an awkward angle can result in a loss of balance and an injury. The greatest danger of power tools is electrocution. Poorly designed tools can also contribute to fatigue from awkward postures or grips, which, in turn, can also lead to accidents. Many tools are not designed for use by left-handed workers or individuals with small hands. Use of gloves can make it harder to grip a tool properly and requires tighter gripping of power tools, which can result in excessive fatigue. Use of tools by construction workers for repetitive jobs can also lead to cumulative trauma disorders, like carpal tunnel syndrome or tendinitis (ILO, 2011). Using the right tool for the job and choosing tools with the best design features that feel most comfortable in the hand while working can assist in avoiding these problems. Ergonomically efficient hand tools are comfortable to use, well adapted to particular construction tasks and suit the physical characteristics of the
workers. Ergonomically efficient tools and correct working techniques allow the workers to use the major body muscles effectively and make the most productive use of their energy. It is the responsibility of the project management to ensure that tools and equipment are maintained in a good condition and are readily available when required for the various work activities (OSHA, 2007). Table 2.1 shows a list of some tools used in housing construction sites.

Table 2.1: Tools and equipment used

| Tools & Equipment      | Uses                                           |
|------------------------|------------------------------------------------|
| Head pan               | Transporting materials like mortar             |
| Masonry trowel         | To place cement mortar                        |
| Measurement Tape       | For taking measurements                        |
| Plumb Bob              | To check vertical alignment of the building   |
| Wheel Barrow           | To transport cement mortar or any materials.   |
| Concrete Mixer         | To thoroughly mix the concrete at site         |
| Vibrator               | To vibrate the concrete while pouring.         |
| Rubber Boots           | To prevent skin from chemical contact          |
| Gloves                 | Prevent contact with dangerous chemicals or machines |
| Safety Glass           | For safety purpose while drilling, hacking, grinding |
| Bump Cutter            | To level fresh concrete surface               |
| Wooden Float           | To give a smooth finish to the plastered area  |
| Chisel                 | To remove excess or waste hard concrete       |
| Framing Hammer         | To drive and remove nails                     |
| Cordless Drill         | To make pilot holes                            |
| Hand Saw               | Used in wood works and shuttering              |
| Measuring Box          | Used to measure the cement and sand while site mixing |
| Hoe                    | For digging and to place concrete, cement mortar |
2.6 Research gaps

In Kenya, there is increasing awareness of health and safety information, especially following the recent enactment of OSHA (2007), WIBA (2007) and NCA Act (2011). The Kenyan constitution (2010) Article 42 also makes it a right for everyone to have a clean and safe environment. Although there is a lot of safety information in the Kenyan public domain, very little has been done in enforcing the safety laws, especially among construction workers. A lot of attention is focused on fatalities and injuries reported from collapsed buildings which are in the rise in the recent past. Little research has been done in Kenya on musculoskeletal disorders across different sectors, thus the number of people suffering from musculoskeletal disorders in the country as a result of their work activities remains statistically unknown. This study thus focused on establishing the prevalence of work-related musculoskeletal disorders among housing construction workers in Mombasa County, Kenya.
CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research design

Descriptive cross-sectional design was used in this study. Descriptive design is a research design that is systematic, empirical enquiring, where the researcher does not have a direct control of independent variable as their manifestation has already occurred or because the inherently cannot be manipulated (Orodho, 2005). The advantage of descriptive cross-sectional studies is that the information is available immediately and can be carried out within a short period of time.

3.2 Study location

This study was done in Mombasa County which is one of the 47 counties in Kenya. The County is located in the south eastern part of the coastal region of Kenya and covers an area of 229.9Km² excluding 65 Km² of water mass which is 200 nautical miles into the Indian Ocean (MCADP, 2017). It borders Kilifi County to the North, Kwale County to the South West and the Indian Ocean to the East. The County lies between latitudes 3°56’ and 4°10’ south of the equator and between longitudes 39°34’and 39°46’east of Greenwich Meridian. The County also enjoys proximity to an expansive water mass as it borders the Exclusive Economic Zone of the Indian Ocean to the East. Figure 3.1 shows a map of the study area.
Figure 3.1: Map of Mombasa County. Source: Wikimedia commons, 2013

3.3 Study population

The target population was 4,400 housing construction workers, drawn from construction sites that were registered with the National Construction Authority by the time of data collection (2016) and had ongoing housing construction projects. According to Ogula (2005), a population is a well-defined or set of people, services, elements and events, group of things or households that are being investigated. Population forms the basis from which the sample is drawn. Table 3.1 shows the distribution of the population.
Table 3.1: Distribution of housing construction workers

| Sub-County | Number of registered housing projects | Total number of workers |
|------------|---------------------------------------|-------------------------|
| Mvita      | 15                                    | 2,117                   |
| Kisauni    | 23                                    | 2,165                   |
| Changamwe  | 5                                     | 98                      |
| Likoni     | 1                                     | 20                      |
| **Total**  | **44**                                | **4,400**               |

3.4 Sample size

This study used a sample of three hundred and fifty four (354) housing construction workers. The target population in this study was finite hence Krejcie and Morgan (1970) formula was used to obtain the sample size.

\[
n = \frac{x^2 N p q}{d^2 (N - 1) + x^2 p q}
\]

\[
n = \frac{3.841 \times 4400 \times 0.5 \times 0.5}{0.5 \times 0.5 (4400 - 1) + 3.841 \times 3.841 \times 0.5 \times 0.5}
\]

N=354.

Where,

\[n = \text{desired sample size; } N = \text{Target population, } p = \text{population proportion (0.5 at 95% confidence level)}\]

q = 1-p,  d = degree of accuracy reflected by the amount of error that can be tolerated at 95% confidence level and \(X^2 = \text{the chi square table value for one degree of} \]
freedom relative to the desired level of confidence ($X^2=3.841$ at 95% confidence level).

To get the exact sample for each cadre, the cadre population was divided by the total population and multiplied by the sample. **Table 3.2** shows the sample size.

$$\text{cadre sample size} = \frac{\text{cadre population}}{\text{total population}} \times 354$$

