# CHARACTERIZATION OF OSTEOARTHRITIS IN PATIENTS SEEN AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, KENYA

BY

**JOSIAH NYAKWARA ONSARE**

**SM/PGORT/05/12**

**A Thesis Submitted In Partial Fulfillment Of The Requirements For The Award Of The Degree Of Master Of Medicine-Orthopedic Surgery Of Moi University**

**SEPTEMBER 2016**

# DECLARATION

DECLARATION BY AUTHOR

This thesis is my original work and I whatsoever have no knowledge of similar work done and presented in any University.

**JOSIAH NYAKWARA ONSARE**

**SM/PGORT/05/12**

**Signature……  Date……**

DECLARATION BY SUPERVISORS

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

1) **Dr. Kibor L. Lelei**

   MBChB, M.MED (Surg), FCS, F ORTHO

   Consultant Orthopedics and Trauma Surgeon, Senior Lecturer, Department of Orthopedics and Rehabilitation, School of Medicine, Moi University

   **Singnature…….. Date…….**

2) **Dr. Barry R. Ayumba**

   MBChB, M.MED (Surg), FCS, MMED (Ortho)

   Orthopedic Surgeon and Senior Lecturer, Department of Orthopedics and Rehabilitation, School of Medicine, Moi University

   **Signature…… Date…….**

## COPYRIGHT

# DEDICATION

To my mother, Eunice Moraa, whom I have loved dearly. Her qualities have taught me selfless love.

## ABSTRACT

**Background:** Osteoarthritis is a major public health issue related to age, which is characterized by progressive loss of articular cartilage that results in pain, functional impairment, disability and diminished quality of life. The disability associated with osteoarthritis (OA) and the difficulty associated with accessing treatment including the associated health care costs makes osteoarthritis an important condition in our set up. The clinical patterns of OA may be different in different cultures due to differences in lifestyle and daily activities. At Moi Teaching and Referral Hospital the clinical patterns of osteoarthritis continue to be dominated by opinions rather than evidence.

**Objective:** To describe the clinical patterns in patients with OA seen at the orthopedic clinic of MTRH.

**Methods:** This was a cross-sectional descriptive hospital based study that characterized osteoarthritis (OA) seen in purposely selected 177 patients consulting for osteoarthritis at MTRH, Eldoret, using an interviewer administered questionnaire. Data analysis focused on descriptive statistics among clinical and demographic characteristics. The clinical characteristics of OA were analyzed on Kellgren and Lawrence scale and The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The relationship of OA pattern with socio-demographic factors was also determined. Statistical tables, bar graphs and pie charts were used to present data.

**Results**: The sample of 177 participants selected during a single clinic visit comprised 80 men and 97 women aged 20 to 81 years. Most patients (75.14%) with OA were 41 years and above. A considerable number (65.54%) of the patients had involved themselves in heavy level activities such as peasant farming. The most common joints affected were the hip (35.02%), the knee (24.29%), spine (15.81%) and the ankle (10.16%), an anatomical distribution that varied with socio-demographic factors of the patients. Most patients presented with worse pain (93.84%), extensive joint destruction (89.26%), and functional limitation (92.66%). More than a quarter (28.25%) of the patients with osteoarthritis had higher BMI. About 25% of patients with OA reported a prior joint destroying disease. Almost half (48.0%) of patients with OA had life threatening co-morbid conditions of which they were on follow up.

**Conclusion:** Advancing age, female gender, cigarette smoking, alcohol consumption, positive family history of osteoarthritis, and involvement in heavy level of activity are significant socio-demographic features seen in patients with osteoarthritis in our setup. The salient clinical characteristics seen in patients with osteoarthritis were severe pain, high grade joint destruction, functional limitation, and higher BMI index. Patients with OA present with other medical conditions that deserve attention. However, infective arthritis and mechanical loading during high level activities may explain the high occurrence of coxarthrosis in the present study.

**Recommendation:** There is need for prevention programs to reduce the burden of osteoarthritis in our set up.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

## LIST OF ABBREVIATIONS AND ACRONYMS

The following abbreviations have been used in the text and mean as indicated.

ABS Australia Bureau of Statistics

ADLs Activities of Daily Living

AIDS Acquired Immune Deficiency Syndrome

AMPATH Academic Model Providing Access to Healthcare

ARV Anti retroviral

ASA American Society of Anesthesiologists

BMP Bone morphogenic protein

ECM Extra cellular matrix

ER Estrogen receptor

GDF 5 Growth differential factor 5

GH Growth hormone

HD Heart disease

HIF Hypoxia induced factor

HIV Human immune virus

HLA Human leukocyte antigen

IFG Impaired fasting glucose

IGF Insulin growth factor

IL Interlukin

IREC Institutional research and ethics committee

LIF Leukemic inhibitor factor

MMP Metalloproteinases

MTRH Moi Teaching and Referral Hospital

NGF Nerve growth factor

NSAIDS Non steroidal anti-inflammatory drugs

OA Osteoarthritis

RA Rheumatoid arthritis

SLE Systemic lupus erythematosus

SMAD Signaling Mothers Against Decapentaplegic

SPSS Statistical package of social sciences

SUFE Slipped capital femoral epiphysis

TGF Transforming growth factor

TIMP Tissue inhibitors of MMPs

TNF Tumor necrosis factor

TRPV4 Transient receptor potential cation channel, sunbunit V, member 4

UG Uasin Gishu

WHO World Health Organisation

YLD Years lived with disability

## ACKNOWLEDGEMENTS

I thank my supervisors, Dr. Lelei K. and Dr. Ayumba B., for the stimulating suggestions and meticulous corrections that they advanced as I carried out this study. I am also beholden to them for their patience and motivation as they nudged me to move forward writing draft after draft what helped my study reach its potential. Their influence will definitely have a profound impact in my future life as a medical practitioner. My sincere gratitude also goes to Ms. Rose Kariuki a nurse at the MTRH out-patient clinic for helping me collect the much needed data. May God bless her as she continues to serve humanity. I am indebted to the patients at MTRH orthopedic outpatient clinic who took time to participate in the study and share their experiences. I am also indebted to Philip Koech and Duncan Odongo, for their statistical assistance in coding and computing my data. I thank my colleagues, from the junior most doctor to the senior most surgeon, for their worthwhile criticism and scientific attitude they displayed in improving my work. They will long be remembered. I also thank Moi Teaching and Referral Hospital management for allowing me to conduct my study in their facility. I appreciate Moi University for admitting me for MMED Orthopedic surgery program and offering me a conducive environment that led to this study. I am grateful to the dean school of medicine for facilitating this research, mock and final thesis defenses. His warm heart attracts us to knowledge. I am grateful to the Government of Kenya for granting me a scholarship that made my studies possible. I would have struggled without their financial support. Finally I thank my family for standing with me to the completion of this study. Without their emotional support I would have faltered. For those that I have inadvertently not acknowledged, may they be consoled by the fact that their input in this research will go a long way in improving knowledge on osteoarthritis.

## DEFINITION OF OPERATIONAL TERMS

For the purpose of this study, the following operational terms are used and imply as indicated.

CHARACTERIZATION: To analyze and describe various categories of osteoarthritis

CLINICAL CHARACTERISTICS: The signs and symptoms of osteoarthritis a patient would feel, or a clinician would find on physical examination or x ray workup

OSTEOARTHRITIS: Joint pain that is associated with an altered joint structure

PAIN: An unpleasant sensory and emotional experience associated with actual tissue damage, or described in terms of such damage

PHYSICAL ACTIVITY: Any bodily movement produced by skeletal muscles that increase energy expenditure above a basal level

SOCIO-DEMOGRAPHIC CHARACTERISTICS: Constituents or elements in or about a patient that brings about certain effects or results that may lead to osteoarthritis e.g., age, gender, ethnicity, residence, occupation, smoking, use of alcohol and family history.

# CHAPTER ONE

# INTRODUCTION

## 1.0 Background to the study

Osteoarthritis (OA) is an illness that contributes to pain and physical limitation in the society. Patients with osteoarthritis suffer from progressive incapacitation in their activities of daily living (Kawano *et al*., 2015). Osteoarthritis is estimated to be the fourth leading cause of disability affecting about 15% of all the people of the world. It also ranks as the fifth highest cause of years lost to disability in the whole population in developed countries, and the ninth highest cause in developing countries. The prevalence of OA is increasing due to the increase in the body mass index of the general population (Hermans *et al*., 2012). Three in five people who are obese are at risk of developing knee osteoarthritis during their lifetime. More so, the risk of developing OA increases with increasing age. A condition that cannot be reversed once it starts, OA deprives communities, both economically and at a personal level (Hawamdeh and Al-Ajlouni, 2013). It affects a person's social functioning and mental health, further diminishing a person's quality of life (Hermans *et al*., 2012). By the condition rendering the patient physically inactive, OA predisposes to the risk of obesity, high cholesterol or vulnerability to heart disease. Osteoarthritis per se does not cause death, but patients may die due to perforated stomach ulcers, due to non-steroidal anti-inflammatory drugs they use in controlling pain (Litwic *et al*., 2013).

Osteoarthritis is characterized by progessive articular cartilage destruction, hypertrophy of bone (osteophytes and subchondral bone sclerosis), joint space narrowing and thickening of the capsule (Table 1). There may be ligamentous laxity, weakening of periarticular muscles, and, in some cases, synovial inflammation (Litwic *et al*., 2013). Clinically, OA is

characterized by joint pain, tenderness, limitation of joint movement, crepitus, occasional effusion, and variable degrees of local inflammation (Hawamdeh and Al-Ajlouni, 2013).

**Table 1 Radiological stratification of osteoarthritis**

| Kellgren-Lawrence scale | Grade comments |
|---|---|
| **0** | No radiographic findings of osteoarthritis |
| **1** | Minute osteophytes of doubtful clinical significance |
| **2** | Definite osteophytes with unimpaired joint space |
| **3** | Definite osteophyte with moderate joint space narrowing |
| **4** | Definite osteophytes with severe joint space narrowing and subchondral sclerosis |

Osteoarthritis can affect any body joint but mainly it affects the hands, spine and weight-bearing joints such as the hips, knees and ankles. It's occurrence in different joints vary widely due to differences in case definition. Osteoarthritis may be defined by radiographic criteria alone (radiographic OA), typical symptoms (symptomatic OA), or by both. Using radiographic criteria, the distal and proximal interphalangeal joints of the hand have been identified as the joints most commonly affected joints, but they are less symptomatic **(**Glyn-Jones *et al*., 2015). In contrast, the knee and hip, which constitute the second and third most common locations of radiographic OA, respectively, are nearly always symptomatic. The first metatarsal phalangeal and carpometacarpal joints are also frequent sites of radiographic

OA, while the shoulder, elbow, wrist and metacarpophalangeal joints rarely present with OA (Zhang *et al*., 2002). Pain is initially felt in the joints during and after activity, but as the disease advances pain occurs with only minimal movement or even at rest (AIHW, 2005). In the aged, pain might not be the main presenting feature; the aged patient simply moves less.

Osteoarthritis requires careful long term management (Yu and Hunter, 2016). When conservative measures of treating osteoarthritis fail, and when pain in a specific joint disables an active individual, to reduce the impact of osteoarthritis in communities, the pharmaceutical gap should be filled by surgical intervention that will restore a joint to normal activity. More than 70% of total hip and knee replacements done are due to degenerative osteoarthritis. In the case of OA, arthroplasty is considered when a patient has extensive joint destruction and other treatments are no longer working (WHO, 2008). Therefore arthroplasty is the latest treatment of severe osteoarthritis. It is mostly reserved for people over age 50. Currently it is the mainstay of surgical treatment of the osteoarthritic hip, knee and glenohumeral joint (WHO, 2008). But joint replacement for small joints is not a common practice as seen in literature.

The decision between cemented or non-cemented prosthesis is a technical one revolving around the age of the patient, the condition of the bone, and the surgeon's experience. Since total joint replacements have an average 15-20 year life before the risk of failure, young patients may need two or more revisions **(**Kotlarz *et al*, 2009). Whenever there is a revision after arthroplasty the bone stock becomes less and the procedure difficult. Also arthroplasty has its disadvantages. It is known to be an invasive, expensive and beyond the reach of many (Ringdahl and Pandit, 2011). Many patients in low income countries do not have

access to arthroplasty, and for that reason they live with disability for the better part of their lives (Bitton, 2009).

Although OA is common around the world and regional variations and demographic disparities exist that influence the occurrence of osteoarthritis, the pattern of the disease varies among populations (Snijders *et al*., 2011). The aim of this study was therefore to evaluate the clinical profiles of patients with OA seen in our set up.

### 1.1 Problem statement

The people who live in the western part of Kenya (the catchment area of MTRH) are primarily farmers who do not commonly use sophisticated farm machinery. The majority of the population is poor black people who mostly do manual jobs a contrast to western countries. They mostly use hand held tools for working and *Boda Boda* (motorcycles) and *Matatus* (passenger service vehicles), high velocity modern means of transportation. In case of high energy accidents, because of their poor socio-economic status, the people in this part of the world tend to delay surgery or because of their poor health seeking behaviors, they seek alternative treatments first and delay to present for conventional treatment, by which time the joints are malaligned and may no longer be preserved. Because of these factors, it is anticipated that the clinical pattern of osteoarthritis in our set up could be different from that of the Western world.

Osteoarthritis is the most common cause of chronic pain and disability, what totally prevents one from living an independent life. It accounts for about 3 % of total years lived with disability, the same percentage as schizophrenia. The physical disability arising from pain and loss of functional capacity reduces the quality of life of a person and increases the risk of further morbidity from coronary heart disease, lung disease, diabetes, obesity, falls,

frailty, and various other ailments. By clinic observations at MTRH, there is a trend of increasing number of patients of different ages, occupations and gender coming to consult for OA. In 2012 there were 226 patients seen who had different kinds of OA. In 2013, 380 patients with OA were seen. In 2014, 500 patients consulted for OA. There is now a situation where there is an increase in the number of patients with OA. Lack of proper orthopedic care for these patients may lead to many years lived with chronic pain and disability and loss of productivity. More so, there are no existing drugs in the market that can prevent, reverse, or halt the progression of osteoarthritis. Without such drugs, the burden of osteoarthritis will likely increase as the population continues to age and accidents occur.

At MTRH the clinical patterns of osteoarthritis have not been studied and documented. Indeed more and more people are showing up to consult for OA but no documented data is available indicating the patterns of OA and the clinical characteristics of patients with OA.

**1.2 Justification**

This study is to document the clinical patterns of OA in our set up. World Health Organization has seen a need that warrants research in Africa to document the true burden of OA (WHO, 2013).

Many people suffer with Osteoarthritis (OA) and its consequent morbidity. As a result, measuring the outcomes associated with OA is particularly imperative to establish a trend and or meaningful relationships. Now, effective control and prevention programs of any disease are known to be linked to the burden of the disease and the health risk of the population.

This study provides information about the magnitude of osteoarthritis in our set up and the socio-demographic factors associated with it. Proper medical care is always critical for most of the people living with OA. This study could be applied to patient care. So, there is need to recognize the patterns of osteoarthritis so as to provide context for control and prevention strategies in our set up.

Despite the burden osteoarthritis poses to communities, educational programmes are not developed for this chronic condition like it has happened for other chronic disorders such as diabetes, osteoporosis and even rheumatoid arthritis (RA). Furthermore the disability associated with OA and the difficulty associated with accessing treatment in a resource limited setting including the associated costs makes osteoarthritis an important condition in our set up. The findings from this study will therefore offer new opportunities that enhance advance prevention strategies, disease prediction and therapeutic intervention.

Because of the significant disability that is associated with OA, it imposes a heavy burden on the community and ultimately the healthcare system. According to Nüesch *et al*., patients with a walking disability have an increased risk of death of 1.93 Odds Ratio (Nüesch *et al*., 2011). The impact of osteoarthritis can be drastically reduced through prevention, arthroplasty and physiotherapy. Therefore understanding the patterns, the severity and associated factors of OA is necessary. This research will produce a highlight on probable areas of intervention and a baseline profile that will improve health planning and guide future management of osteoarthritis.

### 1.3 Research question

What are the clinical characteristics in patients with osteoarthritis?

## 1.4 Objectives

### 1.4.1 Broad objective

To describe the clinical patterns in patients with OA seen at the orthopedic clinic of MTRH

### 1.4.2 Specific objectives

- To establish the socio-demographic characteristics of patients with OA
- To describe the clinical presentation of patients with OA
- To determine co-morbidities in patients with OA

CHAPTER TWO

# LITERATURE REVIEW

## 2.0 Introduction

Osteoarthritis (OA) is the most common form of degenerative joint disease and a leading cause of pain and chronic physical disability in older individuals (Juni *et al.,* 2006). OA remains a therapeutic challenge. Working with the public to change modifiable risk factors, including obesity, remains a priority. Once a disease of old age, it is now becoming problematic for the younger generation. The implications of OA in younger individuals have far reaching effects. Although it does not affect everybody in the same way, incapacitation leads to restriction in activities of daily living such as bathing, toileting, dressing, eating and mobility. Until now OA is not a curable disease, except by total joint replacement, a procedure that may lead to loss of joint function. It is divided into two, primary and secondary osteoarthritis. Primary OA is a condition that develops in a previously normal and undamaged joint with no obvious cause. Secondary OA is a condition which develops in a joint due to well known predisposing factors such as anatomical abnormalities, trauma, inflammatory and metabolic disorders (Arden and Nevitt, 2006).

Osteoarthritis has a multifactorial etiology, and can be considered to be the product of interactions between several factors (Zhang and Jordan, 2010). These include systemic factors, for instance genetics, age, gender, sex hormones, bone density, ethnicity, race and nutrition, as well as local mechanical factors such as joint overload caused by obesity, acute injury and repetitive joint loading, joint deformity (e.g. congenital hip dysplasia) and

particular muscle weakness and atrophy (Arden and Nevitt, 2006). The process involves interactive degradation and repair processes of cartilage, bone and synovium (Iannone and Lapadula, 2003).

