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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DECLARATION

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

Signature: _____ Date: _____

Peninnah Muthoki Kisilu,

This thesis has been submitted for examination with our approval as the University supervisors.

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TUM, Kenya

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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TABLE OF CONTENTS

DECLARATION ..... **ii**

DEDICATION ..... **iii**

ACKNOWLEDGEMENT ..... **iv**

TABLE OF CONTENTS ..... **v**

LIST OF TABLES ..... **x**

LIST OF FIGURES ..... **xi**

LIST OF PLATES ..... **xii**

LIST OF APPENDICES ..... **xiii**

ACRONYMS AND ABBREVIATIONS ..... **xiv**

DEFINITION OF OPERATIONAL TERMS ..... **xv**

ABSTRACT ..... **xvi**

CHAPTER ONE **1**

INTRODUCTION **1**

1.1 Background Information 1

1.2 Statement of the Problem 3

1.3 Objectives of the study 4

1.3.1 Main objective 4

1.3.2 Specific objectives 4

1.4 Research questions 5

1.5 Null hypothesis (H_0) 5

1.6 Justification 5

1.7 Scope of the study 6

1.8 Limitations of the study 6

1.9 Ethical consideration 7

1.10 Conceptual framework 7

CHAPTER TWO 9

LITERATURE REVIEW 9

2.1 Introduction 9

2.2 Factors that can cause MSDs 10

2.2.1 Physical factors causing MSDs 10

2.2.2 Individual factors and MSDs 13

2.2.3 Psychosocial and organizational factors 14

2.3 Legislations governing the construction industry in Kenya 16

2.3.1 Occupational safety and health act (OSHA, 2007) 17

2.3.2 Work injury benefits act (WIBA, 2007) 18

2.3.3 National Construction authority act (NCA, 2011) 18

2.3.4 The Kenyan constitution, 2010 19

2.4 Control of MSDs in the construction industry 19

2.4.1 Engineering controls 20

2.4.2 Administrative controls 21

2.4.3 Personal protective equipment (PPE) 21

2.5 Tools and equipment used in housing construction sites 22

2.6 Research gaps 24

CHAPTER THREE 25

RESEARCH METHODOLOGY 25

3.1 Research design 25

3.3 Study Population 26

3.6 Data collection instruments 31

3.5 Data Collection Procedure 31

3.6 Pilot study 31

3.7 Validity and reliability of data collection instruments 32

3.8 Data analysis and presentation 32

CHAPTER FOUR 34

RESULTS AND DISCUSSION 34

4.1 Introduction 34

4.2.1 Gender of respondents 36

4.2.2 Age of respondents 36

4.2.3 Education level of respondents and MSDs 37

4.2.4 Years worked in the construction industry 38

4.2.5 Body Mass Index (BMI) of respondents 38

4.3 Nature of tools and equipment used 39

4.3.1 Servicing of tools and equipment 39

4.3.2 Improvising tools 40

4.4 Job rotation and working hours 41