**Table 3.2: Sample size**

| Cadre/group           | Target population | Sample size |
|-----------------------|-------------------|-------------|
| Engineers             | 44                | 4           |
| Supervisors/foremen   | 44                | 4           |
| Site contractors      | 44                | 4           |
| Masons                | 660               | 53          |
| Plasters              | 660               | 53          |
| Carpenters            | 176               | 14          |
| Roofers               | 176               | 14          |
| Plumbers              | 88                | 7           |
| Painters              | 132               | 11          |
| Electricians          | 88                | 7           |
| Steel fixers          | 88                | 7           |
| Unskilled casual workers | 2,200             | 176         |
| **Total**             | **4,400**         | **354**     |
3.5 Sampling procedure
Stratified random sampling and simple random sampling were used in this study. According to Mugenda and Mugenda (1999), stratified random sampling involves division of the population into smaller groups known as strata which are based on members’ shared characteristics or attributes. The 4,400 housing construction workers were divided into 12 strata based on the specific work performed by a worker or job cadre namely; engineers, site contractors, foremen, masons, plasterers, carpenters, roofers, plumbers, painters, electricians, steel fixers and unskilled casual workers. A random sample was then picked from within each stratum. Table 3.3 shows the sampling procedure per sub-county.
Table 3.3: Sampling procedure per cadre per Sub-County

| Sub-County | Engineers | Foremen | Contractors | Masons | Plumbers | Painters | Electricians | Steel Fixers | Unskilled Casuals | Total |
|------------|-----------|---------|------------|--------|----------|----------|--------------|--------------|------------------|-------|
| Mvita      | A         | 1       | 1          | 1      | 20       | 7        | 5            | 3            | 3                | 70    | 139             |
| Kisauni    | B         | 1       | 1          | 1      | 28       | 7        | 5            | 3            | 3                | 70    | 155             |
| Changamwe  | C         | 1       | 1          | 1      | 5        | 0        | 2            | 1            | 1                | 32    | 51              |
| Likoni     | D         | 1       | 1          | 1      | 0        | 0        | 2            | 0            | 0                | 4     | 9               |
| Total      | 4         | 4       | 4          | 53     | 53       | 14       | 14           | 7            | 7                | 176   | 354             |
3.6 Data collection instruments

Primary data was collected through a standardized Nordic questionnaire (Appendix 3), observation checklist (Appendix 4) and photography. The items in the questionnaire were designed to capture all the specific objectives of the study. The questionnaire sought to establish the work activities that could lead to a worker developing an MSD, the presence of the MSDs symptoms among workers and the preventive measures that had been put in place to prevent MSDs among workers in the housing construction industry in Mombasa County.

The observation checklist was used to record how work activities were being carried out, the weights being lifted, the postures applied while working and the duration it took to perform a task. Secondary data was collected through review of existing records on MSDs in the housing construction sector from DOSHS and hospital health records.

3.5 Data Collection Procedure

The questionnaires were self-administered to the sampled participants. This gave them a sense of privacy hence increasing the integrity of their responses as well as the quality of data collected. The contractors of all the sampled housing construction sites for the study were contacted in advance to make prior arrangements for the convenient times when the questionnaires could be administered to their workers. The casual workers were available to fill the questionnaires during their lunch breaks only because they had been allocated workload to complete each day. The rest of the respondents (permanent staff) were available at any time of the day. The main researcher and the research assistant filled the observation checklist after observing how various work activities were being performed.

3.6 Pilot study

A pilot study was done involving 12 respondents on two selected housing construction sites in Kwale, a neighbouring County to the selected county to pretest the efficacy of the questionnaires. Kwale County was selected for pretesting due to its similarity in climate as Mombasa County. According to Babbie (2004), a pilot
study is conducted when a questionnaire is given to just a few people with an intention of pre-testing the questions and assists the researcher in determining if there are flaws, limitations or other weaknesses hence necessary revisions prior to the implementation of the study.

3.7 Validity and reliability of data collection instruments
Reliability analysis was done using Cronbach’s Alpha which measures the internal consistency by establishing if certain items within a scale measure the same construct. The reliability of the overall scale’s reliability of the present situation and the desired situation should be above the acceptable level of 0.70 (Hair et al., 1998). The obtained values in this study were above 0.70 hence this data thus gives a measurable account of data acceptable where informed decisions can be made based on statistical information. Table 3.4 shows the values obtained.

| Statements                              | Cronbach's Alpha | Number of Items |
|-----------------------------------------|------------------|-----------------|
| Work activities causing MSDs            | 0.806            | 6               |
| Frequently reported MSDS                | 0.771            | 6               |
| Preventive measures to control MSDs     | 0.728            | 6               |

3.8 Data analysis and presentation
Quantitative data gathered from questionnaires was cleaned, coded, tabulated and entered into Statistical Package for Social Sciences (SPSS) Version 20.0 for analysis. Summary statistics was used to analyze qualitative data. Multiple regression analysis was conducted to test and determine the prevalence of
musculoskeletal disorders among housing construction workers in relation to occupational activities and presence of MSDs.

The theoretical Regression equation \( Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon \) was applied:

Where:

- \( Y \) = Prevalence of musculoskeletal disorders
- \( \beta_0 \) = beta constant
- \( \beta_1, \beta_2, \beta_3, \beta_4 \) and \( \beta_5 \) = regression coefficients
- \( \varepsilon \) = error of estimate at 95% confidence level.

\( X_1 \) = Physical factors (manual handling of heavy weights, repetitive motions, working in awkward postures)

\( X_2 \) = Organizational/administrative factors (job rotation, working hours, use of PPE)

\( X_3 \) = Individual factors (age, gender, BMI, work experience)
CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The presented findings are those drawn from 264 out of 354 administered questionnaires with a response rate of 74.6%. According to Mugenda and Mugenda (1999), a response rate of 50% is adequate for analysis and reporting, a rate of 60% is good and a response rate of 70% and over is excellent. The current study return rate of 74.6% was deemed excellent to give valid analysis of the prevalence of MSDs in Mombasa County.

4.2 Socio-demographic data of the respondents

The demographic characteristics of the respondents were found to be key in determining the prevalence of MSDs among construction workers. The age, gender, BMI and number of years worked in the housing construction industry were captured. Table 4.1 shows the distribution of respondents’ gender, age, height, weight, education level and years worked in the housing construction industry.
Table 4.1: Socio-demographic data of respondents

| Variable          | Trait               | Frequency | Percent (%) |
|-------------------|---------------------|-----------|-------------|
| Gender            | Male                | 262       | 99.2        |
|                   | Female              | 2         | 0.8         |
| Age (years)       | 0-18                | 0         | 0           |
|                   | 19-29               | 94        | 35.6        |
|                   | 30-39               | 108       | 40.9        |
|                   | 40-49               | 47        | 17.8        |
|                   | 50-59               | 13        | 4.9         |
|                   | 60 and above        | 2         | 0.8         |
| Education level   | Never attended school | 26       | 9.8         |
|                   | Primary             | 73        | 27.7        |
|                   | Secondary           | 84        | 31.8        |
|                   | Tertiary/college/University | 81 | 30.7 |
| Height (Feet)     | Below 4.5           | 0         | 0           |
|                   | 4.5-5.0             | 25        | 9.5         |
|                   | 5.1-5.5             | 96        | 36.4        |
|                   | 5.6-6.0             | 105       | 39.8        |
|                   | 6.1 and above       | 38        | 14.4        |
| Weight (Kg)       | Less than 45        | 0         | 0           |
|                   | 45-54               | 28        | 10.6        |
|                   | 55-64               | 137       | 51.9        |
|                   | 65-74               | 69        | 26.1        |
|                   | 75-85               | 26        | 9.8         |
|                   | 85 and above        | 4         | 1.5         |
| Years worked      | 3-8                 | 135       | 51.1        |
|                   | 9-14                | 76        | 28.8        |
|                   | 15-20               | 40        | 15.2        |
|                   | 21 and above        | 13        | 4.9         |
4.2.1 Gender of respondents

The current study found out that majority (99.2%) of the housing construction workers in Mombasa County were males while only 0.8% were women (Table 4.1). These results agree with findings of researches conducted in other countries as reported by Sang and Powell, (2012) who noted that the construction industry remains one of the most male dominated sectors worldwide as women are under-represented. Small number of female workers in the construction sector has been reported in most developed countries such as Canada, United States of America and Australia where the employment rate of women in the construction industry is 3% (Sang and Powell, 2012). The same findings were reported by Madikizela and Haupt (2010), who carried out a study in South Africa and confirmed that most construction firms employed small numbers of women.