In OA synovial membrane, it is the synovial lining cells that play a major role as inflammatory effectors of which interleukin (IL)-1β, tumor necrosis factor (TNF)-α, IL-6, leukemic inhibitor factor (LIF) and IL-17 appear most relevant to the disease. IL-1β and TNF-α are the major catabolic systems involved in the destruction of joint tissues, and may constitute the *in situ* source of articular tissue damage and degradation. However it is not clear whether IL-1β and TNF-α act independently or in concert to induce the pathogenesis of OA, or if a functional hierarchy exists between these proinflammatory cytokines(Iannone and Lapadula, 2003).

It has been found out that many of the genes that are involved in endochondral ossification during childhood are reactivated in adulthood by various joint stressors — particularly mechanical stress, oxidative stress, and inflammatory mediators — in a futile attempt to repair damaged cartilage. The result is hypertrophy of chondrocytes, cartilage destruction, and osteogenesis (in the form of bone spurs). One molecule, hypoxia-inducible factor (HIF)-2$\alpha$, is capable of activating a complex of genes responsible for these processes (Saito *et al.*, 2010). In addition, HIF-2$\alpha$ is found in greater abundance during early- and mid-stage OA than during late-stage OA. In mice, experimentally enhanced production of HIF-2$\alpha$ in chondrocytes accelerates OA and depressed production protects against OA (Yang *et al.*, 2010).

**2.1 Factors associated with osteoarthritis**

According to Hawamdeh and Al-Ajlouni , the exact etiology of OA remains unclear, but it is frequently associated with repetitive microtraumas, previous joint surgery, metabolic or endocrinological factors, heredity, obesity and joint overload. Obesity may be a further factor in the development of osteoarthritis, particularly of the knee and especially in women (Klussmann *et al*., 2008). However, once osteoarthritis has developed, the work-related repetitive movement often makes the disorder worse.

While OA is equally present in men and women, it appears to be more common among younger men (<45 years) and in the older women (>45 years) [Dinesh *et al*., 2013]. In about 20% of adults over 45 years in England have OA of the knee and another 11.11% of adults have osteoarthritis of the hip. The prevalence of OA increases with age and the burden on health care systems will increase exponentially as older adults continue to comprise a larger proportion of the population. By age 65, up to 80% of people have radiographic features of OA in at least one joint. The knee is a frequently affected joint in the lower limb with up to 65% of people over age 65 years of age demonstrating radiographic evidence of knee OA. According to Bohensky *et al.*, 2014, there are considerable geographical variations in the occurrence of OA.

The presence of hand OA is a known risk factor for knee OA (Thompson *et al.*, 2010). Acromegaly and gigantism are abnormalities that develop when there is over production of growth hormone (GH) due to a pituitary adenoma. People who have these conditions end up developing osteoarticular manifestations that is OA. The pathogenesis of arthropathy in acromegaly is due to the initial amounts of GH and then the IGF-I that stimulate the articular

cartilage and peri-articular ligaments ultimately leading to biomechanical changes in the joints.

The characteristic structural features of knee OA are articular hyaline cartilage degradation (seen as non-uniform joint space narrowing on X-ray), osteophytosis, bony sclerosis and subchondral cyst formation. The hallmark symptoms of knee OA are pain on most days, morning stiffness (usually lasting less than 30 minutes), the absence of systemic features and instability leading to a reduction in the capacity to perform activities of daily living (ADLs) (Heiden *et al*., 2009). Data from the Framingham study reveal that disability caused by knee OA equals heart disease and is greater than other common diseases of aging such as diabetes and chronic obstructive pulmonary disorder. Consequently, an understanding of the etiology, pathophysiology and natural history of knee OA is paramount (Slamenda *et al*., 1997).

**2.2 Clinical features**

Pain is the most prominent feature and the most common presenting complaint of osteoarthritis. Pain appears upon motion of the affected joint and resolves with rest. Since cartilage has no nerve supply, the pain comes from subchondral bone, synovium, joint capsule, ligaments, and muscle. Passive and active motion of the joint elicits pain, and coarse crepitus on motion may be heard or palpated. Although the sources of pain are well known, the perception of pain depends on the relationship between structural change and peripheral and central pain processing, with input from cultural, gender, and psychological factors. In osteoarthritis, stiffness in the morning typically lasts less than 20 minutes. After being immobile, some patients report a transient stiffness, the so-called "gelling phenomenon," which also lasts no longer than 20 minutes. As the disease progresses decreased range of motion occurs because of joint surface incongruity and because of

increased pain with motion. Other reasons for decreased range of motion are muscle spasm and contracture, capsular contracture, and mechanical problems related to osteophytes or loose bodies in the joint. Accumulation of synovial fluid may contribute to pain, decreased range of motion, and distention of the capsule (Creamer and Hochberg., 1997).

In a study done by Nelson *et al*., when they examined patterns of multiple joint symptomatic OA, they found that women more often had hand involvement, men more often had lumbosacral spine involvement (unlike the findings in the current study-women had more spine involvement than men and hand OA was rarely reported in both sexes), African Americans more often had knee involvement, and Caucasians more often had hand involvement (Nelson *et al*., 2013). Of the major peripheral joints involved, disease evolution tends to be fastest in the finger joints, and slowest at the knee, with the hip being intermediate.

According to Rosemann *et al.,* the main factors associated with functional disability in patients with osteoarthritis are depression symptoms, pain, few social contacts, a high body mass Index and advancing age. Osteoarthritis is usually associated with a decline in skeletal muscle function and mobility that can be attributed in part to a loss of muscle strength as one ages. It has been reported that such deficits are magnified in older subjects with radiographic evidence of OA (Heiden *et al*., 2009). Knee OA is associated with greater risk of developing disability. More so when medial and patellofemoral joints are involved (Duncan *et al.*, 2011). But muscle strength across a joint is a critical predictor of functional performance and dynamic stability, and disability is common as strength declines with age. Available data suggests that the reduction in muscle strength creates a significant disability burden in those with OA (Schellevis *et al*., 1993). This may lead to activity modifications which may

give a false sense of comfort. Quadriceps weakness in knee OA is not simply a result of aging as knee extensor strength is reduced an additional 20-40% for isometric and isokinetic contractions, compared to healthy older subjects. In a longitudinal prospective cohort study, Slemenda *et al*., followed healthy women for a mean of 31.3 months and reported that quadriceps muscle strength in women who developed radiographic knee OA was 18% lower than those who did not. But McAlindon *et al*., assessed disability with the Stanford Health Assessment Questionnaire in 155 subjects and found there was no association between Kellgren-Lawrence grade (KLG) and disability. For that reason treatment of OA should be planned according to the clinical features and functional status of the patient instead of relying on radiological findings alone.

In the Framingham study (n=946), only 20.7% of hips with radiographic hip osteoarthritis were frequently painful (Kim *et al*., 2015). Bone is very sensitive to pressure pain, and cartilage cushioning is needed to prevent pain with weight bearing. Over time, the wear down of cartilage predisposes to pain. Pain is often the main symptom of osteoarthritis that triggers diagnostic evaluation and treatment and ultimately leads to disability (Torres *et al*., 2006). Osteoarthritis of the spine is a breakdown of the cartilage of the joints and discs in the cervical and lumbar vertebrae. Osteoarthritis produces osteophyte spurs that put pressure on the nerves leaving the spinal column. This can cause weakness and pain in the arms or legs. Pain therefore may be the most important determinant of disability in OA. So, the presence of arthritis may increase the risk of activity limitations in patients predisposing them to obesity, cholesterol disease and heart disease.

Osteoarthritis is treated mostly by use of non steroidal antiinflammatory drugs to relieve pain. Clinical studies in the United States have shown that medical care can offer a 20–50%

improvement in reported osteoarthritis symptoms. Data from patient education studies also suggest that a further improvement of 15–30% is attainable through patient education interventions (Hirano *et al*., 1994). But the use of analgesics like acetaminophen and Ibuprofen to allay the pain of osteoarthritis have been reported to have adverse effects such as liver toxicity and stomach ulcers, respectively(Coleman *et al*., 2008). Steroids injected into painful joints can also be used to manage pain in the face of osteoarthritis. But repeated use of steroid injections can also accelerate the development of arthritic deformities or lead to osteoporosis in some cases. In a study done in America, researchers found that the condition and site-specific self-management education program improved health status of people with osteoarthritis in the short and medium term (Coleman *et al*., 2008). The pain that is associated with OA increases the risk of a patient falling and therefore emphasizes the value of treating pain in patients with OA (Pandya *et al*., 2015). Surgery relieves pain more than it restores range of motion. The best candidate for arthroplasty is the patient who has a definite interruption in some activity of daily living (can't walk more than a block, awakens from sleep with pain in the affected joint) and who has failed physical and pharmacological therapy. For this patient the result will be outstanding because he will be pain-free in the involved joint.

### 2.2.1 Joint destroying disease

People of extremes of age (young children and elderly adults) are most likely to develop septic arthritis (Carpenter *et al*., 2011), probably due to their weak immune system. People with open wounds are also at a higher risk for septic arthritis. In addition, people with pre-existing conditions such as cancer, diabetes, intravenous drug abuse, and immune deficiency disorders have a higher risk of septic arthritis. Anaemic, malnourished, underweight patients

are also at high risk (Christopher, 2007). Septic arthritis is an acute bacterial infection affecting synovial joints. It is an orthopaedic emergency with a potentially high morbidity and mortality. According to Mue *et al*., the knee is the commonest 16 (45.7 %) joint involved followed by the hip joint 11(31.4%). Mostly, septic arthritis is monoarticular but can present as polyarticular in setting of HIV/AIDs (Oniankitan, *et al*., 2011). *Staphylococcus aureus* is the commonest organism cultured in joint aspirate in 19 (54.3%) patients and postoperative complications include joint stiffness 2(5.7%), pain and stiffness 3(8.6%), bony ankylosis2 (5.7%) and limb shortening 1(2.9%) [Mue *et al*., 2013]. Rapid and aggressive administration of antibiotics may return the joint into normal function. But it seems like patients with septic arthritis do not get this treatment (Peltola *et al*., 2009) and the immunosuppressive state accounts for the vulnerability of these patients to septic arthritis.

Perthes disease is a childhood hip disorder initiated by a disruption of blood flow to the femoral head. The ligamentus teres artery dies off before giving time to the medial circumflex artery to take over the blood supply to the femoral head. Due to the lack of blood flow, avascular necrosis sets in and bone stops growing (Majithia, 2007). Over time, healing occurs by new blood vessels infiltrating the dead bone and removing the necrotic bone which leads to a loss of bone mass and a weakening of the femoral head. The bone loss leads to some degree of collapse and deformity of the femoral head and sometimes secondary changes to the shape of the hip socket (concept of congruous incongruity). The disease is most commonly found in children (mainly boys) between the ages of 4 to 8. The main long-term problem with this condition is that it produces a permanent deformity of the femoral head and acetabulum which increases the risk of developing hip osteoarthritis in

adulthood (Kim, 2012). So, the mature femoral head often leads to segmental collapse, resulting in persistent pain and progressive degeneration of the hip joint; osteoarthritis.

Slipped capital femoral epiphysis (SCFE) basically is a fracture through the growth plate, which results in slippage of the epiphysis (Peck, 2010). The femoral epiphysis remains in the acetabulum, while the metaphysis moves in an anterior direction with external rotation. In general, SCFE is caused by increased force applied across the epiphysis, or a decrease in the resistance within the physis to shearing (Novais and Millis, 2012). No single cause accounts for SCFEs, as several factors play a role in the development of a SCFE, particularly mechanical and endocrine (hormone-related) factors. Mechanical risk factors include obesity, coxa profunda, femoral or acetabular retroversion. Slipped capital femoral epiphysis (SCFEs) often occurs in obese adolescent males, especially young black adolescent males, although it also affects females (Novais and Millis, 2012). Obesity is the most significant risk factor in this case. In 65 percent of cases of SCFE, the person is over the 95th percentile for weight. Endocrine diseases also contribute, such as hypothyroidism, hypopituitarism, and renal osteodystrophy. Manipulation of the fracture frequently results in osteonecrosis and the acute loss of articular cartilage because of the tenuous nature of the blood supply of the femoral neck and into the head of the femur. Failure to treat a SCFE may lead to avascular necrosis of the femoral head and subsequent hip osteoarthritis, gait abnormalities and chronic pain (Peck, 2010).

### 2.2.2 Congenital defect

People who are born with abnormally misaligned joints e.g. knee mal-alignment- *genu valgum* or *genu varum*, congenital hip dysplasia, and foot angulations are at a greater risk for

the development of OA. A joint that is abnormal, regardless the type of the defect, increased mechanical load due to heavy lifting or repetitive movement, is a risk factor for OA (Zhang *et al.,* 2011**).**

In pre-osteoarthritis, centre-edge angle, slope of the acetabular roof, acetabular head index, acetabular depth ratio and Japanese Orthopaedic Association (JOA) hip score were significant predictors, while in early osteoarthritis, a broken Shenton's line, cranial joint space and JOA score were significant. On the basis of multiple parameters, formulas for predicting development in patients with pre-osteoarthritis, those with early osteoarthritis, and all patients together were established, with an accuracy of 87%, 71%, and 68%, respectively (Hasegawa *et al*., 1992). A retrospective study of Caucasian cases in the United States suggested 79% of the cases of adult OA were associated with these deformities (Valsequet and Katz, 2010).

### 2.2.3 Body mass index

Osteoarthritis is associated with being overweight or obese, mostly among females. Both cross sectional and prospective studies have found an association between osteoarthritis of weight-bearing joints and obesity or overweight (Zhang and Jordan, 2010). The Framingham Study, for example, predicts early onset knee osteoarthritis among obese people. Overweight has also been known to be a predictor of hip osteoarthritis and important factor in the progression of OA especially of the Knee. Both local and systemic effects may, however, be relevant to a causal relationship between excess weight and osteoarthritis. Being overweight increases the load across a joint, thus increasing the stress on the cartilage that may, in turn, lead to osteoarthritis of weight-bearing joints. Because joint damage is partly dependent on the load the joint has to support, excess body weight leads to osteoarthritis (Blagojevic *et al.,*

2010). This frequently occurs in the hips and knees of heavier patients. A force of nearly three to six times one's body weight is exerted across the knee and hip when walking. For each 1-lb increase in weight, the overall force across the knee in a single-leg stance increases 2 to 3 lb. But, this mechanism does not explain the association between being overweight or obese and osteoarthritis in the hands. Systemic factors, such as a cartilage growth factor may also accelerate cartilage breakdown in various joints (AIHW, 2005). This explains the metabolic component of obesity. Studies have found that excessive amounts of adipose tissue in one's body leads to the production of specific hormones and growth factors. Also being obese worsens the pain associated with hip and knee Osteoarthritis because obesity increases the systemic levels of inflammatory mediators such as adipokines The knee has two joints, the tibiofemoral joint and patellofemoral joint. The patellofemoral joint transmits tensile forces generated by the quadriceps to the patellar tendon. Biomechanically, patellofemoral joint reaction force is up to 7 times the body weight when squatting and 3 times the body weight when descending stairs or a slope. For the tibiofemoral joint, the reaction force is 3 times the body weight when walking and 4 times the body weight when climbing stairs or a slope. So, heavy weight bearing of the knee causes progressive cartilage degeneration of the knee joints that subsequently leads to deformity, either a valgus or varus knee with subsequent OA (Dinesh *et al*., 2013). A valgus painful knee is a disabling condition that can affect patients of all ages. Anti-valgus osteotomies are the treatment of choice to correct the valgus deformity and eliminate pain and other functional problems. In particular, patients with an early arthritis of the lateral femoro-tibial compartment or damage of the cartilage of the lateral femoral condyle are candidates for anti-valgus osteotomies. Both the lateral femoral condyle and the lateral tibial

plateau have convex surfaces, the congruence of which is maintained thanks to the integrity of the lateral meniscus. The absence of the meniscus can lead to a progressive deterioration of the opposing cartilage surface, due to the increased concentration of stress. As for the hip joint, the joint reaction force can reach 3 to 6 times the body weight. (Thompson *et al.*, 2010).

### 2.2.4 Joint trauma

Joint damage such as dislocation, contusion, fracture, tears of the menisci or ligaments, and surgical meniscectomy can interfere with the normal joint leading to OA later (Gelber *et al.*, 2000). An example of an injury that invariably leads to arthritis is a tibial plateau fracture, where the broken area of bone disrupts the cartilage of the knee joint. If an intra-articular fracture is not properly set, the bones heal badly and the joint is put in abnormal stress which leads to osteoarthritis. Longitudinal studies suggest that quadriceps muscle weakness not only results from painful knee osteoarthritis but also is itself a risk factor for structural damage to the joint (Gelber *et al.*, 2000).

### 2.2.5 Inflammation

People who experience a joint infection (septic joint), multiple episodes of gout, or other medical conditions such as rheumatoid arthritis (RA), can develop osteoarthritis of the affected joint. An infection somewhere else in your body (not in a joint) can cause reactive arthritis, also known as Reiter's syndrome. Reactive arthritis is usually caused by an infection with the bacterium Chlamydia. The symptoms usually last 3-12 months. But for some people, the symptoms don't go away, or they go away and come back. Long-term reactive arthritis can lead to joint damage that can lead to OA (Wollenhaupt and Zeidler,

1998). Crystal deposits in the cartilage can cause cartilage degeneration, and osteoarthritis. Uric acid crystals cause arthritis in gout, while calcium pyrophosphate crystals cause arthritis in pseudo gout (Becker, 2005). Most people with RA are not at risk for OA. But severe form of RA can cause joint damage that can eventually lead to osteoarthritis.

### 2.2.6 Nutrition

Articular cartilage is critically dependent upon the regular provision of specific nutrients (glucose and certain amino acids), vitamins (particularly vitamin C), and essential trace elements (zinc, magnesium, and copper, among others). An inadequate diet worsens an already existing OA but does not cause osteoarthritis. In studies that examined levels of vitamin D in the blood, it was found out that patients with low levels of Vitamin D had three times the risk for the progression of OA. In another study, low levels of vitamin C were also associated with the progression of OA (El Miedany *et al.*, 2000).