4.5 Use of personal protective equipment (PPE) 42

4.6 Prevalence of MSDs among construction workers in Mombasa County 44

4.6.1 Reported factors leading to development of MSDs 44

4.6.2 Construction workers reporting MSDs symptoms 44

4.6.3 Body parts reported to experience MSDs symptoms 45

4.6.4 Relationship of MSDs to occupational activities 46

4.6.5 Regression model summary 48

4.6.6 Analysis of variance (ANOVA) 48

4.7 Control measures put in place to prevent MSDs in Mombasa County 49

CHAPTER FIVE 52

CONCLUSIONS AND RECOMMENDATIONS 52

5.1 Conclusion 52

5.2 Recommendations 52

5.3 Suggestions for Further Research 52

REFERENCES 53

APPENDICES 62

LIST OF TABLES

Table 2.1: Tools and equipment used.....23

Table 3.1: Distribution of housing construction workers.....27

Table 3.2: Sample size 28

Table 3.4: Reliability test 32

Table 4.1: Socio-demographic data of respondents 35

Table 4.2: Body Mass Index (BMI) of respondents.....39

Table 4.3: Servicing of tools and equipment.....40

Table 4.4: Use of PPE by construction workers 42

Table 4.5: Number of construction workers reporting body pain 45

Table 4.6: Reported body parts 45

Table 4.7: Regression statistics 47

Table 4.8: Regression model Summary 48

Table 4.9: Analysis of variance.....49

Table 4.10: Measures put in place to prevent MSDs 50

LIST OF FIGURES

Figure 1.1: Conceptual framework showing independent factors causing MSDs.....8

Figure 2.1: Controls for MSDs (Source: NIOSH, 1997) 20

Figure 3.1: Map of Mombasa County. Source: Wikimedia commons, 2013 26

Figure 4.1: Use of improvised tools.....41

Figure 4.2: Reported factors contributing to development of MSDs.....44

LIST OF PLATES

Plate 4.1: Manual handling of heavy weights to the fourth floor.....38

Plate 4.2: A casul worker with improvised shoes 43

LIST OF APPENDICES

Appendix 1: Certificate of Ethical Approval 62

Appendix 2: Consent Form 64

Appendix 3: Survey Questionnaire 65

Appendix 4: Observation Checklist 69

Appendix 5: Publication 71

ACRONYMS AND ABBREVIATIONS

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
WMSDs	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 (Woolf & 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

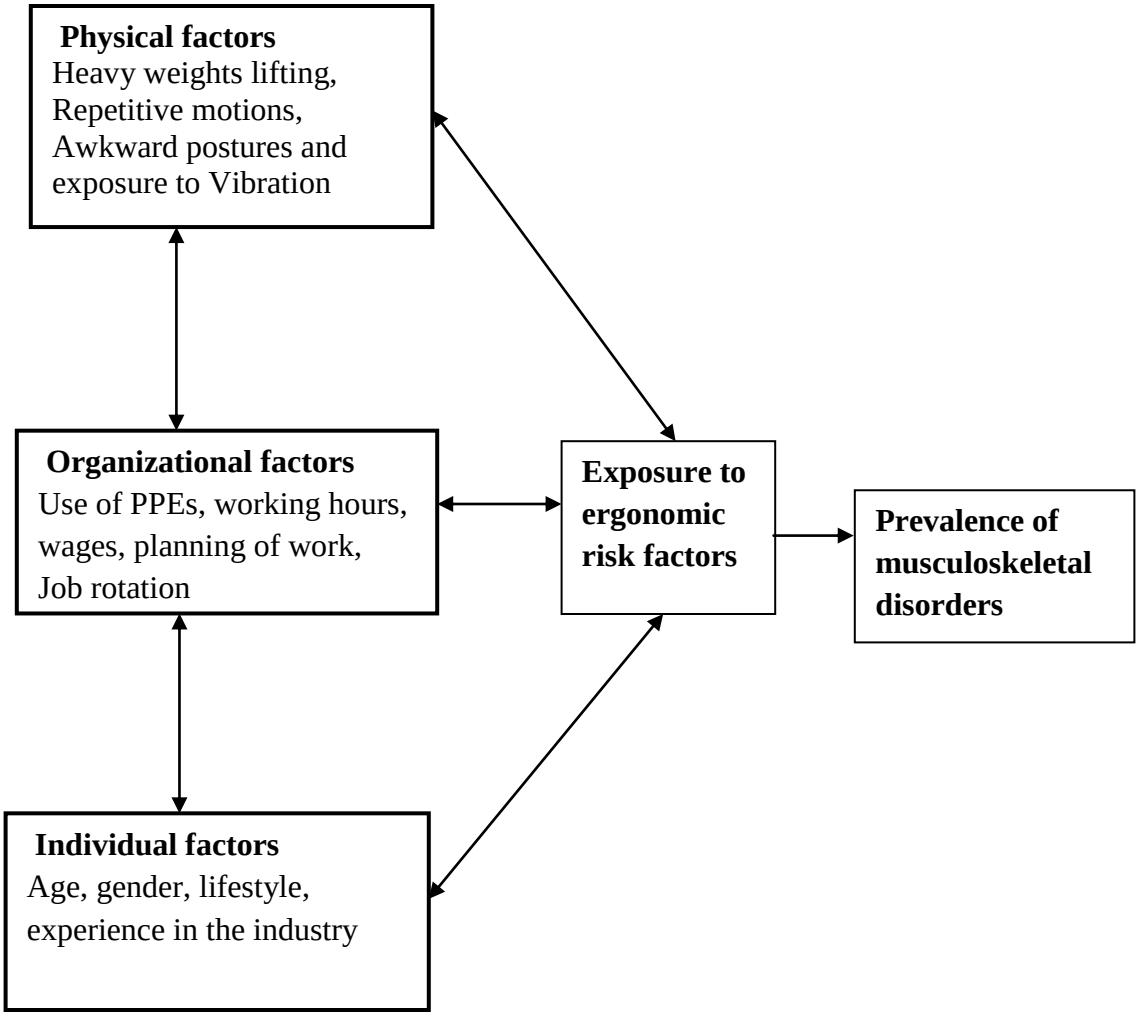
This study was based on self-reported cases of MSDs symptoms among housing construction workers. Self-reported cases may be under-estimated or over-estimated. Additionally, majority of the respondents in this study were casual workers who had been allocated specific work load to complete each day so 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 **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 (Amstrong *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