Construction work is very strenuous and physically demanding (Bernard, 2010). This explains the low rate of women employment in the housing construction industry as men are more masculine and physically strong. The results of this study imply that more men than women in the housing construction sector in Mombasa County are exposed to ergonomic risk factors that can lead to development of MSDs.

4.2.2 Age of respondents

From the findings of this study, minority (0.8%) of the respondents was above 60 years of age while the majorities (40.9%) were between 19-29 years old (Table 4.1). This can be attributed to the fact that the youth are more energetic and physically fit to perform strenuous activities as opposed to the aged population (Williams et al., 2011). Late development is characterized by differential patterns of change and stability with a linear reduction of performance in tasks that are dependent on speed (Verhaeghen et al., 2003). The ability to function in tasks with activities of a heavy physical nature reduces with age (Evans and Hurley, 1995). Ageing also produces postural limitations, with older adults experiencing difficulty stooping, crouching, bending and reaching (Schibye et al., 2001). The aged are also more prone to injuries and fatalities (Coniac, 2009). The findings of the current study established that the
youthful generation form the majority of the workforce in the housing construction industry is Mombasa County hence are more exposed to ergonomic risk factors that could lead to development of MSDs.

4.2.3 Education level of respondents and MSDs

This study established that 9.8% of the housing construction workers had never attended school at all while 59.5% had attained basic education (Table 4.1). This means that majority of the construction population in Mombasa County lack specialized tertiary training and this makes them engage in menial construction duties that do not requires special skills like concrete mixing, carrying building blocks and cement bags. It was observed during the study that the unskilled casual workers for instance ferried coral building blocks on their shoulders to the areas they were required especially to upper floors (Plate 4.1). The number of building blocks carried per day determined the sum of wages a casual worker received at the end of the day. Majority of the casual workers were thus forced to carry more blocks for longer periods in order to accumulate a meaningful amount of money to cater for the day’s expenses. It was noted in the current study that on average a casual worker carried 350 building blocks from ground to upper floors in a day at a rate of two Kenya shillings per block. Bernard et al., (1997) reported that heavy physical work for example lifting and carrying, pushing, pulling and manipulating heavy load as in the construction industry is a classic task leading to the development of MSDs. Exposing workers to heavy physical work contravenes the Kenya OSHA, (2007) which states that an employer shall not require or permit any of his employees to engage in the manual handling or transportation of a load which by reason of its weight is likely to cause the employee to suffer bodily injury. Most of the employers in the housing construction industry in Mombasa County were found to be violating this law.
4.2.4 Years worked in the construction industry

From the findings of this study, housing construction workers retire early as it was established that most (95.1%) of the respondents had worked in the housing construction sector for 3-20 years while only 4.9% had worked for over 20 years (Table 4.1). Brenner and Ahern, (2000) also reported that the construction industry has high levels of early retirement due to permanent disability or ill-health and the most common disability leading to early retirement is MSDs. This industry also has the lowest rate of survival in work without permanent incapacity at aged 65 (Guberan & Usel, 1998). The low numbers of construction workers who had worked for more than 20 years in Mombasa County at the time of data collection may be an indication that majority of have retired as a result of work-related MSDs.

4.2.5 Body Mass Index (BMI) of respondents

The respondents’ BMI was calculated by dividing their weight in kilograms by the square of their height in meters (Table 4.2). Their BMI was categorized into four
classes: underweight, normal weight, overweight, and obese according to the international classification system WHO, (2000).

Table 4.2: Body Mass Index (BMI) of respondents

| Average Weight (Kg) | Average Height (feet) | Frequency | Percent (%) | BMI  | Remarks |
|---------------------|-----------------------|-----------|-------------|------|---------|
| 49.5                | 4.8                   | 28        | 11          | 24.5 | Normal  |
| 59.5                | 5.3                   | 137       | 52          | 23.2 | Normal  |
| 69.5                | 5.8                   | 91        | 34          | 23.2 | Normal  |
| 80.0                | 6.1                   | 3         | 1           | 23.4 | Normal  |
| 87.5                | 5.8                   | 5         | 2           | 29.2 | Overweight |

In the current study, most (98%) respondents had a normal BMI while a few were overweight. BMI establishes the fitness of individuals which also determines their ability to function well especially in high force requirement jobs accompanied by a lot of repetitive motions (Shiri et al., 2010). Nilsen et al. (2011) also found out that high body mass index (overweight and obesity) is an independent risk factor for MSDs of most body parts. The small number of persons with unhealthy BMI in the housing construction industry in Mombasa County implies that weak persons cannot find employment in this industry as they are prone to frequent absenteeism and poor performance.

4.3 Nature of tools and equipment used

4.3.1 Servicing of tools and equipment

This study established that most (64.4 %,) of the tools and equipment used while working were never serviced at all while only 12.9% were always serviced (Table 4.3).
Table 4.3: Servicing of tools and equipment

| Statement               | Frequency (n) | Percentage (%) |
|-------------------------|---------------|----------------|
| They are never serviced | 170           | 64.4           |
| Serviced sometimes     | 20            | 7.6            |
| Always serviced        | 34            | 12.9           |
| I don’t know           | 28            | 10.6           |
| N/A                    | 12            | 4.5            |
| **Total**              | **264**       | **100.0**      |

Hand tools were the ones commonly used in a poorly maintained state for example hammers, saws, chisels and measuring tapes. Poorly maintained tools put undue pressure on the worker to apply more force while performing a task thus exposing them to the risk of developing musculoskeletal disorder. This is in contradiction to the Occupational Safety and Health Act (OSHA 2007) which states that machinery, equipment, personal protective equipment, appliances and hand tools used in all workplaces shall comply with the prescribed safety and health standards and be appropriately installed, maintained and safe guarded (OSHA, 2007).

4.3.2 Improvising tools

A number of workers (17%) were found to be using improvised tools and equipment in order to complete the assigned workload for the day (Figure 4.1).
Personal protective equipment was mostly improvised by construction workers. Improvised tools and equipment can cause fatal injuries to the user and other workers around them. According to OSHA (2007), all tools and equipment should be properly maintained and serviced. Some building contractors in Mombasa County are contravening the law by allowing workers to use unsafe tools and equipment.