Meta-analyses of clinical trials show that avocado-soybean unsaponifiables significantly reduce pain associated with osteoarthritis and may be an effective complementary treatment that could be used in conjunction with traditional pharmaceuticals (Blagojevic *et al*., 2010).

### 2.2.7 Radiological features

More than 80% of persons over the age of 50 have some radiographic evidence of osteoarthritis. The joints most commonly involved are the distal and proximal interphalangeals of the hand, first carpometacarpal of the wrist, hip, knee and cervical and lumbar spine, in an asymmetrical fashion. Joint space narrowing is a non-specific finding that results from degeneration and disappearance of the articular cartilage for any cause. Increased bone density due to subchondral bony sclerosis and marginal osteophyte formation is more specific for osteoarthritis. Osteophytes are a late sign. Bone cysts are seen

as periarticular translucent areas. Advanced disease is associated with subluxation of the joint and gross deformity.

### 2.3 Socio-demographic factors

#### 2.3.1 Heredity

Osteoarthritis is found in several members of the same family suggesting a heredity factor. In fact genetic factors account for up to 65% of variation in the osteoarthritis of hands, hips and the knees (Warman *et al*., 2010). Parents with early-onset osteoarthritis, or osteoarthritis involving more than one joint, are likely to transmit the condition to their children (Evangelou *et al.*, 2009). Through twin studies it has been established that OA and its endophenotypes, are to a large extent genetically determined, but the underlying genetic variants are mostly unknown. Early onset OA, which usually represents a monogenic Mendelian disease type that can be mapped by linkage analysis in families, or by exome sequencing of affected subjects. Late onset OA represents the common form of OA with a usual age at onset of >60 years, and for which genetic association approaches have been shown to be fruitful in identifying underlying genetic factors (Evangelou *et al.*, 2009).

The early onset syndromic OA has a genetic defect and high penetrance in a number of families. These syndromes often concur with other major skeletal abnormalities such as disproportionate short stature and skeletal malformations. These genetic skeletal disorders are caused by disturbances in the complex biochemical process of skeletal development at many stages and vary in their appearance and severity (Warman *et al*., 2010). These disorders are caused by mutations in genes encoding for proteins involved in various functions, for example, extracellular matrix proteins and growth factors which are involved in cartilage and bone development.

Candidate genes for common forms of osteoarthritis include the vitamin D receptor gene (which influences bone density and is near the locus for type II collagen, the major form of collagen in hyaline articular cartilage), insulin-like growth factor I genes, cartilage oligomeric protein genes, and the HLA region. Mutations in SMAD3 (SMAD family member 3) are responsible for the cause of aneurysm-OA syndrome. Also it has been proved that there is existence of a link between aneurysms and OA via the TGF (Transforming Growth Factor) beta signaling pathway. A second gene identified to be involved in OA through family research is the TRPV4 (transient receptor potential cation channel, subfamily V, member 4) gene4. Mutations that reduce channel activity are known to cause inherited osteoarthropathy, which indicates that TRPV4 activity plays a role in articular cartilage homeostasis. Some of the genes found for the monogenic syndromic form of OA, have also been known to be involved in late onset OA. For example, the GDF5 (growth differentiation factor 5) and SMAD3 genes, it has been found that polymorphisms in these genes are associated with knee and hip OA (Valdes *et al.*, 2010). There is one well replicated risk gene which reaches the genome-wide significance level ($p < 5$). Rare, inherited skeletal disorders such as Chondrodysplasia, grebe type and brachydactyly type C are caused by mutations in GDF. Functional variation in this gene, affecting transcription of the gene, has been shown to be implicated in late onset OA in both Asians as well as Europeans (Vaes *et al.*, 2009).

### 2.3.2 Ethnicity

The occurrence of OA in specific joints varies according to race. For example, in comparison to Caucasians, Blacks and Asians are less commonly afflicted with OA of the hip, and black Africans and Malaysians are rarely afflicted with OA of the hand. In a study done by Nelson *et al.*, when they examined patterns of multiple joint symptomatic OA, they

found that African Americans more often had knee involvement, and Caucasians more often had hand involvement (Nelson *et al*., 2013). These differences seen across different races suggest that race is an important risk factor in developing OA in certain joints (Litwic *et al*., 2013). This is determined by the physical and socio-economic environment that people live in.

### 2.3.3 Age

Osteoarthritis may begin at any age, but it is common in older people. For both male and female the average age of onset is about 45 years, a time when most people are living an active life or are following a career path. According to data produced by the Dutch Institute for Public Health, the prevalence of knee OA in those aged 55 and above was 15.6% in men and 30.5% in women (Litwic *et al*., 2013). According to Loeser (2010), age is a strong risk factor in the development of osteoarthritis. This trend levels off at around age 80. This is because the old at that age move less, do not seek medical attention or simply they die with their arthritis (Blagojevic *et al*., 2010). Age-related factors that contribute to the development of OA include a decline in muscle strength, loss of proprioception, degenerative changes in the meniscus and joint ligaments, increased bone turnover, as well as calcification of joint tissues (Felson, 2004). Radiological and autopsy surveys show osteoarthritic changes in joints from age 30 onwards. By age 65, around 80% of the population has some radiographic evidence of osteoarthritis and only one-quarter have pain or disability at that time. The possible age-related mechanisms of osteoarthritis are cartilage becomes more brittle with age. As a person ages, the water content of the cartilage decreases, thus weakening it and making it less resilient and more susceptible to degradation. Cartilage has diminished capacity to repair itself, hormonal changes (e.g.

estrogen withdrawal in females) and the cumulative effects of environmental exposures (AIHW, 2005). Articular tissues are responsive to estrogens. Important cellular events (which are dose dependent) in the joints are regulated by estrogens (Maneix *et al.*, 2008). These beneficial effects of estrogens may be significantly decreased or lost as a result of postmenopausal ovarian insufficiency.

Proprioception is the conscious and unconscious perception of joint position and movement. Proprioception is critical to the maintenance of joint stability under dynamic conditions. Proprioceptive accuracy declines with age and is especially limited in sedentary elderly Persons. Studies have demonstrated that proprioceptive accuracy was worse than that in age-matched controls, suggesting that this deficit precedes and may have a significant contribution to osteoarthritis disease development (Weiler *et al.*, 2000).

Like depression, age is known to be the risk factor most strongly correlated to OA (Wu *et al.*, 2012). The protein deacetylase SirT1 plays a critical role in life span determination and controls fat and glucose metabolism. Chondrocyte survival is increased by full-length SirT1 (Takayama *et al.*, 2009). Loss of full-length SirT1 inhibits the expression of type II collagen and aggrecan.

### 2.3.4 Occupation

The repetitive use of joints is considered to be a risk factor for hip and knee osteoarthritis. Jobs where workers do repetitious tasks, overworking the joints and fatiguing muscles that protect the joints, increase the risk for osteoarthritis in those joints. Occupations which involve kneeling, squatting, and climbing stairs such as assembly line workers, miners, floor layers, Dockers, dairy farming, heavy construction and sports at elite level are all associated with higher rates of knee osteoarthritis (McMillan and Nichols, 2005; Zhang *et al.*, 2011),

while high demand jobs that require heavy lifting and standing, including farming, are associated with hip osteoarthritis (AIHW, 2005; Nonnenmann *et al.*, 2010). Recent studies report an increased incidence of osteoarthritis among jackhammer operators (wrists, hands and elbows), coal miners (knee), floor layers, construction workers, forestry workers and farmers, cotton pickers (fingers), and farmers (hips) [Jensen *et al.*, 2000]. Men are known to be more exposed to occupational risks than women (Zhang *et al.*, 2011). Many occupational activities have been studied extensively but their effects on how they cause osteoarthritis have not been sufficiently elucidated. The proposed mechanism of OA includes biomechanical forces across the joint. Apart from the occupational factors, a number of individual risk factors are critical. An association between mal-alignment of the joint bones and occupational osteoarthritis has been noted (McWilliams *et al.*, 2010). It is therefore important to delineate between job related and other factors that are associated with osteoarthritis in deriving preventive measures in occupational health (Zhang *et al.*, 2011). According to Anne *et al*., Ankle osteoarthritis (OA) is more frequently (70–80%) of post-traumatic origin compared to OA (<10%) of the hip or knee. Significant risk factors were: Weber C fracture, associated medial malleolar fracture, fracture-dislocation, increasing body mass index, age 30 years or more and length of time since surgery (Anne *et al*., 2012). And in our set up, more than 75% of road traffic casualties are economically productive young adults (Odero *et al*., 2003).

### 2.3.5 Sex

Estrogen regulates important beneficial cellular events in joint tissues of women such as decreasing nitric oxide production through the interaction of ER (estrogen receptor) with nuclear factor-kappa B in chondrocytes; increasing proteoglycan production, the ability of

bone to bear mechanical stress and inhibition of osteoclastic bone resorption and the up regulation of a functional uridine diphosphate-glucose dehydrogenase in articular chondrocytes. These beneficial effects of estrogens are lost as a result of postmenopausal ovarian insufficiency (Grabriel *et al.*, 2009). It is now known that in the female sex, cartilage volume loss occurs mostly in the medial compartment (Pelletier *et al.*, 2007).

Studies have shown that women are more susceptible to obesity than men, especially after menopause. Because overweight and obesity are important risk factors for OA and most women are obese, women are at an increased risk for developing OA (Salve *et al*., 2010). In addition to obesity, other factors, such as female hormones lead to the development of OA. Because the presence of certain hormones is associated with OA, and the type and amount of hormones differ between men and women, specific types of OA affect only women. For example, Menopausal OA, also known has Nodal Generalized OA, is caused by hormone level fluctuation and its onset is consistent with the beginning of menopause. The tendency of specific types of OA and the prevalence of obesity in women is the reason why being female can be considered a risk factor for OA. In a study done by Nelson *et al*., when they examined patterns of multiple joint symptomatic OA, they found that women had hand involvement and men had lumbosacral spine involvement.

### 2.3.6 Smoking

In a study done by Amin *et al*., to study the effects of smoking on OA, found that men with knee osteoarthritis who smoked sustained greater cartilage loss and had more severe knee pain than men who did not smoke. But the effect of smoking on the progression of osteoarthritis has not been elucidated (Amin *et al*., 2007). A similar study done by Wilder *et al*., to study the association between cigarette smoking and the development of OA, found

that there was no clear association between smoking and the symptomatology of OA. According to Amin *et al*., smoking may disorder the cells and prevent cell production in cartilage or smoking may raise levels of toxins in the blood, contributing to cartilage loss, or smoking may increase carbon monoxide levels in the blood, upsetting blood oxygenation, which could hinder cartilage repair. Probably the components of smoke, other than nicotine, are responsible for the adverse skeletal effects.

### 2.3.7 Alcohol consumption

Alcohol contributes to joint inflammation, a process that contributes to cytokine and MMPs production that leads to joint cartilage degeneration (Loeser, 2010). A research done by Zhang, found that beer drinking was strongly associated with osteoarthritis… 'the more beer a person drank, the higher the risk of knee osteoarthritis.' Knee osteoarthritis was nearly twice as likely to develop in people who drank eight or more pints of beer per week compared with people who did not drink beer—and the more beer consumed per week, the higher the risk. Beer drinking was also associated with a significantly increased risk of hip osteoarthritis but only in men. But no association was seen between wine and osteoarthritis (Zhang, 2015).

## 2.4 Conceptual framework

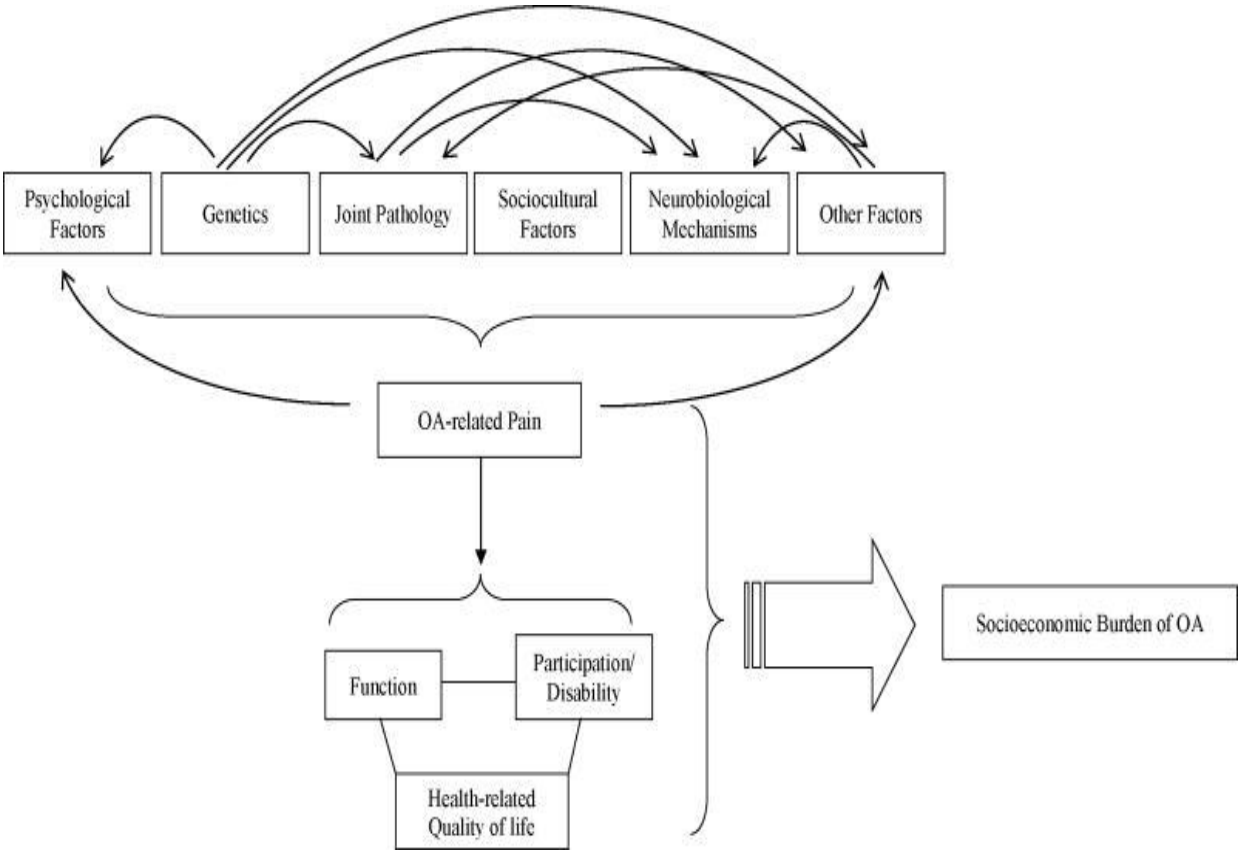



**Figure 1. Osteoarthritis medical model**

The etiology of osteoarthritis is multifactoral. Its impact in the society includes pain, reduced quality of life, and even reduced longevity, lost productivity, and significant costs associated with management of OA. As there is no cure, osteoarthritis management is primarily concerned with controlling pain and improving joint function and the quality of life. Some of the interventional procedures that can be done include osteotomy: performed

in people with early osteoarthritis to redistribute weight bearing and may relieve symptoms and slow the rate of progression. Arthroscopy: arthroscopic debridement and lavage can successfully alleviate symptoms, particularly in the case of degenerative meniscal tears in the presence of mechanical symptoms. However, when there is substantial joint-space narrowing, arthroscopic surgery has limited benefit. Arthrodesis successfully alleviates pain and is commonly performed in the spine and in small points of the carpus, hand and foot. Arthroplasty: total joint Arthroplasty represents the latest advancement in the treatment of osteoarthritis. Currently it is the basis of surgical treatment of the osteoarthritic hip, knee and glenohumeral joints. And this way, pain and disability of end-stage osteoarthritis can be eliminated, restoring patients to near normal function, thus improved quality of life (Figure 1). Prevention can reduce the burden of osteoarthritis and disability in the society. Avoiding joint trauma, preventing obesity and modifying occupation-related exposure through ergonomic approaches are all recommended for the prevention of osteoarthritis. Therefore effective prevention, early intervention and optimal management of osteoarthritis preserves a person’s independence.

# CHAPTER THREE

# METHODOLOGY

## 3.0 Introduction

This chapter is about where and how the research was done. It presents 11 sections: the study site, study design, subjects, determination of sample size, sampling techniques and research tools, data analysis and presentation, inclusion criteria, exclusion criteria, study limitations, ethical considerations, and conflict of interest.

**3.1 Study site:** The study was carried out at Moi Teaching and Referral Hospital (MTRH), Eldoret. Eldoret is a town in Rift valley, about 350Km northwest of Nairobi. It is the administrative centre of Uasin Gishu County (Appendix 1). Uasin Gishu (UG) county lies in the mid west of Rift Valley and borders six counties: Elgeyo Marakwet county to the East, Trans Nzoia to the north, Kericho to the south, Baringo to the south east, Nandi to the south west and Bungoma to the west. The Latitude and Longitude of Uasin Gishu is $0^0 32' 22'' N$ and $35^0 19' 11'' E$ respectively. Lying south of the Cherangani Hills, the local elevation varies from about 2100 metres above sea level at the airport to more than 2700 metres in nearby areas (7000–9000 feet). The high altitude is an ideal training ground for many middle and long distance athletes. Kalenjin ethnic groups are renowned for exceptional performance in athletics. Temperatures in Uasin Gishu range from a minimum of $8.4^0$ C to a maximum of $27^0$ C. It has two rainy seasons with average rainfall from 900mm to 1,200mm per annum. Uasin Gishu County is home to 894,179 people as per the 2009 National Statistics, representing 50% male and 50% female. It is largely a cosmopolitan region, with the Nandi people of indigenous Kalenjin communities having the highest settlement. Other communities with notable presence in the county especially in urban settlements include

Luhya, Kikuyu, Luo, Kamba, Kisii among others. Although traditionally pastoralists, modern Kalenjin communities are mainly large scale wheat and maize farmers earning the county a name for being Kenya's bread basket. The town is abuzz with farmers processing and delivering their produce to the National Cereals and Produce Board (NCPB). The county is a crucial transport corridor linking Kenya to Uganda, Eastern Congo, Rwanda and Southern Sudan. Dairy farming is also done in large scale in most parts of the county. Various food and horticultural crops also do well in the highly arable land. The town is abuzz with farmers processing and delivering their produce to the National Cereals and Produce Board (NCPB). Fourty percent (40%) of this is rural population while 54% is urban. Uasin Gishu County boasts of over 770 primary schools, 158 secondary schools and about 15 tertiary institutions. The county is also a manufacturing hub, with numerous industries and factories providing employment to thousands of its urban population. Nationally recognised manufacturing industries like Rupa Mills Limited, Raiply, Ken-Knit, Lochab Brothers, Kenya Creamaries Cooporation, wheat factories, pyrethrum factory and Kandola and Son's. Poverty in UG county is 49% as per the Kenya National Bureau of Statistics of 2007 are in Eldoret. The major causes of poverty here are unemployment, lack of markets for farm produce and high costs for farm input.