(Schnieder, 2001). 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 41of 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.

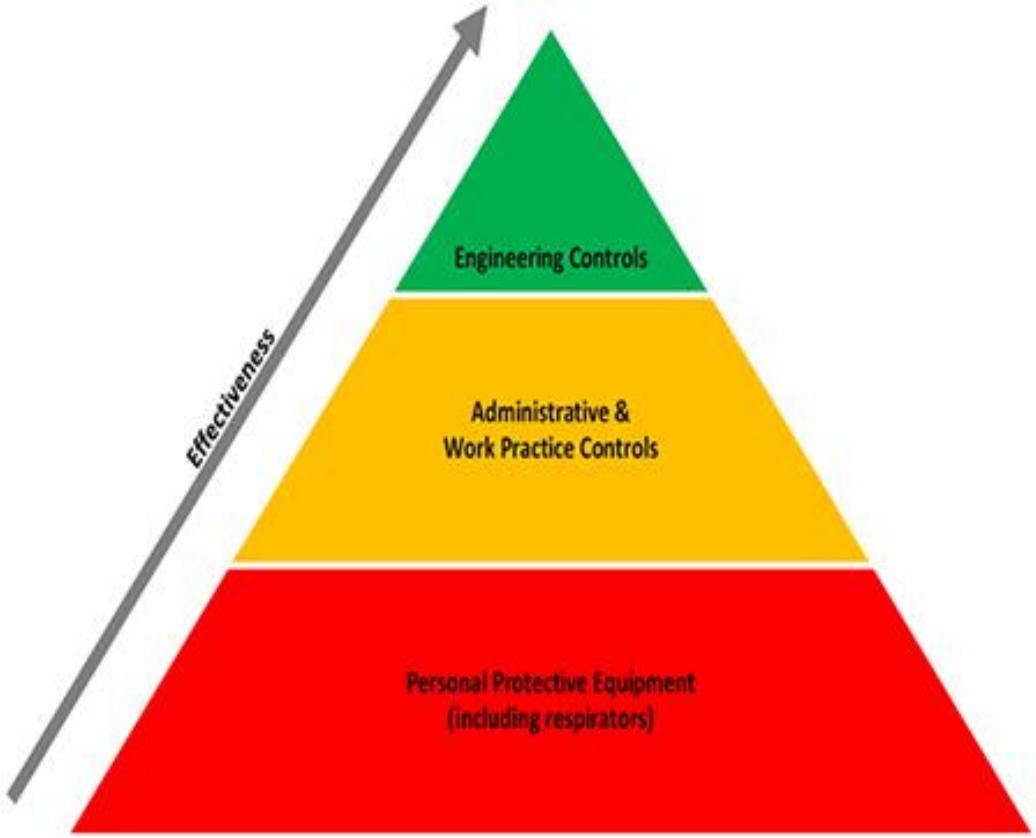


Figure 2.1: Controls for MSDs (Source: NIOSH, 1997)