4.4 Job rotation and working hours
This study found that 27.3% of the respondents were working for more than 8 hours in a day. The reason for working for more hours was to complete the assigned workload and meet the strict deadlines set by the building contractors. It was also established that 95.5% of the respondents did not have job rotation so the whole working hours were spent doing the same task. Working for long hours without breaks and job rotation increases the chances of a worker developing musculoskeletal disorders, (NIOSH, 1997). Best practices like job rotation have been found to reduce the cases of MSDs among production workers in highly repetitive jobs with heavy loads (Mathiassen, 2006). This has been shown to help in cost reduction and
promotion of health of workers (Keir et al., 2011). The prevention and health promotion for workers occurs through switching between different tasks with different levels of exposure and biomechanical applications, which in theory reduce the cumulative and or average exposure that should in turn promote the reduction of musculoskeletal and cognitive overloads (Keir et al., 2011). OSHA, (2007) requires that employees be given breaks in between working hours and shorter shifts for strenuous activities in order to rest but this study found the opposite hence the law is being violated by building developers in Mombasa County.

4.5 Use of personal protective equipment (PPE)

This study found that 57.2% of the respondents were provided with PPE by their employers but they did not make proper use of them while 15.1% were not given PPE at all. Only 27.7% of the respondents were using the provided PPE in construction sites that had constant supervision (Table 4.4).

Table 4.4: Use of PPE by construction workers

| Statement                                    | Frequency (n) | Percent (%) |
|----------------------------------------------|---------------|-------------|
| PPE provided and used correctly              | 73            | 27.7        |
| PPE provided but not correctly being used    | 151           | 57.2        |
| PPE not provided and not used at all         | 40            | 15.1        |
| **Total**                                    | **264**       | **100**     |

Construction workers who were not using provided PPE by their employers claimed that the high temperature and humidity experienced in Mombasa County were not PPE friendly hence the PPE were more of a burden that a protective gear. The annual mean temperature in Mombasa County is 27.9°C with a minimum of 22.7°C and a maximum of 33.1°C and the average humidity at noon is about 65% (MCADP, 2017). Some of the construction workers not provided with PPE by their employers were found to be improvising for themselves (Plate 4.2).
According to OSHA, (2007), every employer shall provide and maintain for the use of employees in any workplace where employees are employed in any process involving exposure to wet or to any injurious or offensive substance, adequate, effective and suitable protective clothing and appliances, including, where necessary, suitable gloves, footwear, goggles and head coverings. The same Act also states that an employee shall at all times wear or use any protective equipment or clothing provided by the employer for the purpose of preventing risks to his safety and health. An employer or employee who contravenes the provisions of this Act commits an offence and shall, on conviction, be liable to a fine or imprisonment or both. From the findings of this study, most developers and construction workers in Mombasa County are contravening the law for failure to use PPE.
4.6 Prevalence of MSDs among construction workers in Mombasa County

4.6.1 Reported factors leading to development of MSDs

Most respondents (61%) reported that physical factors (repetitive tasks, heavy weight handling and using awkward postures while working) were the leading cause of MSDs among housing construction workers (Figure 4.2).

![Graph showing reported factors contributing to development of MSDs]

Figure 4.2: Reported factors contributing to development of MSDs

This finding demonstrates that housing construction workers in Mombasa County are exposed to various risk factors that can lead to development of MSDs.

4.6.2 Construction workers reporting MSDs symptoms

Results revealed that majority (98.1%) of the respondents reported to have had experienced body pain, ache, discomfort or numbness in various body parts in the last twelve months and only 2.7% had sought medical attention for their condition in the same period (Table 4.5).
Table 4.5: Number of construction workers reporting body pain

| Statement                                                                 | Frequency (n) | Percent (%) |
|---------------------------------------------------------------------------|---------------|-------------|
| Experienced pain, ache, discomfort or numbness in past 12 months           | 259           | 98.1        |
| Condition interfered with normal work in past twelve months                | 157           | 60.6        |
| Had pain, ache, discomfort or numbness within last seven days              | 71            | 27.4        |
| Sought medical advice for the condition in last twelve months              | 7             | 2.7         |

This research finding implies that majority of housing construction workers in Mombasa County are reporting to be affected by MSDs as a result of their work activities but unfortunately only a few seek medical attention.

4.6.3 Body parts reported to experience MSDs symptoms

From this study, it was discovered that lower back was the most reported (68%) body part to be affected by MSDs (Table 4.6).

Table 4.6: Reported body parts

| Reported body part  | Frequency (n) | Percent (%) |
|---------------------|---------------|-------------|
| Neck                | 8             | 3           |
| Shoulders           | 18            | 7           |
| Upper back          | 33            | 12.7        |
| Wrist and Elbow     | 5             | 2           |
| Lower back          | 176           | 68          |
| Hips/thighs         | 7             | 2.7         |
| Knees               | 9             | 3.5         |
| Ankles and feet     | 3             | 1.1         |
| **Total**           | **259**       | **100**     |
These results agree with Latza et al. (2000) who reported that the back is the body part most frequently injured in the construction industry and the major cause of injury is overexertion. Oude et al., (2011) also established that in any population of working construction workers, more than half suffer from occasional or frequent musculoskeletal complaints and the lower back is the major complain. Lenderink et al. (2012) conducted a study in USA among construction workers who had had acute musculoskeletal injuries. It was reported that, almost half had on-going symptoms two months later while 40% had symptoms 12 months after the injury. Those who reported chronic symptoms also reported that their quality of life was substantially affected. Symptoms that persisted more than two months varied according to body part affected. Knee, leg, groin and hip injuries were most likely to last beyond two months followed by shoulder, neck and low back problems; while foot and ankle injuries and upper extremity injuries recovered the most rapidly (Lenderink et al., 2012). The fact that ankles recover more quickly explains the low number of those affected in Mombasa County. The back also takes longer to recover hence the high number of MSDs reported in the current study. This study finding asserts that housing construction workers in Mombasa County do indeed experience MSDs symptoms.

### 4.6.4 Relationship of MSDs to occupational activities

From the findings of this study, there is a strong positive relationship between the dependent variable (prevalence of musculoskeletal disorders) and the independent variables (physical factors, organizational factors and individual factors). From Table 4.7, the equation \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon \) became: \( Y = 0.271 + 0.348X_1 + 0.162X_2 + 0.581X_3 + 0.05 \).
Table 4.7: Regression statistics

| Model               | Unstandardized Coefficients | Standardized Coefficients | T      | Sig. |
|---------------------|-----------------------------|---------------------------|--------|------|
|                     | B                           | Std. Error                | Beta   |      |
| (Constant)          | .271                        | .204                      | 1.328  | .185 |
| Physical factors    | .348                        | .066                      | .309   | 5.295| .000 |
| Organizational factors | .162                      | .069                      | .144   | 2.345| .020 |
| Individual factors  | .581                        | .039                      | .601   | 14.871| .000 |

*a. Dependent Variable: Prevalence of musculoskeletal disorders*

The regression results established that taking physical factors, organizational factors and individual factors into account constant at zero, prevalence of musculoskeletal disorders will be 0.321. The findings also show that holding organizational factors and individual factors constant, a unit increases in physical factors will lead to a 0.348 increase in prevalence of musculoskeletal disorders. Additionally, holding physical factors and individual factors constant, a unit increases in organizational factors will lead to a 0.162 increase in prevalence of musculoskeletal disorders while holding organizational factors and physical factors constant a unit increases in individual factors will lead to a 0.581 increase in prevalence of musculoskeletal disorders. Further, it was observed that 95% level of confidence, physical factors had a 0.000 level of significance and organizational factors had 0.020 while Individual factors had 0.000. This shows that all independent variables were statistically significant (p<0.05). This research finding implies that there is high prevalence of MSDs symptoms among majority of housing construction workers in Mombasa County.
4.6.5 Regression model summary

The model summary in Table 4.8 provides the R, R², adjusted R² and the standard error of estimate, which can be used to determine how well a regression model fits the data. R squared is the fraction of the variation in dependent variable (prevalence of musculoskeletal disorders) that can be accounted for by independent variables (physical factors, organizational factors and individual factors). In this case, R-Square shows that 64.1% of variation was explained. This indicates that in the current study, the independent variables were significant in causing MSDs.