Moi Teaching and Referral Hospital is a second national referral hospital in Kenya with 800 beds capacity. It offers a wide range of health services both Out-Patient and In-Patient. The services are supported by modern state of the art clinical and diagnostic equipment manned by trained and qualified medical, para-medical and support staff of different cadres both from the hospital and Moi University, College of Health Sciences, administered through the various Clinical Departments in the hospital. The hospital attends to patients from the North

Rift Region, Western Kenya, parts of Eastern Uganda and Southern Sudan, making a catchment area of about 20 million people. The hospital also trains students from the University of East Africa, Baraton, Moi University, Kenya Medical Training Centre (KMTC) and the ECN (enrolled community nurse) upgrading programme. Academic Model Providing Access to Healthcare (AMPATH) is a partnership between Moi University School of Medicine, Moi Teaching and Referral Hospital (Kenya's second national referral hospital), and a consortium of United States medical schools led by Indiana University, AMPATH promotes and fosters a comprehensive approach to HIV/AIDS control that complements and enhances the existing health infrastructure. AMPATH addresses food and income security needs, delivers and monitors ARV treatment, and fosters prevention of HIV transmission through community-based health education and prevention of maternal to child transmission. Recently the Moi Teaching and Referral Hospital commission a Ksh. 400 million Chronic Disease Centre and 120 bed capacity Shoe for Africa children's hospital. It is part of the strategic plan to make the hospital a fully fledged referral institution.

The department of surgery, to achieve its goals, works in collaboration with other departments of the hospital e.g. laboratory, physiotherapy, occupational therapy, nutrition, orthopedic technology, social work, theatres, orthopedic plaster and other personnel of both the Hospital and Moi University, School of Medicine. Due to its wide catchment area, the department experiences high bed occupancy of between 100%-150 %, this leads to straining of the available resources. The female surgical wards require expansion since it currently accommodates female orthopaedics, female surgery, paediatric surgery and burns cases.

**3.2 Design:** A cross-sectional descriptive hospital based study purely used to assess the frequency and distribution of OA in patients seen at orthopedics clinic of MTRH from 1st January to 30th November 2015.

**3.3 Study population:** Patients with a diagnosis of OA on the Kellgren and Lawrence scale (standardized radiological evidence of OA), had joint pain, had been referred to the orthopedic clinic of MTRH and had consented for the study, were consecutively selected.

**3.4 Determination of sample size**

This being a hospital-based study, the sample size required in order to be 95% sure that the proportion of the patients who suffer knee, hip, shoulder, ankle, wrist, elbow and spinal osteoarthritis was within plus or minus 5% of the population proportion of 69% was estimated using the following formula (Evan Morris):

$$n = \frac{N^2 P(1-P)}{\left( E^2 (N-1) + Z^2_{1-\alpha/2} P(1-P) \right)}$$
$$= \frac{380^2 \times 0.69(1-0.69)}{0.05^2 \times (380-1) \times 1.96^2 \times 0.69(1-0.69)},$$
$$= 177$$

where P, equal to 69%, is the population proportion of those who suffer osteoarthritis,

$\delta$ is the margin of error equal to the 5% used in this study,

and $Z_{1-\alpha/2}$ is the $(1-\alpha/2)\times 100\%$ quartile of the standard normal distribution.

This gave a total of 177 patients.

The population proportion of 69% was obtained from a study done by (Thomas *et al*, 2004).

Given that sampling was done consecutively provided the participants met the inclusion criteria and had consented, there was no need to adjust this sample size for finite population. Thus the final minimum sample size that was needed in this study was 177.

### 3.5 Sampling method and research tools

There was purposeful selection of patients with OA during a single clinic visit to consult for osteoarthritis. The study tool was an interviewer administered questionnaire (Appendix 3). Questions for the anatomical location for OA, WOMAC scores for pain and functional disability, Kellgren and Lawrence grading (1957) and the associated demographic factors for OA were included in the questionnaire. The questionnaire also had questions about socio-demographic characteristic, co-morbidity, history of surgery, history of joint injury and history of hysterectomy. The respondent's height and weight were measured for BMI (body mass index) calculation. Height measurements were taken with subjects standing erect with bare-feet and heels touching and eyes directed straight ahead. A meter ruler was placed on a level floor at the zero mark. A pointer placed directly horizontal to the vertex of the head with one end pointed to the mark in the meter ruler revealed the reading of the height to the nearest 0.1 cm. Body mass index was calculated as a measure of weight relative to the height by dividing the weight in kilograms (kg) by the squared height in meters (m).

#### 3.5.1 Validity

Kothari (2004) defines validity, as the degree to which an instrument measures what it is supposed to measure. The validity of the questionnaire (Appendix 3) was determined by ensuring that questions/items in it conformed to the study's Conceptual Framework (Fig 2.2.1). The researcher also used expert judgment which was done by contacting supervisors to ensure the relevance, wording and clarity of the questions or items in the instrument.

### 3.5.2 Reliability

Gay (1996) defined reliability as the degree of consistency that the instrument demonstrates. After pilot testing the questionnaire at Uasin Gishu district hospital, an institution with similar characteristics to those in this sample, reliability of the instrument, on multi-item variables, was determined by recasting of questions and items on the questionnaire. The researcher used this method because it was expected that some items or questions would have several possible answers.

## 3.6 Data analysis and presentation

Data collected during the study was verified, cleaned and entered into software data management program Statistical Package for Social Scientists (SPSS) version 20. Descriptive statistics and frequency distributions were generated for the patients' demographic and disease related clinical characteristics. Data was then presented in comprehensive tables showing the responses of each category of variables. Statistical tables, bar graphs and pie charts were used to present the data. Continuous data e.g. age, weight, height, BMI was presented as means, standard deviations, and medians. Categorical data such as gender, physical activities, family history and smoking habits were presented in proportions, frequencies and percentages. Relationships of OA pattern with age, body mass index (BMI), sex, ethnicity, family history of OA, history of injury, previous surgery, occupation, sports participation, co-morbidity and area of residence of the respondent were determined. Weight was measured to the nearest 0.1 kg (shoes, socks and bulky clothing removed) using a single pair of electronic scales. In both men and women, normal weight was defined as a body mass index between 18.5 $Kg/M^2$ -25 $Kg/M^2$, overweight as 25 $Kg/M^2$ or more but less than 30 $Kg/M^2$, and obesity as 30 or more $Kg/M^2$. The Western Ontario and

McMaster Universities Osteoarthritis Index (WOMAC) was used to measure outcomes of osteoarthritis (Appendix 3). The WOMAC measures five items for pain, two for stiffness, and 17 for functional limitation (Appendix 3). Physical functioning questions covered everyday activities. The WOMAC used was of 5-point Likert-type. The test questions were scored on a scale of 0-4, which corresponded to the scores for each subscale. The raw scores were sufficient statistics for estimating the patient's level of pain and physical functioning at the ordinal level. Radiographic classification of OA severity was based on the Kellgren and Lawrence scale with patients having a score of 2 classified as mild OA, a score of 3 classified as moderate OA, and a score of 4 classified as severe OA. Physical activities were categorized as light, moderate or heavy. The light intensity activity is an activity that is classified as < 3 METS. One MET, or metabolic equivalent, is the amount of oxygen consumed while sitting at rest. Thus, an activity classified as 2 METS would be equal to 2 times the amount of oxygen consumed while sitting at rest (1 MET). Moderate intensity activities are defined as activities ranging between 3 - < 6 METS**.** Vigorous intensity activities are defined as activities ≥ 6 METS**.** Vigorous activities require the highest amount of oxygen consumption to complete the activity. The following activities were regarded as light intensity and included standing, ironing and leisurely walking. The moderate category included such activities as lifting or carrying light objects, sweeping or mopping, cooking, track driving, painting and vacuuming as well as brisk walking. Heavy activities ranged from lifting, pushing or carrying heavy loads (>11.4Kg) e.g., in carpentry, lumbering, splitting firewood, tilling land with a hoe or forked *jembe*, shoveling, brick making, brisk cycling, and strenuous sports (WHO, 2009).

**Table 2 Categories of levels of physical activity**

| **Light**<br><br>**<3.0 METs** | **Moderate**<br><br>**3.0–6.0 METs** | **Heavy**<br><br>**>6.0 METS** |
|---|---|---|
| • Walking—slowly<br>• Sitting—using computer<br>• Standing—light work (cooking, washing dishes)<br>• Fishing—sitting<br>• Playing most instruments | • Walking—very brisk (4 mph)<br>• Cleaning—heavy (washing windows, vacuuming, mopping)<br>• Mowing lawn (power mower)<br>• Bicycling—light effort (10–12 mph)<br>• Badminton—recreational<br>• Tennis—doubles | • Walking/hiking<br>• Jogging at 6 mph<br>• Shoveling<br>• Carrying heavy loads<br>• Bicycling fast (14–16 mph)<br>• Basketball game<br>• Soccer game<br>• Tennis—singles |

### 3.7 Eligibility

#### 3.7.1 Inclusion criteria

Patients seen at orthopedic clinic with osteoarthritis confirmed by radiological diagnostics (plain radiographs, anteroposterior and lateral views) ≥grade II on the Kellgren and Lawrence scale (Table 1) indicating OA who were 18 years and above (Figure 2).

#### 3.7.2 Exclusion criteria

- Patients with incomplete information
- Patients with pain but no X ray reports
- Patients who didn’t consent
- Patients with systemic diseases such as RA, SLE, Psoriasis

### 3.7.3 Study procedure

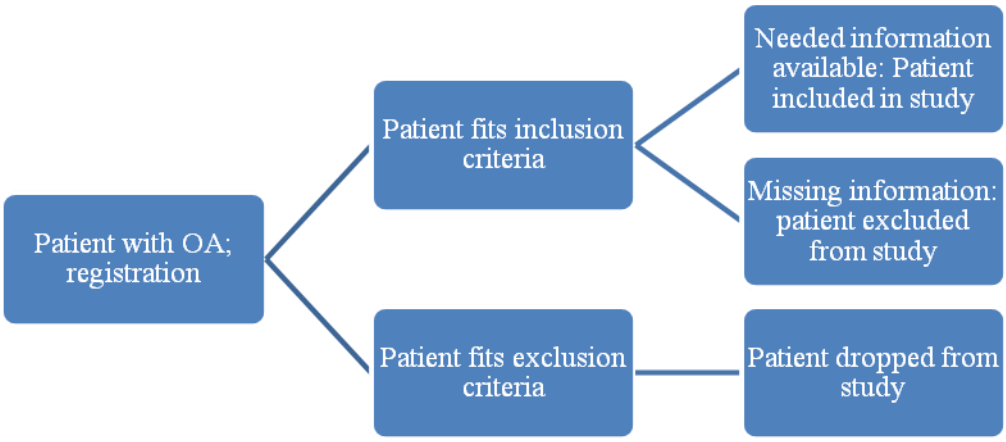



**Figure 2 Study flow**

### 3.8 Study limitations

The primary limitation of the cross-sectional study design is that because the exposure and outcome are simultaneously assessed, there is generally no evidence of a temporal relationship between exposure and outcome. Also a cross-sectional study evaluates prevalent rather than incident outcomes and thus excludes people who develop the outcome but die before the study is done. As such, there is a bias toward including in the study individuals with more favorable survivorship. Again, because of the cross-sectional study design that was used, the revealed factors could not be confirmed as predictors over time. The fact that a control group with people without OA was lacking may have led to an underestimation of the impact of OA in the current study.

One of the problems with case definition (Kellgren and Lawrence scale) is that many people with positive x-ray findings have no pain or disability (Scott, 2009). On the contrary, some patients report pain but show no radiological evidence. With Kellgren and Lawrence scale, there are several inconsistencies in the interpretation of the grading descriptors which may result in large inter-observer scoring variations, a factor that can vary studies. In addition,

main sources of data on osteoarthritis were based on radiographs of only the joint with pain in each person. To minimize this, a radiograph was corroborated by medical history.

The sample was small from a hospital based study and may not be representative of all osteoarthritis patients in Kenya. The findings are based on a cross-section of patients who had osteoarthritis and were referred to Moi Teaching and Referral Hospital. A larger sample size is required to ensure representative distribution of the population.

### 3.9 Ethical considerations

Approval to conduct the study was sought from the Institutional Research and Ethics Committee (IREC) [Appendix 4] and the hospital administration (Appendix 5). Informed consent was sought from all eligible patients before involving them in the research (Appendix 2). Treatment was not withheld in an event that the patient refused to consemt. Participant confidentiality was also assured. The research findings will be disseminated through seminars, conferences and submission of a bound copy to Moi University, School of Medicine library.

### 3.10 Conflict of interest

There was no conflict of interest for the researcher to disclose.

# CHAPTER FOUR

# RESEARCH FINDINGS

## 4.0 Introduction

This chapter gives a detailed account of the results from the data collected and analyzed. It presents the research findings guided by individual objectives. The study analyzes the socio-demographic factors affecting the occurrence of osteoarthritis and describes the clinical characteristics of patients with OA. The findings are presented in the form of statistical tables, bar graphs and pie charts. The following specific objectives were investigated:

1) To establish the socio-demographic characteristics of patients with OA
2) To describe the clinical presentation of patients with OA
3) To determine co-morbidities in patients with OA

## 4.1. Socio-demographic characteristics of patients with osteoarthritis

Two hundred and ten questionnaires were handed out to respondents and a response rate of 84.3%% was returned and used for data analysis. One hundred and seventy seven (177) patients with OA were interviewed. Eighty of them were men, and women were 97. They were both in the age range of 20 to 81 years. The results are spread over a mean of 2.26, median of 2.00 and a standard deviation of 0.971.

**Table 3 Socio-demographic characteristics**

| Social factor | Status | Percentage |
|---|---|---|
| Marital status | Married | 68% |
| | Separated | 20% |
| | Single | 12% |
| Highest level of education | None | 32% |
| | Primary | 28% |
| | Secondary | 19% |
| | Post secondary | 21% |
| Smoking | Yes | 15% |
| | No | 85% |
| Family history of OA | Positive | 42% |
| | Negative | 58% |
| Alcohol consumption | Yes | 45% |
| | No | 55% |

Most patients were in marriage, most of the patients had primary level of education as the highest attained or did not have any formal education, a good number of them were smokers (15%), 42% of the patients with OA had a positive family history of osteoarthritis and 45% consumed alcohol (Table 3).

### 4.1.1 Age

In this study, older patients, that is, 41 years and above represented a significant number (75.14%) of patients with osteoarthritis seeking care (Figure 3). In this age range Hip OA was more prevalent, 75.08% of all the hip cases seen. In the present study, knee OA was the second most prevalent type of OA, comprising 67.44% of knee osteoarthritis. Vertebral OA was the third most common degenerative condition in the old people, comprising of all the

spine cases at MTRH. No case of spine osteoarthritis was seen in young patients (under 40 years) [Figure 3]. The cases of hip OA (22.96%), knee OA (32.56%) and ankle (44.44%) OA that were seen in young people were largely due to joint destroying condition e.g., joint injury, congenital defect or a joint destroying condition.

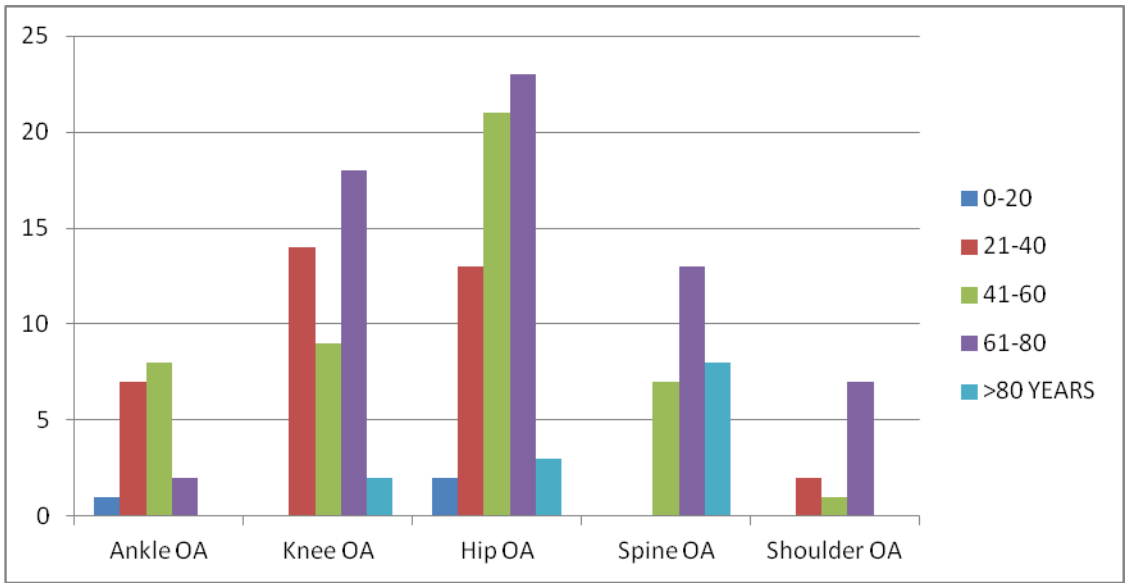



**Figure 3 Distribution of OA with age**

### 4.1.2 Sex

In this study in patients with hip OA, more women were affected (59.68%) than their male counterparts (Figure 4). In Knee OA both genders were affected almost equally (51.16% females and 48.84% males). In the cases of Ankle OA more men were affected (55.55%) than women (44.45%). In vertebral OA female patients had the highest number of cases (60.71%). But in elbow osteoarthritis, men were predominantly affected (80%) [Figure 4].