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 229.9Km^2 excluding 65 Km^2 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^{0}56' and 4^{0}10' south of the equator and between longitudes 39^{0}34'and 39^{0}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.

$$n = \frac{x^2 Npq}{d^2(N-1) + x^2 pq)}$$

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

N=354.

Where,

n = desired sample size; N = Target population, p = 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 = 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.

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

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	Code	Engineers	Foremen	Contractors	Masons	Plasterers	Carpenters	Roofers	Plumbers	Painters	Electricians	Steel fixers	Unskilled casuals	**TOTAL**
Mvita	A	1	1	1	20	20	7	5	3	5	3	3	70	**139**
Kisauni	B	1	1	1	28	28	7	5	3	5	3	3	70	**155**
Changamwe	C	1	1	1	5	5	0	2	1	1	1	1	32	**51**
Likoni	D	1	1	1	0	0	0	2	0	0	0	0	4	**9**
Total		**4**	**4**	**4**	**53**	**53**	**14**	**14**	**7**	**11**	**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.

Table 3.4: Reliability test

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 ($Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$ was applied:

Where;

Y= Prevalence of musculoskeletal disorders

β_0, =beta constant

$\beta 1$, β_2, β_3, β_4 **and** β_5 = regression coefficients

ε = 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.

Plate 4.1: Manual handling of heavy weights to the fourth floor

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 20years 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).**

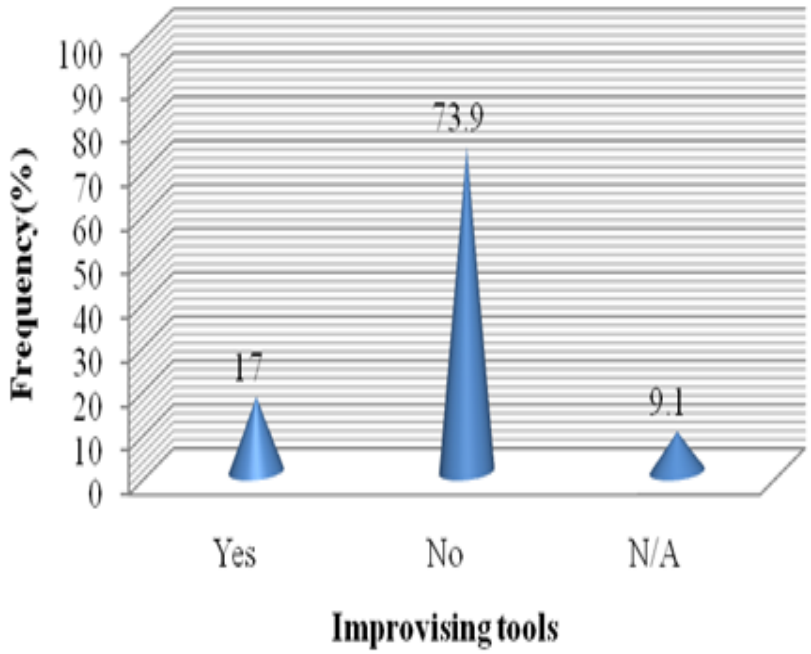


Figure 4.1: Use of improvised tools

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^{0}C with a minimum of 22.7^{0}C and a maximum of 33.1^{0}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).**