Table 4.8 Regression model Summary

| Mode | R   | R Square | Adjusted R Square | Std. Error of the Estimate |
|------|-----|----------|-------------------|---------------------------|
|      | .800² | .641    | .637              | .380                      |

Predictors: physical factors, organizational factors and individual factors.

4.6.6 Analysis of variance (ANOVA)

Analysis of variance was used to test the fitness of the regression model and a significant F value of 154.569 (p = 0.000) was obtained (Table 4.9).
This means that the regression model obtained was statistically significant and can be deemed fit for prediction purposes. Hence, the data obtained rejects the null hypothesis which states that there are no musculoskeletal disorders among housing construction workers in Mombasa County and accepts the alternative that various factors lead to MSDs. Thus, the factors under study significantly contribute to MSDs in the housing construction industry.

The Kenyan constitution, (2010) article 42 states that everyone has a right to a healthy and clean environment. The Occupational Safety and Health Act (OSHA, 2007) also requires every occupier to provide his/her employees with a safe work environment. This study shows otherwise in Mombasa County and is violation safety laws.

**4.7 Control measures put in place to prevent MSDs in Mombasa County**

The findings of this study established that out of the 44 construction sites sampled, majority (72.7%) practiced the use of PPE only which is the least effective measure of controlling MSDs (Table 4.10).
Table 4.10: Measures put in place to prevent MSDs

| Controls put in place                                      | Frequency (n) | Percent (%) |
|-----------------------------------------------------------|---------------|-------------|
| Engineering controls                                      | 1             | 2.3         |
| Administrative controls and work practice controls        | 7             | 15.9        |
| PPE only                                                  | 32            | 72.7        |
| No control in place at all                                | 4             | 9.1         |
| **Total**                                                 | 44            | **100**     |

This study found out that 2.3% of the construction site managers had put in place the three controls of MSDs including engineering controls, administrative and work practice controls and use of PPE. Some of their operations had been automated and they were using cranes to move heavy weights to upper floors (Table 4.10). 15.9% of the construction site managers had no engineering controls but they had put in place administrative/work practice controls coupled by the use of PPE. These sites had strict supervision, regular breaks and job rotation for their workers. It was revealed that in 9.1% of the construction sites, there was no any form of controls put in place to prevent MSDs and workers were over exposed to health and safety hazards as a result.

Engineering controls are usually the most effective long-term approach to reducing ergonomic hazards as they eliminate the risk factors present in a specific construction task (Bust et al., 2005). Manufacturers can also employ engineering controls to modify the size or design of materials. In the U.K for example, a focus group feedback showed that kerbs which were redesigned by reducing their size, using a lighter concrete and adding handholds lead to reduction of MSDs among the workers (Bust et al., 2005).

Administrative and work practice controls come second in preventing MSDs after engineering controls. These include changes in work procedures for example having written safety policies, supervision, job rotation, trainings with the aim of reducing duration, frequency and severity of exposure to hazards (Construction Safety Council, 2012). According to NIOSH (1993), surveillance of workplaces was found
to reduce the number of occupational injuries and fatalities in Alaska. Stretch exercises can also be used to reduce injury and increase performance (Choi et al., 2014). Site exercise programs have been suggested and implemented as preventive measures against upper extremity MSDs in developed countries (McGorry & Courtney, 2006). According to OSHA, (2007), employers have the responsibility of protecting workers’ health and safety by providing a safe work environment. From the current study, construction workers in Mombasa County were found to be exposed to ergonomic risk factors that could cause MSDs due to failure to implement the right control measures.
CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion
This study concludes that the construction sector is male dominated (99.2%) hence more men are exposed to MSDs than women in Mombasa County. The study also established that 98.1% of the housing construction workers reported to have suffered from MSDs symptoms with the lower and upper back being the most reported body parts. Very few construction workers (2.7%) sought medical advice for suspected cases of MSDs meaning the health of the affected will continue deteriorating if urgent measures are not put in place. Based on the third objective, very little had been done to prevent MSDs among construction workers in Mombasa County by the responsible parties.

5.2 Recommendations
This study recommends safety trainings to all construction workers before deployment particularly on ergonomics. It also recommends enforcement of OSHA, (2007) and NCA, (2011) to the letter and routine site inspections to ensure compliance to the law. Another recommendation is awareness creation among construction workers on the importance of routine medical examinations for early detection and control of MSDs. Finally, the study recommends awareness creation among building contractors and construction site managers on the importance of implementing engineering controls and work-practice controls in addition to the use of PPE so as to effectively prevent MSDs.

5.3 Suggestions for Further Research
This study was based on self-reported cases of MSDs symptoms among housing construction workers in Mombasa County. Self-reported symptoms may be underestimated or over-estimated (NIOSH, 1997). It is thus suggested that longitudinal studies based on medical examinations be carried out among housing construction workers in Mombasa County to verify the prevalence of MSDs.
REFERENCES

Ammendolia, C. Cassidy, D. Steensta, I. Soklaridis, S. Boyle, E. Howard, H. & Bhupinder, B. (2009). Designing a workplace return-to-work program for Occupational low back pain: an intervention mapping approach. *American Journal of Medicine. 10*(65).

Armstrong, T. Buckle, P. Fine, L. Hagberg, M. Jonsson, B. Kilbom, A. … & Viikari-Juntura, E. (1993). A conceptual model for work-related neck and upper-limb musculoskeletal disorders. *Scandinavian Journal of Work Environment Health, 19*(2), 73–84.

Arndt, V. Rothenbacher, D. Daniel, U. Zschenderlein, B. Schuberth, S. & Brenner, H. (2004). All-cause and cause specific mortality in a cohort of 20 000 construction workers; results from a 10 year follow up. *American Journal of Occupational Environmental Medicine. 61*, 419-425.

Babbie, E., (2004). *The Practice of Social Research*. Belmont CA: Wadsworth.

Bakker, E.W., Verhagen, A.P., Van, T.E., Lucas, C., & Koes, B.W. (2009). Spinal mechanical load as a risk factor for low back pain: a systematic review of prospective cohort studies. *Spine, 34*, E281-E293.

Baldwin, M. (2004). Reducing the cost of work related musculoskeletal disorders:targeting strategies to chronic disability cases. *Journal of Electromyography and Kinesiology, 14*, 33-41.

Bernard, B. P. (2010). Musculoskeletal disorders and workplace factors: a critical,review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and lower back. *NIOSH Publication, 97*-141.