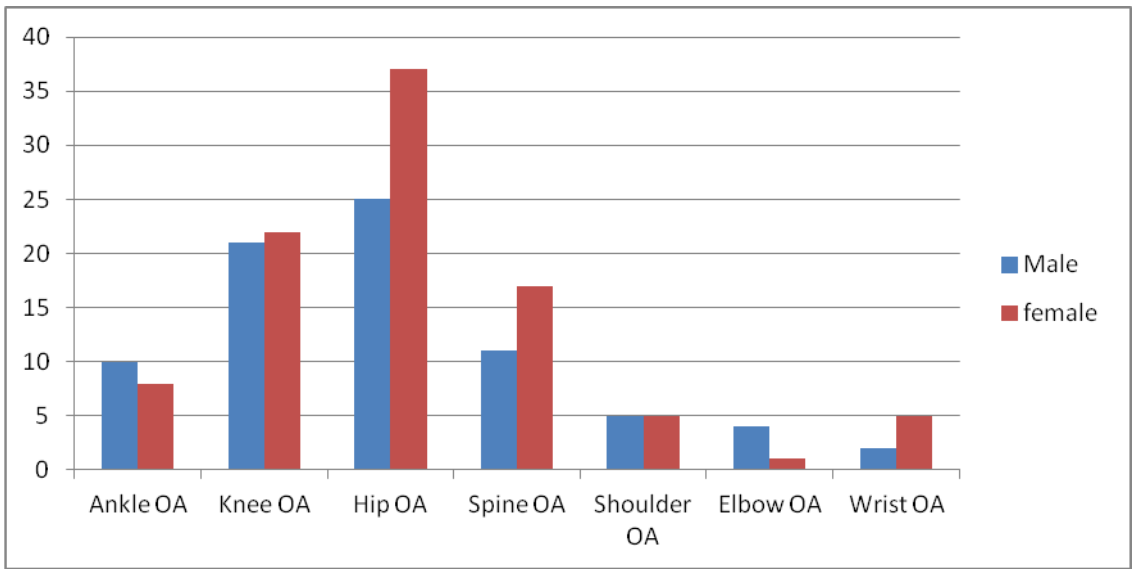



**Figure 4 Distribution of OA by gender**

### 4.1.3 Occupation

In this study, a significant number of patients (38.71%) who were consulting for hip OA were peasant farmers (Figure 5). These farmers had spine OA (71.43%) and knee OA (39.53%) mostly. Most of the affected joints were the weight bearing joints (the hip, knee and lumbar spine). Most patients (83.33%) who consulted for ankle OA were casuals (who mainly use hands or hand tools to perform their duties such as mechanics, construction workers, carpenters, painters, cleaners, hairdressers, house helps, farm hands, masons), unemployed or were motorbike riders. In this study the unemployed and casuals also presented with Knee OA (51.16%), hip OA (43.54%), and spine OA (21.42%). Overall a significant number (65.54%) of the patients reported to have been involved in heavy level activities and 24.86% Moderate level of activities.

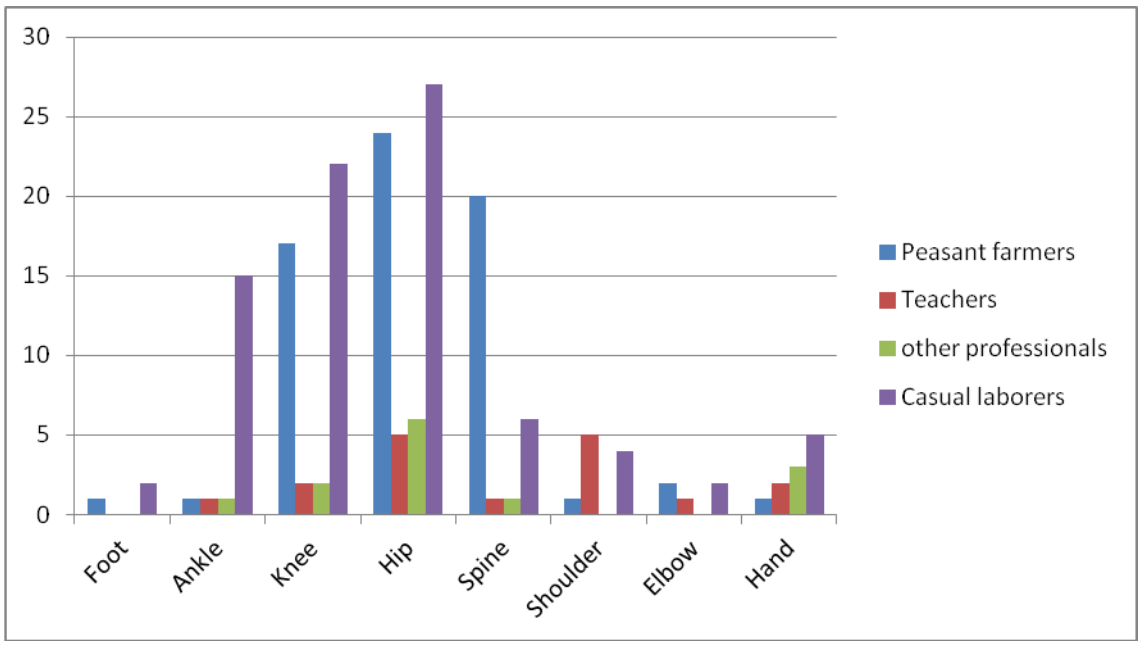



**Figure 5 Distribution of OA by occupation**

## 4.2 Clinical characteristics associated with osteoarthritis

### 4.2.1 Anatomical distribution of osteoarthritis

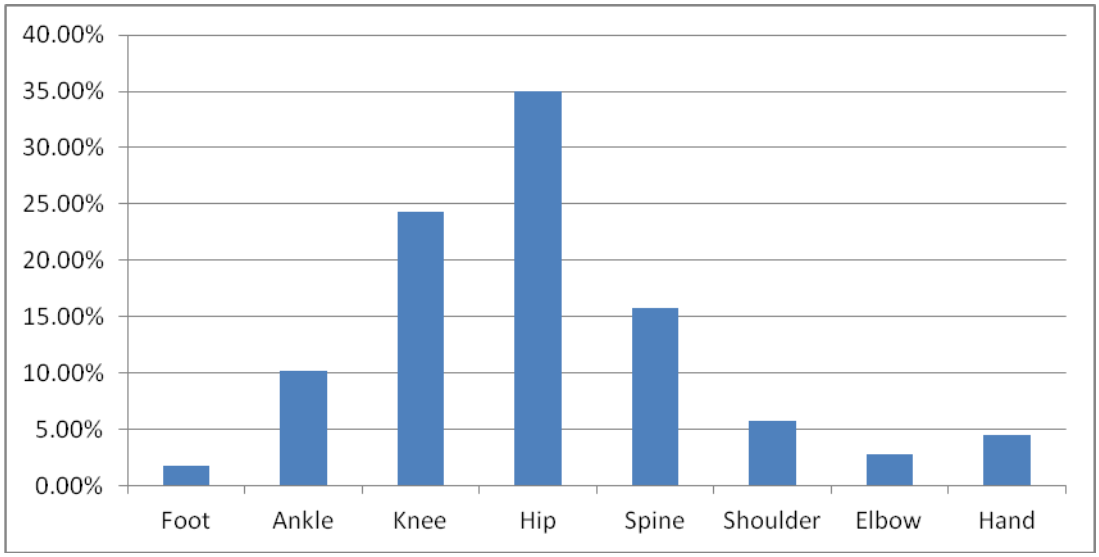



**Figure 6 Patterns of osteoarthritis**

In the present study, the most common locations of osteoarthritis in patients coming for review at the MTRH out-patient clinic were (in decreasing order of frequency); the hip joint (35.02%), the knee joint (24.29%), spine OA (15.81%) and ankle OA (10.16%) [Figure 6]. About 45% of patients with OA presented with bilateralism. A small group of patients seen at the clinic had arthritis of the shoulder joint, the hand and elbow joints.

### 4.2.2 Radiological patterns of osteoarthritis

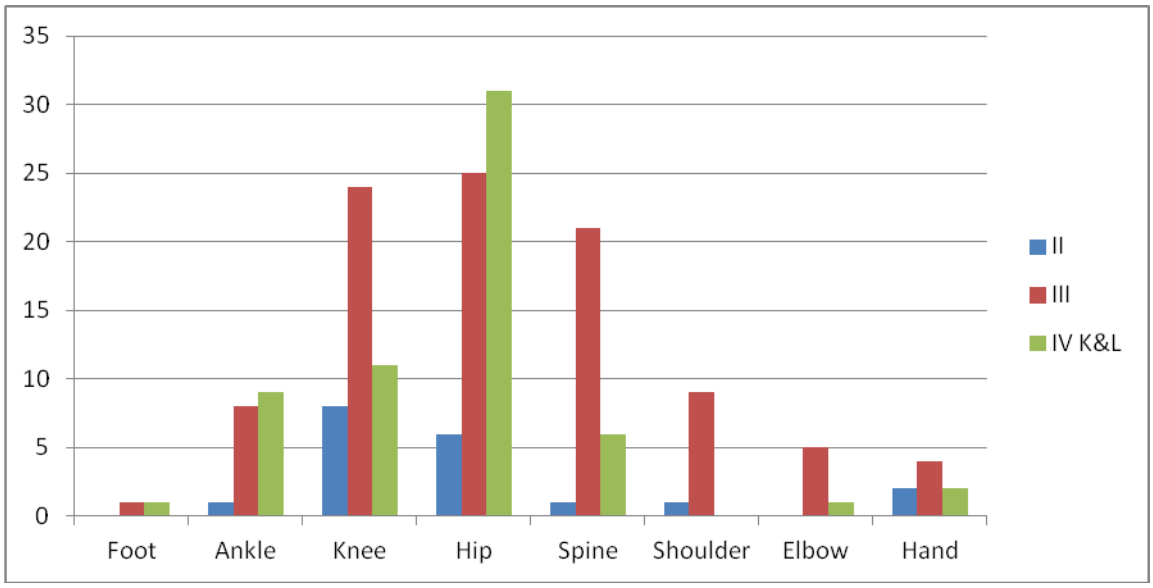



**Figure 7 Radiological grades of osteoarthritis**

In the present study, most (89.26%) of the patients presented with advanced stages of OA, Kallegren-Lawrence $\geq$ III (Figure 6). These stages are high grade and associated with severe pain, joint destruction and joint movement limitation. A majority were patients with Hip OA, knee OA, spine OA and ankle OA (Figure 7). Meaning that, for some reason, the patients arrived at the clinic when they already had severe pain and the joints had been

destroyed. In this study therefore, a significant number of cases of arthritis seen at MTRH clinic are advanced, Hip OA, Knee OA, Spine OA and Ankle OA.

### 4.2.3 Physical disability

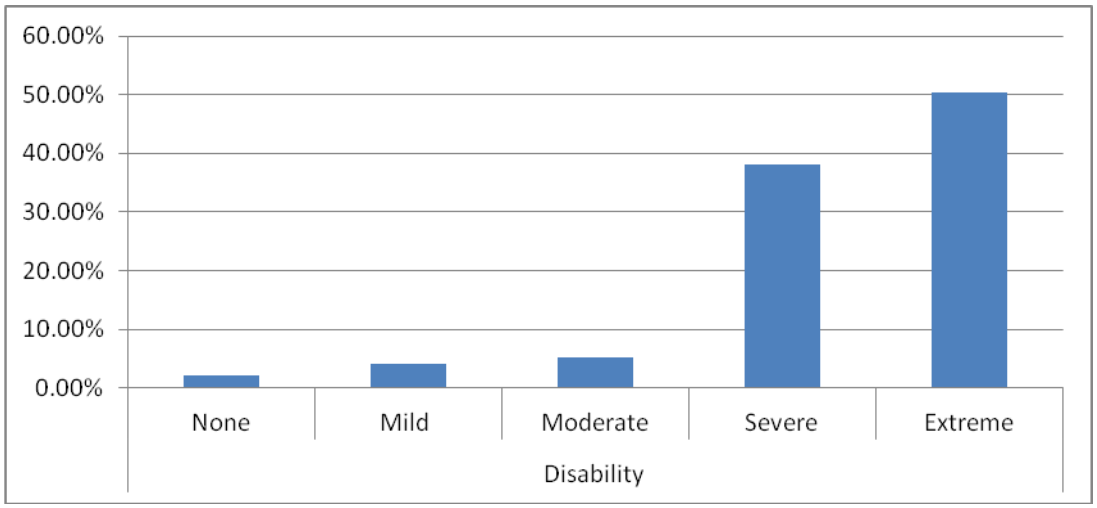



**Figure 8 Functional limitation as per WOMAC scores**

About half (50.42%) of patients with osteoarthritis were experiencing extreme functional disability, 38.06% severe functional disability, 5.16% moderate disability and 4.18%, 2.18% mild disability and no disability respectively in the Likert type WOMAC scores (Figure 8).

### 4.2.4 Self reported pain

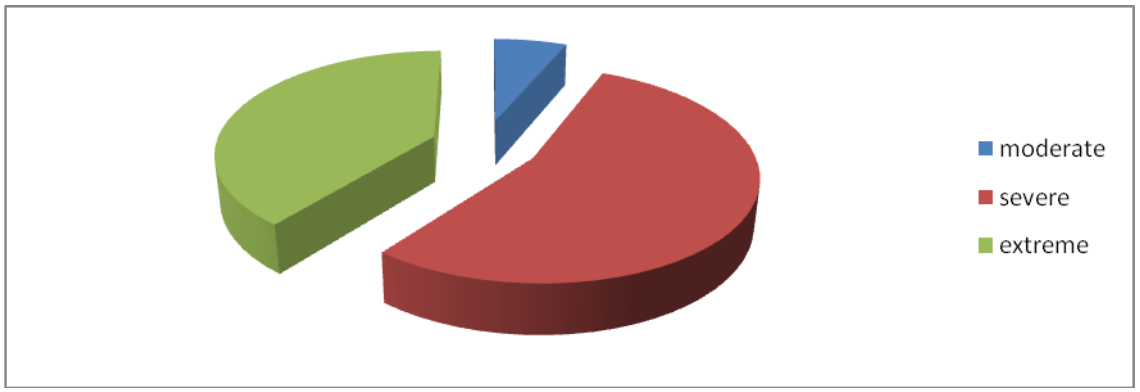



**Figure 9 Pain categories as per WOMAC scores**

Pain presentation varied in patients with osteoarthritis (Figure 9). Most of the patients in this study indicated that they had pain due to their OA in most days. More than half (54.02%) of them were experiencing extreme pain, 39.59% had severe pain and a small number (6.39%) experienced moderate pain on the WOMAC Likert type scale. And women reported higher pain scores than men.

### 4.2.5 Body mass index and osteoarthritis

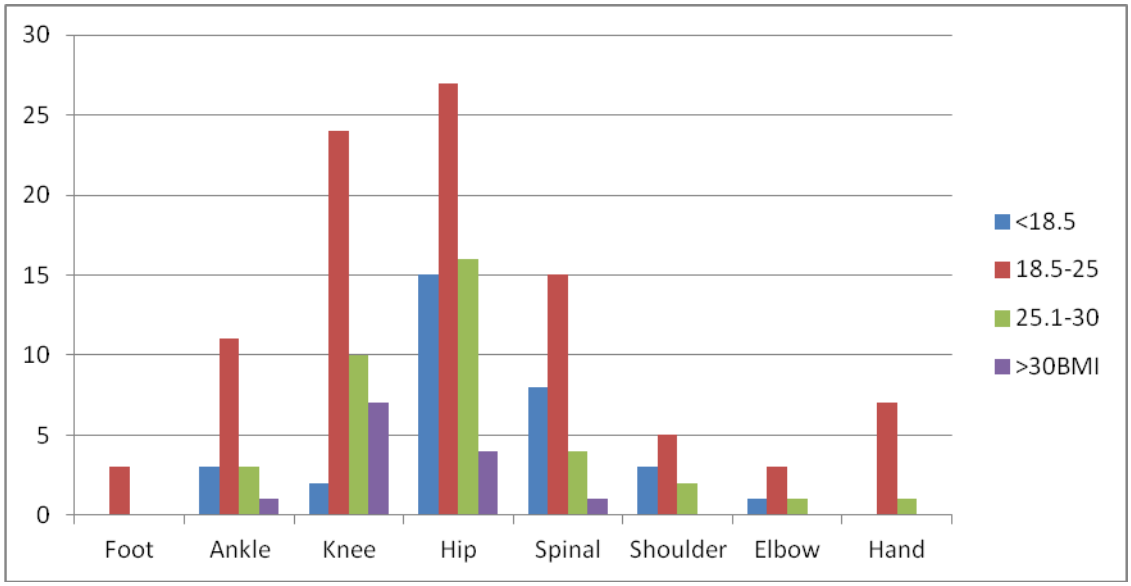



**Figure 10 Distribution of OA by BMI**

In the instant study, in patients who consulted for hip OA (32.26%), Knee OA (39.43%), vertebral OA (17.86%) and ankle OA (22.22%), they were either overweight or obese. That is, averagely, about 28.25% of all patients were overweight and or obese. In this study other patients who consulted for OA, had a normal (53.67%) weight or were underweight (18.08%) (Figure 10).