Plate 4.2: A casul worker with improvised shoes

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).**

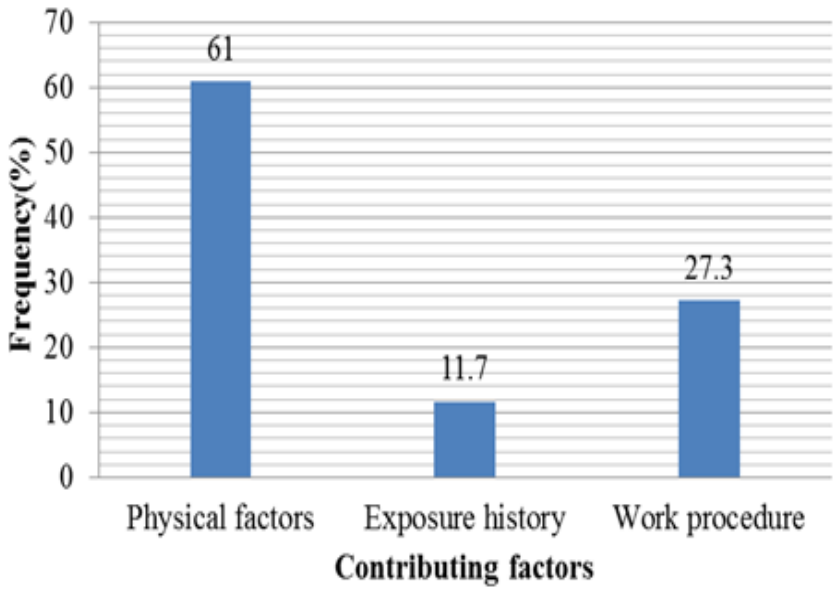


Figure 4.2: Reported factors contributing to development of MSDs

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 $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$ 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, R^2, adjusted R^2 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
	.800[a]	.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).**

Table 4.9: Analysis of variance

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	67.080	3	22.360	154.569	.000[b]
	Residual	37.611	260	.145		
	Total	104.691	263			

a. Dependent Variable: Prevalence of musculoskeletal disorders

b. Predictors: (physical factors, organizational factors and individual factors)

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 under estimated 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

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APPENDICES

Appendix 1: Certificate of Ethical Approval

NACOSTI ACCREDITED

ERC/MSc/041/2016

Pwani UNIVERSITY

ETHICS REVIEW COMMITTEE

ACCREDITTED 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

PTO

Pwani UNIVERSITY
Ethics Review Committee,
Pwani University, www.pu.ac.ke, email: t.rewe@pu.ac.ke, tell: 0719 182218.
The ERC, Giving Integrity to Research for Sustainable Development

NACOSTI ACCREDITED

Pwani UNIVERSITY

ERC/MSc/041/2016

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.

Pwani UNIVERSITY

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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

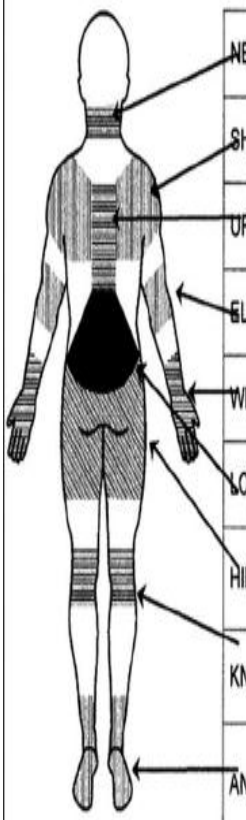
17. What are your reasons for the chosen factor in reference to question No. 16?
    ……
    ……
    ……..

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.



	Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:	During the last 12 months have you been prevented from carrying out normal activities (e.g. job, housework, hobbies) because of this trouble in:	During the last 12 months have you seen a physician for this condition:	During the last 7 days have you had trouble in:
NECK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
SHOULDERS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
UPPER BACK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
ELBOWS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
WRISTS/ HANDS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
LOWER BACK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
HIPS/ THIGHS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
KNEES	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
ANKLES/ FEET	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes

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…….

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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