Bernard, B. P. (1997). Putz-Anderson, V., Burt, S.E & Cole, L: Musculoskeletal disorders and workplace factors: a critical review of epidemiologic
evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. DHHS (NIOSH) Publication, 97-141.

BMUS [United States Bone and Joint Initiative] (2008). *The Burden of Musculoskeletal Diseases in the United States*, (2nd ed.). Rosemont, IL: American Academy of Orthopaedic Surgeons.

Boschman, J.S. Van der Molen, H.F. & Sluiter, J.K. (2012). Response rate of bricklayers and supervisors on an internet or a paper-and-pencil questionnaire. *International Journal of Industrial Ergonomics*, 42, 178-182.

Brenner, H. & Ahern, W. (2000). Sickness absence and early retirement on health grounds in the construction industry in Ireland. *Journal of Occupational Environmental Medicine*, 57, 615-620.

Bust, P.D., Gibb, A.G. & Haslam, R.A. (2005). Manual handling of highway kerbs: Focus group findings. *Journal of Applied Ergonomics*, 36, 417-425.

Chaffin, D.B., Herrin, G.D., Keyserling, W.M. & Foulke, J.A. (1977). Pre-employment strength testing in selecting workers for materials handling jobs. *National Institute for Occupational Safety and Health*, 77(163).

Choi, S.D. & Rajendran, S. (2014). Construction workers’ perception of stretch and flex program effectiveness in preventing work-related musculoskeletal disorders. *Proceedings of the XXVI Occupational Ergonomics and Safety Conference*.

Cohen, A. Gjessing, C. Fine, L. Bernard, B. & McGlothlin, J. (1997). Elements of ergonomics programs: A primer based on workplace evaluations of musculoskeletal disorders. *National Institute for occupational safety and health, DHHS (NIOSH) Publication*, 97(117).
Coniac, B. (2009). Ageing Workers in the Construction Industry, their vulnerability and management, Vulnerable Workers Working Group Information Paper.

Construction Safety Council, (2012). *Health Hazards in Construction Workbook*. US: CSC.

Constitution of Kenya, (2010. National council for law reporting. Retrieved from: www.kenyalaw.org

Cook, T.M., Rosecrance, J.C. & Zimmerman, C.L (1996). Work-related Musculoskeletal Disorders in Bricklaying: a Symptom and Job factors Survey and Guidelines for Improvement. *Applied Occupational Environment Hygiene, 11*, 1335-1339.

DHHS, (1997). Musculoskeletal disorders and work-place factors- a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity and low back. *NIOSH publication*, 19 - 97.

DOSHS, (2011). *Kenya Annual Report*. Nairobi: Directorate of Occupational Health and Safety Services.

Evans, W.J. & Hurley, B.F. (1995). Age, Gender and Muscular Strength, *Journal of Gerontology, 50*, 41-44.

Flanagan, F. Jewell, C. Larsson, B. & Sfeir, C. (2001). *Vision 2020: Building Sweden’s future*, Sweden: Chalmers University of Technology.

Gerr, F. Fethke, N.B. Anton, D. Merlino, L. Rosecrance, J. Marcus, M & Jones, MP. (2014). A prospective study of musculoskeletal outcomes among manufacturing workers: II. Effects of psychosocial stress and work organisation factors. *Human Factors, 56*, 178–190.
Gilgil, E, Kaçar, C, Bütün, B, Tuncer, T, Urhan, S, Yıldırım, C,… & Dündar, U. (2005). Prevalence of low back pain in a developing urban setting. *Spine, 30*, 1093-98.

Guberan, E & Usel, M. (1998). Permanent work incapacity, mortality and survival without work incapacity among occupations and social classes: a cohort study of ageing men in Geneva. *International Journal of Epidemiology, 27*, 1026-1032.

Hagberg, M., Silverstein, B., Wells, R., Smith, M., Hendrick, H., & Carayon, P. (1995). *Work-related musculoskeletal disorders (WMSDs)*: a reference book for prevention. London, England: Taylor and Francis.

Hair, Jr. J. F., Anderson, R. E., Tatham, R. L., & Black, W. C., (1998). *Multivariate Data Analysis* (5th ed.). New York: Macmillan Publishing Company.

Hinnen, U, Laubli, T, Guggenbuhl, U, & Krueger, H. (1992). Design of check-out systems including laser scanners for sitting work posture. *Scandinavian Journal of Work Environment and Health, 18*, 186–194.

Holmström, E. & Ahlborg, B. (2005). Morning warming-up exercise - Effects on musculoskeletal fitness in construction workers. *Applied Ergonomics, 36*, 513-519.

Holmström, E.B., Lindell, J., & Moritz, U. (1992). Low back and neck/shoulder pain in construction workers: Occupational workload and psychosocial risk factors. Part 2: Relationship to neck and shoulder pain. *Spine, 17*(6), 672-677.

ILO (2011). *Encyclopaedia of Occupational Health and Safety*, Geneva: ILO.

Keir, P.J, Sanei, K., & Holmes, M.W.R (2011): Task rotation effects on upper extremity and back muscle activity. *Applied journal of Ergonomics, 42*(6), 814–819.
KNBS (2015). *Economic survey*. Nairobi: Kenya national bureau of statistics.

KNBS (2015). *County statistical abstract; Mombasa County*. Nairobi: Kenya national bureau of statistics.

Krejcie, R. V & Morgan, D.W (1970). Determining sample size for research activities.

Latza, U. Karmaus, W. Sturmer, T. Steiner, M. Neth, A & Rehder, U. (2000). Cohort study of occupational risk factors of low back pain in construction workers. *Journal of Occupational Environmental Medicine*, 5, 103-107.

Lenderink, A.F. Zoer, I. Van der Molen, H.F. Spreeuwers, D. & Frings-Dresen, M.H. (2012). Review on the validity of self-report to assess work-related diseases. *International journal of Occupational Environmental Health*, 85, 229-251.

Lopez, A., Mathers, C., Ezzati, M., Jamison, D, & Murray, J. (2006). Global and regional burden of disease and risk factors, 2001: Systematic analysis of population health data.

Lubeck, DP. (2003). The costs of musculoskeletal disease: Health needs assessment and health economics. *Best Practice & Research Clinical Rheumatology*, 17(3), 529–539.

Ludewig, P.M. & Borstad, J.D. (2003). Effects of a home exercise program on shoulder pain and functional status in construction workers. *Journal of Occupational and Environmental Medicine*, 60(11), 841-849.

Marras, W.S., Lavender, S.A., Leurgans, S.E., Rajulu, S.L., Allread, W.G., Fathallah, F.A., & Ferguson, S.A. (1993). The role of dynamic three-dimensional trunk motion in Occupational-related low back disorders: the effects of workplace factors trunk position and trunk motion characteristics on risk of injury, *Spine*, 18(5), 617-628.
McCauley Bush, P. (2011). *Ergonomics: Foundational Principles, Applications and Technologies, an Ergonomics*. Boca Raton, FL: CRC Press, Taylor & Francis

MCADP, (2017). *County annual development plan*. County government of Mombasa. Mombasa: MCADP.