### 4.2.6 History of joint destroying disease

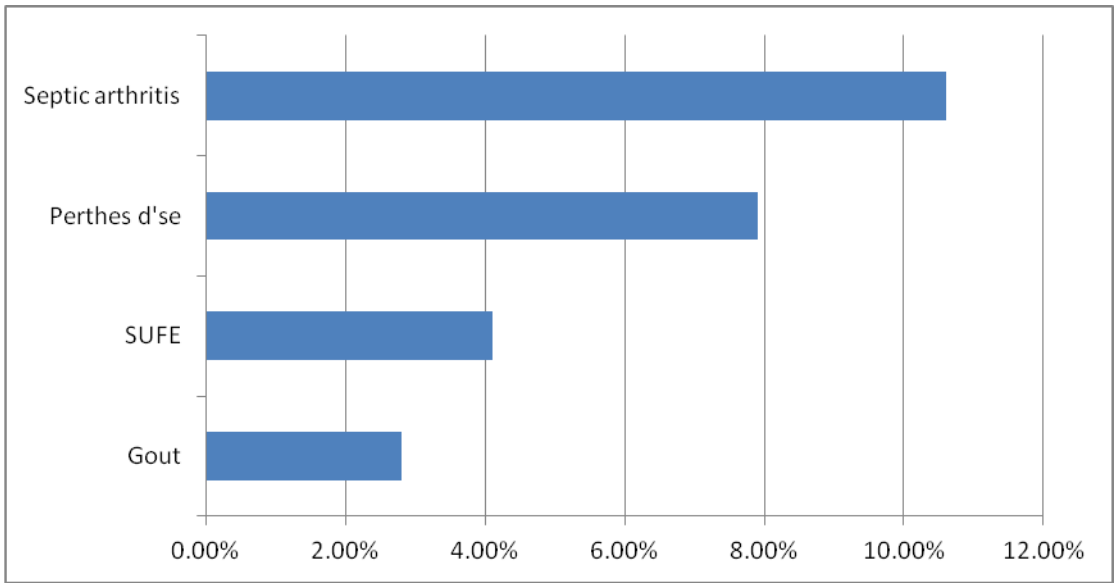



**Figure 11 Prevalence of joint destroying disease in OA**

In this study about a quarter (25.34%) of patients with OA reported that they had had a joint destroying condition before developing osteoarthritis. A significant number (10.57%) of the patients with a joint destroying disease had had infective arthritis due to either tuberculosis or bacterial joint suppuration. Another significant number (7.86%) had had Perthes disease prior to developing osteoarthritis. About 6.91% of patients who consulted for osteoarthritis had either slipped upper femoral epiphysis or gout preceding the development of OA (Figure 11).

### 4.2.7 History of congenital joint disease

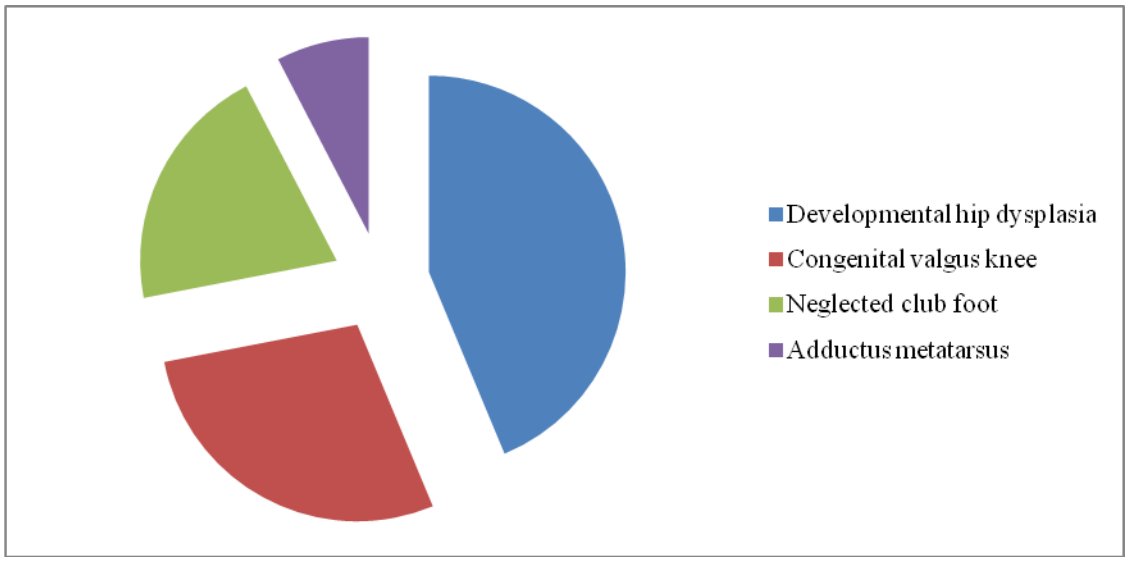



**Figure 12 Prevalence of congenital joint anomaly in OA**

In this study, 9.31% of patients with osteoarthritis indicated that they had a congenital joint condition prior to developing OA in the affected joint. Most of them had had developmental hip dysplasia (4.07%) and congenital valgus knees (2.63%), a few had neglected clubfoot (1.9%) and adductus metatarsus [0.71%] (Figure 12).

### 4.2.8 Osteoarthritis comorbidity

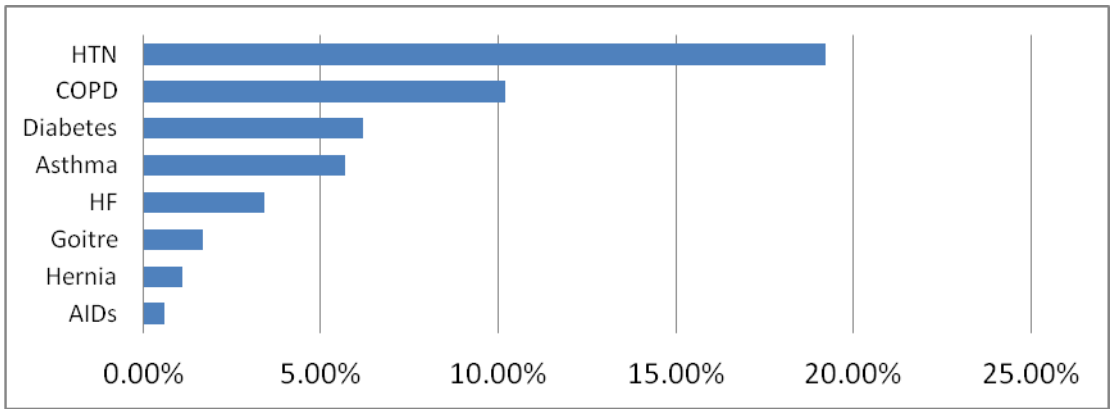



**Figure 13 Medical conditions in patients with OA**

In this study, almost half (48%) of patients with osteoarthritis had comorbidities. In a decreasing order, a significant number of patients had hypertension (19.21%), chronic obstructive airway disease (10.17%), diabetes (6.21%), Asthma (5.65%), heart failure (3.38%) and others like goiter, hernia and immunosuppression (Figure 13).

# CHAPTER FIVE

# DISCUSSIONS

## 5.0 Introduction

This chapter discusses the findings obtained in the study as per the objectives. It discusses the socio-demographic factors of patients with osteoarthritis, the clinical characteristics in patients with OA and it describes the co-morbidities in patients with OA.

## 5.1 Demographic characteristics

A significant number of patients with OA had a low level of education. Probably the low level of education influenced the kind of occupations the patients were in. In a study by Rosemann *et al.*, it was also found that low level of education was associated with severe radiological findings as well as severe pain in patients with osteoarthritis. In another study by Kawano *et al* found that there is a robust association between a low level of education and a low quality of life in patients with osteoarthritis. A higher level of education is known to help in coping strategies in chronic conditions such as OA (Rosemann *et al*., 2007). In the present study, a significant number of patients with osteoarthritis were married. To most people, family is the motivating factor to go out to work so as to provide for them. This may also be an important factor when it comes to a patient needing help. In a research done to determine the effect of social contacts in patients with osteoarthritis showed that programs that were offered to patients in set ups involving spouses resulted in the success of those programs (Keefe *et al*., 2004). So, one would expect the success of any program initiated here for the patients with osteoarthritis banking on the support the patients will get from their family.

### 5.1.1 Age

In the present study, a significant numbe of patients with osteoarthritis were above 40 years. Older patients accounted for most of the coxarthrosis (hip OA) cases seen at MTRH. In a similar study done in South Africa, hip OA was found to be more common in people who are 55 years and above (Usenbo *et al.,* 2015). This may be attributable to menopause, mere degeneration of joints due to over use, and exposure to joint injury or surgery as the years go by. Along with increase in age, there is an exponential increase in the associated risk factors for OA such as obesity, joint injury and smoking. In the multivariate relationship of OA with age there was a strong Pearson's correlation, *P* value 0.01 (Appendix 4). This was proved by the Chi-Square test which showed a significant coefficient of 0.05. So, this finding supports the fact that OA is a common health problem in middle and old age.

### 5.1.2 Sex

In the present study, osteoarthritis was more common in women than men. These results were similar to the finding by Yashimura *et al.* (2012). This could be attributable to the effects of estrogen hormone in women (presence of oestrogen receptors in cartilage has been demonstrated) and cases of obesity being more in women than men. This may also be attributable to smaller joints, small surface area of cartilage and lax ligaments in women (due to the effects of estrogen). But it may also be seen as women are more likely than men to seek for osteoarthritis treatment and men may not be coming to consult due to higher pain tolerance. In the analysis of the multivariate relationship of OA and sex, there was a significant Pearson's correlation, *p* value 0.01 (Appendix 4). But the Chi-Square test proved that there is no relationship with a significant coefficient that is 0.05 or 0.01.

### 5.1.3 Occupation

The main occupation of the patients with osteoarthritis was peasant farming and casual labor. In a similar study done in France, those who worked in Agriculture sector were found to have high osteoarthritis prevalence rate ratio (2.8; 95% CI 2.5 to 3.2) (Rossignol *et al*., 2005). Most cases of hip osteoarthritis cases, knee osteoarthritis cases and spine osteoarthritis cases involved farmers. In our set up farming is an occupation that is most commonly practiced in our set. Hip and knee osteoarthritis are more prevalent in agricultural workers than other occupational groups, significantly impacting the ability of poor small hoder farmers and farm workers to maintain a livelihood (Kirkhorn *et al*., 2003). Farming in this part of the world is done manually which leads to recurrent joint stress and/or injury to the peasant farmer. This eventually predisposes to degenerative osteoarthritis. It is known that repeated same movement occupational exposure leads to joint destruction and hence degenerative OA. Overall, most patients with OA had been involved in heavy level activities. The physical demands of the respective activity levels therefore puts the people involved at risk of developing OA. The Pearson's correlation between occupation and OA was positive and significant, *p* value 0.05 (Appendix 4). Osteoarthritis was more common in those performing heavy physical activity. This was proved by Chi-Square test that showed a significant coefficient at 0.01.

Multivariate analysis of socio-demographic factors allows for efficient estimation of measures of association while controlling for a number of confounding factors simultaneously.

## 5.2 Clinical characteristics of patients with osteoarthritis

### 5.2.1 Osteoarthritis anatomical distribution

In the present study, the joints most commonly affected were the hip, the knee, spine and ankle. A similar study done in South Africa supports these findings. The highest prevalence of 33.1% for knee osteoarthritis in rural South Africa among patients consulting for Osteoarthritis (95% CI 27.70 to 38.50) was reported among adults aged over 35 years (Usenbo *et al*., 2015), asimilar finding to the present study. In another study done in France, knee osteoarthritis affected over half (59.3%) of the patients. The second most anatomical area involved in men was osteoarthritis of the hip with 35.4% and in women, osteoarthritis of the hand with 42.7%, which also represented the highest rate of bilaterality with 70.9% of women having a bilateral hand osteoarthritis problem (Usenbo *et al.*, 2015). In the present study the percentage of patients with hip osteoarthritis was higher than the findings in Europe probably due to the wide age range that was included and the contribution from septic arthritis that is common in our set up. Also, in our environment, because of HIV/AIDs, there is a higher occurrence of septic arthritis (Louthrenoo, 2008). And septic arthritis has the hip as its favorite site. Also, in the current study both primary and secondary osteoarthritis were included unlike the European studies. Additionally, cases of post traumatic osteoarthritis are higher in our set up and significantly contribute to hip osteoarthritis (Dunet *et al*., 2013). Anyhow, there are different kinds of osteoarthritis in our set up especially of weight bearing joints. But these joints are amenable to arthroplasty. Our set up will therefore need to increase the current number of orthopedic surgeons in both public and private hospitals so as to provide the required orthopedic care for the people with osteoarthritis. Also patients must be made aware of the help that is available to them.

### 5.2.2 Radiological patterns of osteoarthritis

In the present study, most patients presented with advanced stages of osteoarthritis (OA) on the Kallegren-Lawrence scale. A similar research done by Duygu *et al*., (2012) in the Kellgren and Lawrence Index, 34.2% of patients with OA were grade 2, 50.0% were grade 3, and 5.3% had grade 4. In a study done by Ledingham *et al*, 61 per cent of patients had severe OA, 28% moderate OA, and 11% mild athritic changes. Yet in another study done by Hawamdeh and Al-Ajlouni in Jordan, it was found that 13% of patients with OA had mild radiographic changes, 33.6% of patients had moderate radiographic changes and 53% of patients had severe radiographic features. These stages are associated with severe pain, severe joint destruction and joint movement limitation, a clear indication for surgery. But there was no correlation found in the Chi-Square test between the Kellgren and Lawrence grade and the anatomical site OA. Complications encountered in the current study may be attributed to long duration of symptoms and delay in seeking treatment. This means that a majority of the people in the current study were arriving at the clinic with incapacitating osteoarthritis. This may be attributable to the delay in making the correct diagnosis and referring patients in time. Coming late to the hospital is most likely due to the nature of people's health seeking behavior. Some patients have periods of months, even years, in which they are relatively free of trouble and the condition may appear stable for long periods of time. Some of the people wrongly know that nothing can be done after being offered a diagnosis of OA. So, they stay away. During that time osteoarthritic degeneration marches on. Probably most of these patients make many trips to health facilities for their symptoms before a diagnosis of osteoarthritis is made. This may cause a lot of suffering to the patient.

### 5.2.3 Functional limitation

Over half of patients with OA had a long term disability emanating from their condition. In a similar study, 30.7% of patients with OA were unable to do home chores, and 3.6% of the patients were forced to take time off work within six months because of their disability. Some needed to change jobs because of their disability (Maetzel *et al*., 2004). This was seen in patients with long standing hip or knee OA with extensive joint destruction, pain in most days and stiffness with functional limitation sequela. This made most patients incapable of using public transportation, descending downhill, getting out of bed, taking off socks and or stockings, lying in bed, getting in and out of bathroom, sitting, toileting, performing light and heavy domestic duties leading to reduced quality of life in osteoarthritis patients. This meant that patients with OA were unable to do, or always needed help with, one or more core activities. This way osteoarthritis contributed significantly to physical disability of the adult population in the present study. The interruption of one's daily life is an undesirable consequence of osteoarthritis and fear of worsening symptoms can lead to psychological disturbance in the affected individual (AIHW, 2005). With arthroplasty, the disability (and pain) of end-stage osteoarthritis can be eliminated, restoring patients to near normal function.

### 5.2.4 Pain

Most of the patients in this study indicated that they had incapacitating pain due to OA in most days. In a similar research done in Jordan, 16.8% of patients with OA had mild pain, 38.3% had moderate pain, and 44.8% of patients had severe pain (Hawamdeh and Al-Ajlouni, 2013). In the present study, patients experienced pain on walking on flat surfaces, walking up and down stairs, at night, sitting and when lying down, and even when standing

upright. As a result, pain contributed greatly to the morbidity of osteoarthritis. Also pain is known to impact on functional limitation and quality of life in patients with osteoarthritis (Jhun *et al*., 2014). In the present study, women experienced more pain than men probably due to their lower pain threshold intolerance. Patients who were overweight or obese also reported higher incidences of pain, probably due to excess mechanical loading of their joints. This finding is similar to a study done by Cimmino *et al*., who noted a strong relationship between pain and BMI≥30 kg/$m^2$ (odds ratio = 1.52; 95% confidence interval, 1.42 to 1.61) among patients with OA. Pain is only eliminated with ankle fusion or joint replacement surgery. But the majority of patients with osteoathritis in developing countries do not have access to joint replacement surgery, and as a result they endure severe disability for a substantial part of their lives, placing an enormous burden on their communities (Bitton, 2009).

### 5.2.5 Body mass index

In the present study, more than quarter of patients with OA had higher BMI indices. In a similar study done by Hawamdeh and Al-Ajlouni, it was found that patients with mild radiographic OA had an average BMI of 26.29, those with moderate radiographic OA had an average BMI of 29.04 and those with severe radiographic OA had an average BMI of 30.57. Excess body weight increases tremendously the forces transmitted across the weight bearing joints. It has also been known that excess weight contributes to physical disability in patients with osteoarthritis (Batsis *et al*., 2014). It has also been known that obesity is a risk factor for the development of deep sepsis after hip arthroplasty (Dowsey and Choong, 2008). Something an orthopedic surgeon should worry about when planning to do total hip arthroplasty in an obese patient with severe hip osteoarthritis. In the instant study, in the

multivariate analysis of the relationship of OA and higher BMI index, there was a strong Pearson's correlation between body mass index and OA, *p* value 0.01 (Appendix 4). But body mass index is a known modifiable risk factor for OA. Thus maintaining the proper weight or reducing weight through altered diet and increased physical exercise can lower the risk of developing OA and subsequently lower the burden of OA in our set up. Again higher BMI does not explain the occurrence of hand osteoarthritis in obese people (Pottie *et al*., 2006). Because the association between obesity and OA extends beyond weight-bearing joints, this suggests that this link is not solely based on mechanical factors. These findings therefore support the view of a strong metabolic component in the pathogenesis of OA.

### 5.2.6 History of a joint destroying disease

In this study about a quarter of patients with OA had a joint destroying condition prior to the diagnosis of osteoarthritis in that particular joint. A detailed clinical, radiographic and morbid anatomical study of 327 cases of osteoarthritis of the hip was done by Solomon. In all but twenty-seven some predisposing abnormality of the joint was diagnosed: 107 (33%) were associated with major pathology such as Perthes' disease or epiphysiolysis; minor acetabular dysplasia was present in sixty-seven (20%), with a male: female ratio of 1:10; minimal femoral head tilt was demonstrated in fifty-nine (18%), the male: female ratio being 14:1; and septic arthritis 13% (Kelly *et al*., 2015). Abnormalities in the joints lead to loss of articular congreuence and abnormal transmission of forces across the affected joint. These factors when they occur in young people, they lead to degenerative joint disease and hence precocious osteoarthritis, a situation that reduces their productivity and escalates the cost of care. This findings support the hypothesis that osteoarthritis occurs due to a secondary underlying abnormality of the joint.

### 5.2.7 History of congenital condition

In this study, 9.31% of patients with osteoarthritis indicated that they had a congenital joint condition prior to developing OA in the affected joint. This was either dues to developmental hip dysplasias, congenital valgus knee, neglected clubfoot or adductus metatarsus. Congenital anomalies predispose to osteoarthritis by altered biomechanics due to abnormal joint development and alignment that places greater loads across the affected joints than normal. This means joint incongruity or abnormal weight bearing predisposes to early degenerative OA. A study done by Morvan *et al*., established a relationship between OA and hip dysplasia. The prevalence of OA was found to be higher in patients with HD, with significant differences for abnormal acetabular inclination angle [THE] (19.1% vs 11.4%; $p < 0.0001$) and abnormal centre edge [CE] (11.3% vs 7.5%; $p = 0.04$). By logistic regression, only abnormal HTE remained associated with OA. Children with developmental hip dysplasia resulting in a hypoplastic acetabular articulation coupled with a deformed femoral head often develop progressive and severe arthritis of the hip in late adolescence or young adult life (precocious osteoarthritis). In a research done by Hesagawa *et al*., 86 hips with subluxation or dysplasia were studied to determine the natural course of the condition and propose suitable treatment. Thirty-three percent of the joints developed early osteoarthritis within 9.2 years of follow up, while 66% hips developed advanced-stage osteoarthritis within 7.8 years.

### 5.2.8 Osteoarthritis co-morbidities

In the present study, almost half of patients with osteoarthritis had other disease conditions. In a decreasing order, a significant number of patients with OA had hypertension, chronic obstructive airway disease, diabetes mellitus, Asthma, heart failure and others. Similar

studies in America have shown that peptic ulcer disease and renal disease are associated with OA. Close to 40% of patients in the National Health and Nutrition Examination Survey (NHANES) database with OA also have hypertension, compared to a 25% prevalence in the population as a whole. Renal impairment (serum creatinine > 1.5 mg/dL) has been reported in about 37% of individuals with OA compared to 27% of the general population (Singh *et al*., 2002). And in a population of patients with knee osteoarthritis, the most frequently reported co-morbidities were cardiovascular (33%) and gastrointestinal (29%) [Chan *et al*., 2009]. In general practice based studies in Holland showed that chronic conditions such as diabetes, heart disease, and OA often occur together (Schellevis *et al*., 1993). Generally this studies are comparable to the current study except that lifestyle conditions such as hypertension and cardiovascular diseases were way beyond the local findings. This could be due to differences people in the third world and western countries are exposed to. There are more cases of obesity in the west than in a developing country. Peptic ulceration in patients with OA was high in the west while no case was recorded in the present study. This could be attributable to the high rate of NSAID use in the west. As their side effects, NSAIDS cause peptic ulceration. Probably patients with OA in our set up have other ways of allaying pain.

In the multivariate analysis of OA relationship with co-morbididty, there was a strong Pearson's correlation, *p* value 0.01 (Appendix 4). The explanation for specific co-morbidity may lie in shared mechanisms of disease or the impact with which one condition may have on increasing vulnerability to another. Now, an osteoarthritis patient's ability to adhere to lifestyle recommendations may be compromised by a co-morbid condition. For example, an individual with Chronic Obstructive Pulmonary Disease (COPD) or asthma may find achieving an adequate exercise level to lose weight effectively difficult. Also osteoarthritis

patients take medication from different prescribers, a situation that may predispose to polypharmacy and consequent adverse drug interactions. So, patients with OA have other medical conditions that may require careful consideration.

# CHAPTER SIX

# CONCLUSION AND RECOMMENDATIONS

This chapter presents conclusion and recommendation of the results from the data collected and analyzed. The purpose of the study was to characterize osteoarthritis among various patients who were consulting for osteoarthritis in the out-patient clinic at MTRH, Eldoret, Kenya. For a critical understanding of this purpose the following specific objectives were investigated: 1). To establish the socio-demographic characteristics of patients with OA 2). To describe the clinical presentation of patients with OA, and 3). To determine co-morbidities in patients with OA.

Two hundred and ten questionnaires were handed out to respondents and a response rate of 84.3% was returned and used for data analysis.

## 6.1 Conclusion

On the basis of the objectives, findings and discussions, the following conclusions were drawn from the study:

1. Advancing age, female gender, cigarette smoking, alcohol consumption, positive family history of osteoarthritis, and involvement in heavy level of activity are significant socio-demographic features seen in patients with osteoarthritis in our setup.
2. The salient clinical characteristics seen in patients with osteoarthritis were severe pain, high grade joint destruction, functional limitation, many years lived with osteoarthritis, and higher BMI index.

3. Patients with OA present with other medical conditions that deserve attention

### 6.2 Recommendations

Based on the findings and conclusions from the study, the researcher came up with the following recommendations:

1. Spread awareness about OA, its prevention and rehabilitation. This will reduce the impact of OA in our set up.
2. Conservative management options like exercises, physiotherapy and reduction of weight should be implemented in peripheral facilities to deal with complications of OA. The county governments should also subside the cost of arthroplasty in order to reduce the burden of OA in communities.
3. To achieve better outcomes, osteoarthritis patients need multidisciplinary approach in their management.

### 6.3 Recommendation for further research

There is need for population based further research to determine the true impact of osteoarthritis in our set up.

## REFERRENCES


Akinpelu A.O, Alonge T.O, Adekanla B.A, Odole A.C. (2009). Prevalence and pattern of symptomatic knee osteoarthritis in Nigeria: a community based study. *The Internet Journal of Allied Health Sciences and Practice;* 7: 1–7.

Amin S, Niu J, Guermazi A, Grigoryan M, Hunter D, Clancy M, (2007). Cigarette Smoking And The Risk for Cartilage loss and Knee Pain In Men With Knee Osteoarthritis, *Annals of Rheumatoid Diseases*. Jan; 66(1): 18–22.

Anne Lübbeke, Davide Salvo, Richard Stern, Pierre Hoffmeyer, Nicolas Holzer (2012). Risk factors for post-traumatic osteoarthritis of the ankle: an eighteen year follow-up study. *International Journal of Orthopedics*. Jul; 36(7): 1403–1410

Arden N, and Nevitt M.C (2006). Osteoarthritis: epidemiology. *Best Practice and Research Clinical Rheumatology*. 20:3-25.

Batsis J.A, Zbehlik A.J, Barre L.K, Mackenzie T.A, Bartels S.J. (2014). The impact of waist circumference on function and physical activity in older adults: longitu-dinal observational data from the osteoarthritis initiative. *Journal of Parenteral and Enteral* Nutrition.; 13:81

Becker, Michael A. (2005). *Arthritis and Allied Conditions: A textbook of Rheumatology edition 15*. Rhode Island; Lippincot Williams and Wilkins.

Bitton R. (2009). "The Economic Burden of Osteoarthritis." *American Journal of Managed Care* 15(8): S230-S235.

Blagojevic M, Jinks C, Jeffery A, Jordan K.P. (2010). Risk factors for onset of osteoarthritis of the knee in older adults: a systematic review and meta-analysis. *Osteoarthritis and cartilage*; 18:24-33.

Bohensky M, Barker A, Morello R, De Steiger R.N, Gorelik A, Brand C. (2014). Geographical variation in incidence of knee arthroscopy for patients with osteoarthritis: a population-based analysis of Victorian hospital separations data. *Internal Medicine Journal*. Jun; 44(6):537-45.

Buckwalter JA1, Martin J.A.: (2004) Sports and osteoarthritis, *Current Opinion in Rheumatology*.; 16(5):634-9. Lippincott Williams and Wilkins

Carpenter, CR; Schuur, J.D; Everett, W.W; Pines, J.M. (2011). "Evidence-based diagnostics: adult septic arthritis.". *Academic Emergency Medicine* 18 (8): 781–96.

Chan K, Ngai H, Ip K, Lam K, Lai W. (2009). Co-morbidities of patients with knee osteoarthritis. *Hong Kong Medical Journal.*;15:168-172.

Chan Kim, Michael C Nevitt, Jingbo Niu, Mary M Clancy, Nancy E Lane, Thomas M Link, Steven Vlad. (2015). Association of hip pain with radiographic evidence of hip osteoarthritis: diagnostic test study. *British Medical Journal*;351:598

Christopher B.D. (2007). Septic arthritis in Western and sub – Saharan African Children – a review. *International Journal of Orthopedics*; 31(2):137–144.

Chronic rheumatic conditions" Fact Sheet. World Health Organization. http://www.who.int/chp/topics/rheumatic/en/. Accessed September 2008.

Cimmino MA, Sarzi-Puttini P, Scarpa R, Caporali R, Parazzini F, Zaninelli A, Marcolongo R. (2005). Clinical presentation of osteoarthritis in general practice: determinants of pain in Italian patients in the AMICA study. *Seminars in Arthritis and Rheumatism - Journal;* 35(Suppl 1):17-23

Coggon, D., Reading, I., Croft, P., McLaren, M., Barrett, D., and Cooper, C. (2001) Knee osteoarthritis and obesity. 'Focusing osteoarthritis management on modifiable risk factors and future therapeutic prospects' *Therapeutic Advances* in *Musculoskeletal Disease* 1(1) 35:47 full text accessed at http://tab.sagepub.com/cgi/reprint/1/1/35 accessed January 2015

Coleman S, Briffa K, Conroy H, Prince R, Carroll G, McQuade J. (2008). 'Short and medium-term effects of an education self-management program for individuals with osteoarthritis of the knee, designed and delivered by health professionals: a quality assurance study'. *Biomedical Central Musculoskeletal Disorders Journal*; 8(9):117.

Creamer P, and Hochberg M.C. (1997). Why does osteoarthritis of the knee hurt--sometimes? British Journal of Rheumatology. Jul;36(7):726-8.

Dinesh Bhatia, Tatiana Bejarano, and Mario Novo (2013). Current interventions in the management of knee osteoarthritis, *Journal of Pharmacy and Bioallied Sciences*. 5(1): 30–38.

Dowsey M. and Choong P. (2008). Obesity a Major Risk Factor for Prosthetic Infection after Primary Hip Arthroplasty, *Clinical Orthopaedics and Related Research Journal*, 466(1):153-8 ·

Duncan R, Francis R.M, Collerton J, and Jagger C. (2011). Prevalence of arthritis and joint pain in the oldest old: findings from the Newcastle 85+ study. *Age and Ageing Journal*; 40:752-5.

Dunet B., Tournier C., Billaud A., Lavoinne N., Fabre T., Durandeau A. (2013). Acetabular fracture: Long-term follow-up and factors associated with secondary implantation of total hip arthroplasty. *Orthopaedics and Traumatology: Surgery and Research*, 99(3); 281-290.

El Miedany, Y.M., Mehanna A. N and El Baddini M. A (2000). Altered bone mineral metabolism in patients with osteoarthritis, *Joint, Bone and Spine Journal*; 67 : 521-7

Evangelou E, Chapman K, Meulenbelt I, Karassa F.B, Loughlin J, Carr A and Loughlin J. (2009). Large-scale analysis of association between GDF5 and FRZB variants and osteoarthritis of the hip, knee, and hand. *Arthritis and Rheumatism Journal*;60:1710.

Felson D.T. (2011). Risk factors for osteoarthritis: understanding joint vulnerability. Clinical orthopaedics and related research ;(427 Suppl):S16–21 Following Intraarticular Fractures, *Iowa Orthopedics Journal*. ;31:1-20

Franklin J, Ingvarsson T, and Englund M, (2010); Association between occupation and knee and hip replacement due to osteoarthritis: a case-control study, *Arthritis Research and Therapy*.; 12(3): R102

Gay, L.R. (1996). Educational research: *Competencies for analysis and application*. New Jersey: Prentice Hall.

Gelber, A.C. et al. (2000). Joint Injury in Young Adults and Risk for Subsequent Knee and Hip Osteoarthritis. *Annals of Internal Medicine*;133:321-328.

Glyn-Jones, S; Palmer, A. J; Agricola, R; Price, A. J; Vincent, T. L; Weinans, H; Carr, AJ (2015). "Osteoarthritis.". *Lancet* 386: 376–87.

Hasegawa Y, Iwata H, Mizuno M, Genda E, Sato S, Miura T. (1992). The natural course of osteoarthritis of the hip due to subluxation or acetabular dysplasia. *Archives of Orthopaedic and Trauma Surgery*;111(4):187-91.

Hawamdeh Z. M. and Al-Ajlouni J. M. (2013). The Clinical Pattern of Knee Osteoarthritis in Jordan: A Hospital Based Study *Int J Med Sci* ; 10(6):790-795.

Heiden, T.L., Lloyd D.G., and Ackland T.R, (2009). Knee extension and flexion weakness in people with knee osteoarthritis: is antagonist cocontraction a factor? *Journal of orthopaedic and sports physical therapy*.39(11): p. 807-15.

Hermans J, Koopmanschap M.A, Bierma-Zeinstra S.M, van Linge J.H, Verhaar J.A, and Reijman M, (2012). Productivity costs and medical costs among working patients with knee osteoarthritis. *Arthritis Care Research*;64(6):853-61.

Hirano P. C, Laurent D. D, Lorig K. (1994). Arthritis patient education studies, 1987-1991: a review of the literature. *Patient Education and Counseling Journal*. Aug;24(1):9-54

Hunter D. (2007) 'In the Clinic:Osteoarthritis' Annals of Internal Medicine 47:ITC8-2

Iannone F and Lapadula G. (2003). The pathophysiology of osteoarthritis. *Aging Clinical and Experimental Research.* Oct;15(5):364-72.

Jensen L. K, Mikkelsin S, Loft I. P, Eenberg W, Bergmann I, Logager V. (2000). Radiographic knee osteoarthritis in floor layers and carpenters. *Scandinavian Journal of Work, Environment and Health*. Jun;26(3):257-62

Jhun H.J, Sung N.J, Kim S.Y. (2013). Knee pain and its severity in elderly Koreans: prevalence, risk factors and impact on quality of life. *Journal of Korean Medicine and Science*.;28(12):1807-13.

Kawano M.M, Araújo I.L.A, Castro M.C, Matos M.A. (2015). Assessment of quality of life in patients with knee osteoarthritis. *Actaortop.bras*. 23(6), Nov./Dec. 2015; 1413-78

Keefe F.J, Blumenthal J, Baucom D, Affleck G, Waugh R, Caldwell D.S, Beaupre P, Kashikar-Zuck S, Wright K, Egert J, and Lefebvre J.(2004). Effects of spouse-assisted coping skills training and exercise training in patients with osteoarthritic knee pain: a randomized controlled study. *Pain*, 110:539-549.

Kelly L. Adler, Christopher Cook,Yi-Meng Yen, Brian D. Giordano,(2015). Current Concepts in Hip Preservation Surgery. Sports Health: A Multidisciplinary Approach, November/December 7( 6) 518-526.

Kim C, Linsenmeyer K. D, Vlad S. C, et al.(2014). Prevalence of radiographic and symptomatic hip osteoarthritis in an urban United States community: the Framingham osteoarthritis study. Arthritis Rheumatol;66:3013-7.

Kim, H. K. (2012). Pathophysiology and new strategies for the treatment of Legg-Calve-Perthes disease. *Journal of Bone and Joint Surgery*, 94(7); 659-69.

Kirkhorn S, Greenlee RT, Reeser JC. (2003).The epidemiology of agriculture-related osteoarthritis and its impact on occupational disability. *Wisconsin Medical Journal*.;102(7):38-44.

Klubmann A, Gebhardt H, Liebers F, von Engelhardt L. V, Dávid A, Bouillon B, Rieger MA.(2008) Individual and occupational risk factors for knee osteoarthritis - Study protocol of a case control study. *Musculoskeletal Disorders Journal*;9:26.

Kothari C. R. (2004). *Research methodology: Methods and techniques* (2nd ed.). India: New Age International publishers.

Ledingham J, Dawson S, Preston B, Milligan G, and Doherty M. (1992). Radiographic patterns and associations of osteoarthritis of the hip. *Annals of Rheumatology Disorders*. Oct; 51(10): 1111–1116.

Lievense A, Bierma-Zeinstra S, and Verhagen A,(2001) 'Influence of work on the development of osteoarthritis of the hip: a systematic review' *Journal of Rheumatology*;28:2520–2528

Loeser R. F., (2010). Age Related Changes in the Musculoskeletal System and the Development of Osteoarthritis, *Clinics in Geriatric Medicine*. Aug; 26(3): 371–386.

Louthrenoo, W. (2008). Rheumatic Manifestations of Human Immunodeficiency Virus Infection. *Current Opinion in Rheumatology*, 20, 92-99.

Maetzel A, Li L. C, Pencharz J, Tomlinson G, Bombardier C, (2004). The Community Hypertension and Arthritis Project Study Team. "The economic burden associated with osteoarthritis, rheumatoid arthritis, and hypertension: a comparative study." *Annals of Rheumatic Disorders*; 63:395-401.

Majithia V, Geraci SA (2007). "Rheumatoid arthritis: diagnosis and management". *American Medical Journal* 120 (11): 936–9.

Maneix L, Beauchef G, Servent A, Wegrowski Y, Maquart FX, Boujrad N, et al. (2008). Beta-oestradiol up-regulates the expression of a functional UDP-glucose dehydrogenase in articular chondrocytes: comparison with effects of cytokines and growth factors. *Rheumatology*; 47:281-8.