McGorry, R. & Courtney, T.K. (2006). Work site exercise programs: Are they an effective control for musculoskeletal disorders of the upper extremities. *Professional Safety, 51*(4), 25-30.

Mathiassen, S.E. (2006). Diversity and variation in biomechanical exposure: what is it, and why would we like to know? *Applied Ergonomics, 37*(4), 419–427.

Mugenda, O.M. & Mugenda, A.G., (1999). *Research Methods: Quantitative and Qualitative approaches*. Nairobi: Act Press.

Murray, J & Lopez, A. (1997). Regional patterns of disability-free expectancy and disability-adjusted life expectancy: Global Burden of Disease Study.

Nilsen, T., Holtermann, A. & Mork, P (2011). Physical exercise, body mass index, and risk of chronic pain in the low back and neck/shoulders: longitudinal data from the Nord-Trondelag Health Study. *Journal of Epidemiology*. 174, 267-273.

NIOSH (1993). Fatal injuries to workers in the United States, 1980-1989: a decade of surveillance. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (*NIOSH*) Publication, 93-108.

NIOSH, (1997). *Muscloskeletal disorders (MSDs) and workplace factors. A critical review of epidemiologic evidence for work-related musculoskeletal*
disorders of the neck, upper extremity and lower back. U.S: department of health and human services.

Ogula, P. A., (2005). Research Methods. Nairobi: Catholic University of East Africa Publications.

Olson, D. L. (1999). An onsite Ergonomic Program: a model for Industry.

Orodho, J.A., (2005). Essential of educational and social sciences research methods. Kenya

OSHA, (2007). The occupational safety and health act., Nairobi: Government printer.

OSHA, (2004). Occupational safety and health administration. U.S: department of labour.

Oude, K.M. Blatter, B. Geuskens, G.A. & Koppes, L.L. (2011). Factors associated with the ability and willingness to continue working until the age of 65 in construction workers. International Journal of Occupational and Environmental Health, 6(2), 345 456.

Punnett, L., Fine, L.J., Keyserling, W.M., Herrin, G.D., & Chaffin, D.B. (1991). Back disorders and non-neutral trunk postures of automobile assembly workers. Scand. J. Work Environ. Health, 17, 337-346.

Rissen D, Melin B, Sandsjo L, Dohns I, & Lundberg U. (2002): Psychophysiological stress reactions, trapezius muscle activity and neck and shoulder pain among female cashiers before and after introduction of job rotation. Work Stress, 16 (2), 127–137.

Sang, K. & Powell, A. (2012). Gender inequality in the construction industry: Lessons from Pierre Bourdieu, Proceedings of the 28th Annual ARCOM Conference, 3-5 September 2012, Edinburgh, United Kingdom, 237-247.
Sato, T. O & Coury, H.J. (2009). *Evaluation of musculoskeletal health outcomes in the context of job rotation and multifunctional jobs*. *Appl Ergonomics, 40*(4), 707-712.

Schiybe, B., Hansen, A.F., Sogaard, K., & Christensen, H. (2001). *Aerobic power and muscle strength among young and elderly workers with and without physically demanding work tasks*. *Applied Ergonomics, 32*, 425-431.

Schneider S. P. (2001). Musculoskeletal Injuries in Construction: A review of the Literature. *Journal of Applied Occupational Environmental Hygiene, 16*(11), 1056–1064.

Shiri, R., Karppinen, J., Leino, P., Solovieva, S & Viikari, E. (2010). The association between obesity and low back pain: a meta-analysis. *Am J Epidemiol. 171*, 135-154.

Solomon, C. Poole, J. Palmer, K.T. & Coggon, D. (2007). Health related job loss: findings from a community based survey. *Journal of Occupational and Environmental Medicine, 64*, 144–149.

Stattin, M. & Jarvholm, B. (2005). Occupation, work environment and disability pension: a prospective study of construction workers. *Scandinavian Journal of Public Health, 33*, 84-90.

Stocks, S.J. McNamee, R. Carder, M. & Agius, R.M. (2010). The incidence of medically reported work-related ill health in the UK construction industry. *Occupational Environment Medicine. 67*, 574-576.

Sturmer, T. Luessenhoop, S. Neth, A. Soyka, M. & Karmaus, W. (1997). Construction work and low back disorder. Preliminary findings of the Hamburg Construction Worker Study. *Spine, 22*, 2558-2563.

Van der Molen, H.F. Sluiter, J.K. & Frings-Dresen, M.H. (2009). The use of ergonomic measures and musculoskeletal complaints among carpenters
and pavers in a 4.5-year follow-up study. *American journal of industrial medicine.* 52, 954-963.

Verhaeghen, P., Steitz, D.W., Sliwinski, M.J., & Cerella, J. (2003). Aging and dual-task performance: A meta-analysis. *Psych Aging.* 18, 443–460.

Vessey, M.P., Villard-Mackintosh, L. & Yeates, D. (1990). Epidemiology of carpal tunnel syndrome in women of childbearing age. Findings in a large cohort study. *International Journal of Epidemiology,* 19(3), 655–659.

Volinn, E (1997). *The epidemiology of low back pain in the rest of the world. A review of surveys in low- and middle-income countries.* *Spine,* 22, 1747-54.

Von, K.M. Ormel, J. Keefe, F.J. & Dworkin, S.F. (1992). Grading the severity of chronic pain. *International Journal of Occupational Safety Ergonomics,* 50, 133-149.

Walker, B. (2000). The Prevalence of Low Back Pain: A Systematic Review of the Literature from 1966 to 1998. *Journal of Spinal Disorders,* 13(3), 205-217.

WHO 2000). *Obesity: preventing and managing the global epidemic,* Geneva: WHO.

WIBA, (2007). *The work injury benefit act,* Nairobi: Government printer.

Williams, E.Y; Gibb, A.G.F; Gyi, D.E; & Haslam, R.A. (2011). *Constructive Ageing: A Survey of Workers in the Construction Industry,* cib W099 international conference, August, Washington DC, Virginia Tech publishing, CD, 14pp, Retrieved from; www.workinglate-owl.org/

Woolf, A.D. & Pfleger, B. (2003). Burden of major musculoskeletal conditions. *Bulletin of the World Health Organization,* 81(9), 646–656.
APPENDICES

Appendix 1: Certificate of Ethical Approval

[Image of Certificate of Ethical Approval]

NACOSTI ACCREDITED

ETHICS REVIEW COMMITTEE
ACCREDITED BY THE NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION (NACOSTI, KENYA)

CERTIFICATE OF ETHICAL APPROVAL

THIS IS TO CERTIFY THAT THE PROPOSAL SUBMITTED BY:

PENINNAH MUTHOKI KISILU

REFERENCE NO:
ERC/MSc/041/2016

ENTITLED:
Determination of prevalence of work related musculoskeletal disorders among housing construction workers in Mombasa County

TO BE UNDERTAKEN AT:
MOMBASA COUNTY

FOR THE PROPOSED PERIOD OF RESEARCH

HAS BEEN APPROVED BY THE ETHICS REVIEW COMMITTEE
AT ITS SITTING HELD AT PWANI UNIVERSITY, KENYA
ON THE 21ST DAY OF MARCH 2016

CHAIRMAN

SECRETARY

LAY MEMBER

Pwani University
Ethics Review Committee.

Pwani University, www.pwani.ac.ke, email: ercrev@pwani.ac.ke, tel: 0719 182218.
The ERC: Giving Integrity to Research for Sustainable Development
NOTICE:

This decision is subject to the information available at the time of APPROVAL. The Committee may on its own motion and/or by application by a Party, review its decision on the grounds of discovery of new and important information which was not reasonably within its knowledge at the time of decision or on account of mistake or error apparent on the face of the record, or for any other sufficient reason, provided the researcher shall be given prior opportunity to be heard.
Appendix 2: Consent Form

My name is Peninnah M. Kisilu, a student at the Jomo Kenyatta University of Agriculture and Technology Mombasa campus. I am undertaking a Master of Science degree in Occupational Safety and Health (MSc. OSH). I am carrying out a study on the prevalence of work related musculoskeletal disorders among housing construction workers in Mombasa County. The findings of the study will lead to recommendation of strategies to prevent/minimize the occurrence of musculoskeletal disorders among workers in the housing construction sector.

You are kindly requested to take about 20 minutes and fill up a questionnaire. All information given will be confidential and used for the purpose of this research work only. The questionnaires are also anonymous and your name will not appear anywhere. There is no any form of victimization to you whatsoever for participating. You are encouraged to seek clarification or express your concerns in the whole process. You are also allowed to skip any question you feel is unfriendly to you and you can as well terminate the interview process at any time.

If you agree to participate kindly sign below:

Name…………………………………..Signature………………..Date…………

Investigator: Name: Peninnah Kisilu Signature………………………..

Telephone: 0722816254

Email: peninah.kisilu@gmail.com
Appendix 3: Survey Questionnaire

QUESTIONNAIRE SERIAL NUMBER..................

INSTRUCTIONS TO RESPONDENT

❖ Kindly tick against your preferred choice
❖ Fill in where there are spaces provided

A. Personal information of the respondent

1. What is your job description?
   a) Unskilled casual worker ( )
   b) Skilled casual/contract worker (specify area of specialization)
   c) Permanent staff (foreman, site engineer, site contractor)

2. What is your gender?
   a) Male  b) Female

3. What is your age (in years)?
   a) Under 18 b) 19-29 c) 30-39 d) 40-49 e) 50-59 f) 60 and above

4. What is your Education level?
   a) Not attended school b) Primary c) Secondary d) College/University/Tertiary institution

5. Height in feet (researcher to take height)?
   a) 4.5 and below b) 4.6-5.0 c) 5.1-5.5 d) 5.6-6.0 e) 6.1 and above

6. Weight in Kilograms (researcher to weigh respondent)?
   a) Less than 45 b) 45-54 c) 55-64 d) 65-74 e) 75-85 f) 85 and above

7. For how many years have you worked in the housing construction industry?
   a) 3-8 years b) 9-14 years c) 15-20 years d) 21 and above

8. What are your major daily work activities? (tick all your major activities)
   a) Brick laying  b) Plastering  c) Masonry  d) Roofing  e) Concrete mixing
   f) Electrical installation  g) Carpentry  h) Plumbing  i) Steel fixing
   j) Others (specify)
   ……………………………………………………………………………………………

9. Which of the above mentioned tasks do you find most strenuous and why?
10. List the tools and equipment you use in your daily work activities:










11. How often are the tools and equipment you use for work serviced?
   a) I don’t know  b) Never serviced  c) Sometimes  d) Always

12. Do you often improvise tools and equipment to use at work?
   a) Yes  
   b) No  

   If YES in question 12 above, what are the reasons?










13. For how many hours do you work in one day










14. Do you sometimes do work for more hours/overtime?
   a) Yes  
   b) No  

15. If YES in question 14 above, what are the reasons for you doing overtime?










16. Which one of the following factors do you think contributes most to musculoskeletal disorder symptoms or workplace injuries in your workstation?
   a) Physical factors and nature of work  
   b) Exposure history/years worked  
   c) Work procedures e.g. long working hours  

17. What are your reasons for the chosen factor in reference to question No. 16?










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B. Frequently incurred MSDs symptoms and injuries

18. Have you experienced body pain/discomfort or numbness in the last 12 months?

   a) Yes  b) No

19. If Yes in question No. 18 above, use the diagram provided to indicate the body parts that are most affected.

   Use the diagram below to answer question 19 above.

   ![Diagram of body parts and options for MSD symptoms]

   Source: U.S. National Library of Medicine; History of Medicine Division [www.nlm.nih.gov/hmd]
20. Have you sought medical advice on this condition in the last 12 months?
   
a) Yes
b) No

21. If your answer is NO in question 20 above, why haven’t you sought medical help?
   ..............................................................................................................................................
   ..............................................................................................................................................

C. Perception of MSDs symptoms to work relatedness

22. In your opinion, are the body pains you experience related to your daily work activities?
   
a) Yes  b) No

23. If Yes in question No. 22 above, what are your reasons
   ..............................................................................................................................................
   ..............................................................................................................................................

24. How often do you report the experienced injuries/pain while at work?
   
a) Never b) Rarely c) Frequently d) Always

25. Explain your answer in question 24 above
   ..............................................................................................................................................
   ..............................................................................................................................................

26. To whom do you report injuries/pain incurred while at work?
   a) Colleagues/workmates b) Line supervisor  c) Site manager
d) Health officer/doctor  e) DOSHS office

27. Is there anything you think would make your workplace more comfortable and safe? If so, please explain
   ..............................................................................................................................................
   ..............................................................................................................................................

THE END

THANK YOU FOR YOUR TIME.
Appendix 4: Observation Checklist

Task performed:
…………………………………………………………………………………………
…………………………………………………………………………………………
………………

Number of workers performing the task
…………………………………………………………………………………………
……

Review of task

Process:
   a) Duration of the task…………………………………………………………
   b) Variety of tasks……………………………………………………………
   c) Machines/equipment used in the task……………………………………
   d) Posture required……………………………………………………………
   e) Frequency of task performance/repetitive………………………………

Materials:
   a) Weight………………………………………………………………………
      ……
   b) Distance moved……………………………………………………………

Environment:
   a) Temperatures………………………………………………………………
      ………
   b) Working space……………………………………
   c) House keeping……………………………………………………………

Equipment:
   a) Working height……………………………………………………………

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b) Location of controls .............................................

c) Mobility ..........................................................

d) Maintenance ..................................................

e) Adjustability ..................................................

Human:

a) Insufficient training on techniques ..................

b) Behavior observed ..........................................

Observed risks:

..........................................................
..........................................................
..........................................................
..........................................................
..........................................................
Appendix 5: Publication

Peninnah Muthoki Kisilu, Prof. Erastus Gatebe & Dr. Joseph B. Msanzu. Prevalence of work-related musculoskeletal disorders among housing construction workers in Mombasa County, Kenya. *International Journal of advanced research* 5(6), 1674-1684.

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