McAlindon T. E, Kellingray S, Stuart B, Coggon D, and Dieppe P. A. (2000). Risk factors for the incidence and progression of radiographic knee osteoarthritis. *Arthritis and Rheumatology*. May;43(5):995-1000

McMillan G, Nichols L.(2005). Osteoarthritis and meniscus disorders of the knee as occupational diseases of miners. *Occupational and Environmental Medicine*;62(8):567.

McWilliams D. F, Doherty S, Maciewicz R. A, Muir K. R, Zhang W. Y, Doherty M. (2010). Self-reported knee and foot alignments in early adult life and risk of osteoarthritis. *Arthritis Care Research*; 62(4):489.

Morvan J., Bouttier R, Mazieres B, Verrouil E, Pouchot J, Rat AC, and Guellec D. (2013). Relationship between hip dysplasia, pain, and osteoarthritis in a cohort of patients with hip symptoms. *Journal of Rheumatolology*.40(9):1583-9.

Mue D. D, Salihu M. N, Awonusi F. O, Yongu W. T, Kortor J. N, and Elachi I. C.(2013) The Epidemiology And Outcome Of Acute Septic Arthritis: A Hospital Based Study. *Journal of West African College of Surgeons*. 3(1): 40–52.

Murphy L, Schwartz TA, Helmick CG, et al. (2008). Lifetime risk of symptomatic knee osteoarthritis. *Arthritis and Rheumatology.* 59(9):1207-1213.

Nelson A. E, Golightly Y. M, Renner J. B, Schwartz T. A, Kraus V. B, Helmick C. G, Jordan J. M. (2013). Brief Report: Differences in multijoint symptomatic osteoarthritis phenotypes by race and sex: The Johnston County Osteoarthritis Project. *Arthritis and Rheumatism*; 65(2):373-377.

Nonnenmann M. W, Anton D. C, Gerr F, Yack H. J. (2010). Dairy farm worker exposure to awkward knee posture during milking and feeding tasks. *Journal of Occupation Environment and Hygien*; 7(8):483-485.

Novais, Eduardo N.; Millis, Michael B. (December 2012). "Slipped Capital Femoral Epiphysis: Prevalence, Pathogenesis, and Natural History". *Clinical Orthopaedics and Related Research* 470 (12): 3432–3438

Nüesch E, Dieppe P, Reichenbach S, Williams S, Iff S, and Jüni P,(2011). All cause and disease specific mortality in patients with knee or hip osteoarthritis: population based cohort study. *British Medical Journal*; 342: d1165.

Odero W, Khayesi M, Heda PM. (200). Road traffic injuries in Kenya: magnitude, causes and status of intervention. *International journal of injury control and safety promotion* 10(1-2):53-61.

Odero W. (1995). Road Traffic Accidents in Kenya: An Epidemiological Appraisal. *East Afran Medical Journal.* 72(5):299-305.

Oniankitan, O., Bagayogo, Y., Fianyo, E., Koffi-Tessio, V., Kakpovi, K., Tagbor, K.C., Houzou, P. and Mijiyawa, M. (2011) Infectious Arthritis in Hospital Patients in Lomé, Togo. *Médecine Tropicale*: *Revue du Corps de Santé Colonial*,71, 61-62.

Pandya N. K, Draganich L. F, Manuer A, Piotrowski G. A, Potter L: (2005). Osteoarthritis of the knees increases the propensity to trip on an obstacle. *Clinical Orthopedics and Related Research*, 431:150-6.

Peck, D. (2010). "Slipped capital femoral epiphysis: Diagnosis and management". *American family physician* 82 (3): 258–262.

Pelletier J, Raynauld J, Berthiaume M, Abram F, Choquette D, and Haraoui B, (2007). Risk factors associated with the loss of cartilage volume on weight bearing areas in knee osteoarthritis patient assessed by quantitative magnetic resonance imaging: a longitudinal study. *Arthritis Research and Therapy*; 9:R74.

Peltola H, Pääkkönen M, Kallio M. J, Kallio P. E. (May 2009). "Prospective, randomized trial of 10 days versus 30 days of antimicrobial treatment, including a short-term course of parenteral therapy, for childhood septic arthritis."*Clinical Infectious Disease Journal*. 48 (9): 1201–10.

Pottie P, Presle N, Terlain B, Netter P, Mainard D, Berenbaum F. (2006). Obesity and osteoarthritis: more complex than predicted! *Annals of Rheumatic Disorders*; 65:1403–1405.

Rahman N, Penm E and Bhatia K (2005). *Arthritis and musculoskeletal conditions in Australia*. Australian Institute of Health and Welfare. Arthritis series no. 1. Cat. no. PHE 67. Canberra: AIHW.

Ringdahl E, and Pandit S. (2011). Treatment of knee osteoarthritis. *American Family Physician.* 83:1287–92

Rosemann Thomas, Laux Gaunter and Kuehlein Thomas. (2007). Osteoarthritis and functional disability: results of a cross sectional study among primary care patients in Germany. *Musculoskeletal Disorders*, August; 8:79

Rossignol M, Helmick C. G, Jordan J. M, and Kington R. S (2005). Primary Osteoarthritis of hip, knee and hand in relationship to occupational exposure, *Ocupation and Environment Medicine*; 62:772-777.

Saito T. Fukai A, Mabuchi A, Ikeda T, Yano F, Ohba S, Nishida N, and Akune T, (2010). Transcriptional regulation of endochondral ossification by HIF-2$\alpha$ during skeletal growth and osteoarthritis development. *Natural Medicine Journal* Jun; 16:678.

Salve H, Gupta V, Palanivel C, Yadav K, Singh B. (2010). Prevalence of knee osteoarthritis amongst perimenopausal women in an urban resettlement colony in south Delhi. *Indian Journal of Public Health*; 54:155–7.

Schellevis F. G, Van der Velden J, Van de Lisdonk E, van Eijk J. T, van Weel C. (1993). Comorbidity of chronic diseases in general practice. Journal of Clinical Epidemiology; 46:469–73.

Scott, D., (2009) 'Osteoarthritis' in *British Medical Journal Clinical Evidence* accessed at http://clinicalevidence.bmj.com/ceweb/conditions/msd/1122/1122_background.jsp January 2015

Singh G, Miller J, Lee F, Pettitt D, Russell M. (2002). Prevalence of cardiovascular disease risk factors among US adults with self-reported osteoarthritis: data from the Third National Health and Nutrition Examination Survey. *American Journal of Managed Care*; 8:S383-S391.

Slemenda C, Brandt K. D, Heilman D. K, Mazzuca S, Braunstein E. M, Katz B. P, Wolinsky F. D. (1997). Quadriceps weakness and osteoarthritis of the knee. *Annals of Internal Medicine*. Jul 15;127(2):97-104.

Snijders G. F, den Broeder A. A, van Riel PLCM, Straten V. H. H. P, de Man F. H. R, van den Hoogen F. H. J, van den Ende C. H. M, (2011). Evidence-based tailored conservative treatment of knee and hip osteoarthritis: between knowing and doing. *Scandinavian Journal of Rheumatology.*; 40:225-31

Solomon L.(1976). Patterns of osteoarthritis of the hip. Journal of Bone and Joint Surgery; 58(2):176-83.

Symmons D, Mathers C, Pfleger B. The Global Burden of Osteoarthritis.(2000) WHO Report 2006. Available: http://www.who.int/healthinfo/statistics/bod_osteoarthritis.pdf. Accessed 2015 December 19.

Takayama K, Ishida K, Matsushita T, Fujita N, Hayashi S, Sasaki K, et al. (2009). SIRT1 regulation of apoptosis of human chondrocytes. *Arthritis and Rheumatology;* 60(9):2731e40.

Thomas E, Peat G, Harris L, Wilkie R, Croft PR. (2004). The prevalence of pain and pain interference in a general population of older adults: cross-sectional findings from the North Staffordshire Osteoarthritis Project; *Bone and Joint Disease Journal*; 110(1-2):361-8.

Thompson L. R, Boudreau R, Hannon M, and Newman A (2010): The association of osteoarthritis risk factors with localized, regional and diffuse knee pain, *Osteoarthritis and Cartilage Journal*, 18(10); 1244–1249.

Torres L., Dunlop D. D., Peterfy C., (2015). "The relationship between specific tissue lesions and pain severity in persons with knee osteoarthritis," *Osteoarthritis and Cartilage*, 14(10), 1033–1040.

Usenbo A, Kramer V, Young T, Musekiwa A (2015) Prevalence of Arthritis in Africa: A Systematic Review and Meta-Analysis. *PLoS ONE* 10(8): e0133858. doi:10.1371/journal.pone.0133858 [1].

Vaes R. B, Rivadeneira F, Kerkhof J. M, Hofman A, Pols H. A, and Uitterlinden A. G,(2009). Genetic variation in the GDF5 region is associated with osteoarthritis, height, hip axis length and fracture risk: the Rotterdam study. *Annals of Rheumatology Disorders*; 68: 1754.

Valdes A. M, Spector T. D, Tamm A, Kisand K, Doherty S. A, and Dennison E. M,(2010). Genetic variation in the SMAD3 gene is associated with hip and knee osteoarthritis. *Arthritis and Rheumatism Journal*; 62:23-47.

van Dijk GM, Veenhof C, Lankhorst GJ, and Dekker J. (2009). Limitations in activities in patients with osteoarthritis of the hip or knee: the relationship with body functions, comorbidity and cognitive functioning. *Disability Rehabilitation Journal*; 31(20):1685-91.

Warman ML, Cormier-Daire V, Hall C, Krakow D, Lacman R, and LeMerrer M, (2011). Nosology and classification of genetic skeletal disorders: 2010 revision. *American Journal of Medical Genetics*; 155A:943e68.

Weiler, H. T, Pap G, and Awiszus F. (200). The Role of Joint Afferents in Sensory Processing in Osteoarthritic Knees, *Rheumatology*; 39:850-856

WHO (2009). *Exercise and Physical Activity Guide for Health Promotion. Framework for Accelerating the Communication of Physical Activity Guidelines*. Tokyo, Ministry of Health.

WHO(2015) The Burden of Musculoskeletal Conditions at the Start of the New Millenium: Report of a WHO Scientific Group-Geneva. Available: http://whqlibdoc.who.int/trs/WHO_TRS_919.pdf. Accessed 2015 October 30.

Wilder F. V, Hall B. J, Barrett J. P Jr, Lemrow N. B. (2002). History of acute knee injury and osteoarthritis of the knee: a prospective epidemiological assessment. The Clear water Osteoarthritis Study. *Osteoarthritis Cartilage*; 10:611–616

Wilder FV, Hall BJ, Barrett JP. (2003). Smoking and osteoarthritis: is there an association? The Clearwater Osteoarthritis Study. Osteoarthritis Cartilage;11(1):29-35.

Wollenhaupt, J. and Zeidler, H. (1998). "Undifferentiated arthritis and reactive arthritis". *Current opinion in rheumatology* 10 (4): 306–313.

Wu Z, Schimmele C. M, Chappell N. L. (2012). Aging and late-life depression. *Journal of Aging and Health*; 24(1):3e28.

Yang S., Ryu J. H and Oh H. (2010). Hypoxia-inducible factor-2$\alpha$ is a catabolic regulator of osteoarthritic cartilage destruction. *Natural Medicine* Jun; 16:687.

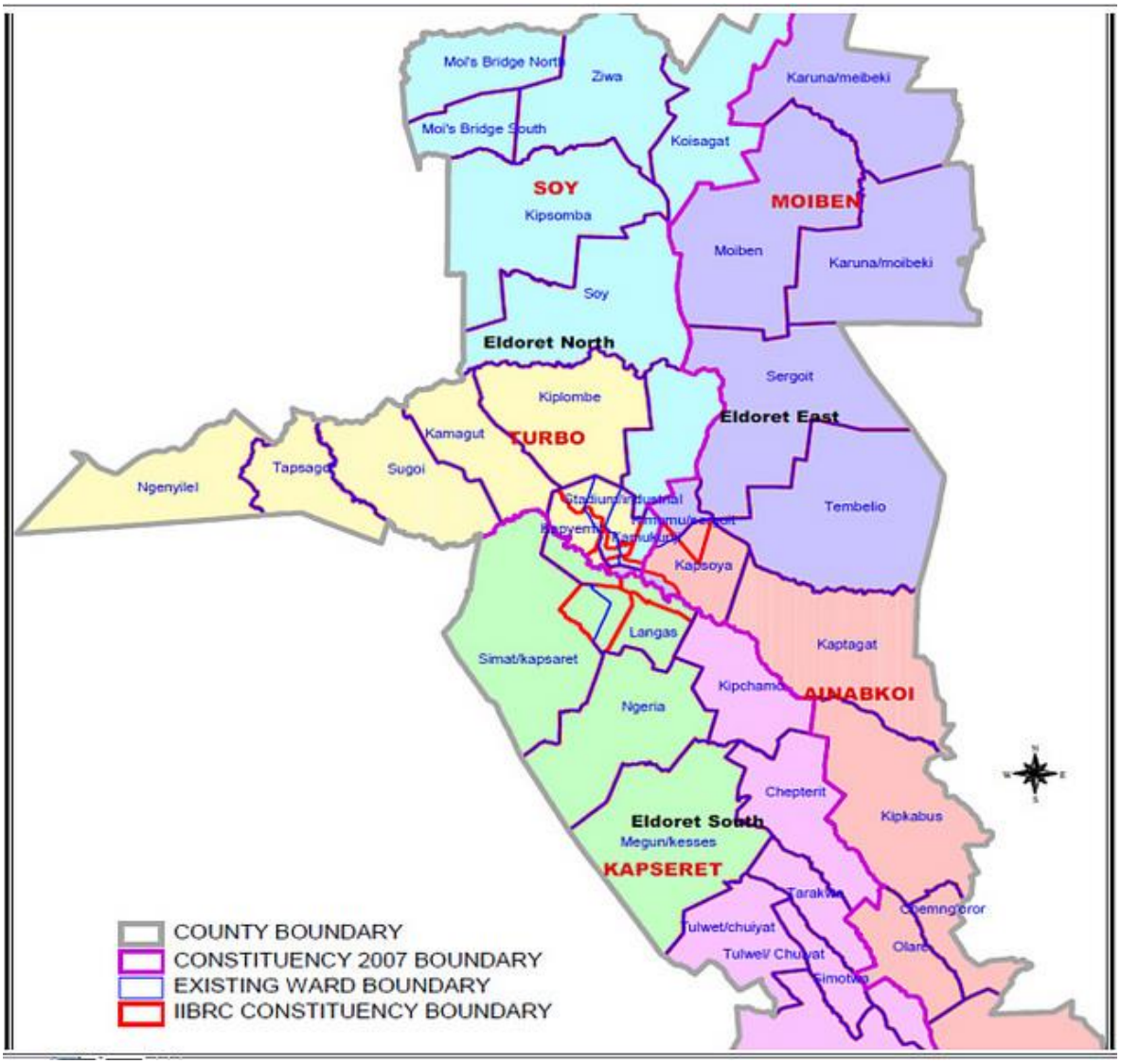
Yoshimura N, Muraki S, Oka H, and Mabuchi A, (2009). Prevalence of knee osteoarthritis, lumbar spondylosis, and osteoporosis in Japanese men and women: the research on osteoarthritis/osteoporosis against disability study. *Journal of Bone and Mineral Metabolism*. 27(5); 620–628

Zhang W, Moskowitz R. W, Nuki G, Abramson S, Altman R. D, Arden N, *et al* (2008). OARSI recommendations for the management of hip and knee osteoarthritis, Part II: OARSI evidence based, expert consensus guidelines. *Osteoarthritis Cartilage*,16: 137.

Zhang Y, and Jordan J. M (2010). Epidemiology of osteoarthritis. *Clinics in Geriatric Medicine*; 26:355-69.

# APPENDICES

**Appendix 1**. Map of Uasin Gishu County showing the location of Eldoret, the study area



**Appendix 2.** Introductory letter and consent to participant

You are being asked to take part in a study. The study aims at finding out the joints in our bodies that are most frequently affected by osteoarthritis, the clinical characteristics associated with the condition and the socio-demographic factors that are associated with osteoarthritis in our set up. The findings from this study will go a long way in improving community health and social development by increasing knowledge about osteoarthritis and ultimately mitigating its burden. Your participation in this study will therefore help us determine the current situation and the existing gaps, what may consequently trigger interventional programs. Your involvement is voluntary and you can pull out at any point of the study even after consenting. We shall value every piece of information we are going to get from you and keep it confidential. Thank you for finding time to contribute to humanity.

**Signature of consenting**

……

**Date**

**……**

**Appendix 3.** Questionnaire

This research seeks to characterize osteoarthritis and describe its clinical and socio-demographic associations in your community. The data elicited will inform health policies that will in turn be of benefit to your community and humanity.

Joint with osteoarthritis

- Ankle
- Knee
- Hip
- Spine
- Shoulder
- Elbow
- Hand
- Foot

Age…….

Sex

- male
- female

If female, history of hysterectomy

- yes
- no

Level of education

- none
- primary
- secondary
- college

Marital status

- married
- single
- separated/divorced/windowed

Alcohol consumption

- Yes
- No

Smoking

- yes
- no

Number of sticks per day……..

Years smoked……

Occupation……

Light intensity activity

- Standing
- Ironing
- Leisurely walking.

Moderate activity

- Lifting or carrying light objects (11kg)
- Scouring floors
- Fast walking. Walking briskly (3 miles per hour or faster, but not race-walking)
- Water aerobics

- Bicycling slower than 10 miles per hour
- Tennis (doubles)
- Ballroom dancing
- General gardening

Heavy activities

- Lifting or carrying heavy objects,
- Working at a quarry
- Tilling land with heavy tools
- Shoveling
- Carpentry,
- mechanics
- Race walking, jogging, or running
- Swimming laps
- Tennis (singles)
- Aerobic dancing
- Bicycling 10 miles per hour or faster
- Jumping rope
- Heavy gardening (continuous digging or hoeing)
- Hiking uphill or with a heavy backpack
- Splitting firewood, brisk cycling, and other strenuous sports

Family history of Osteoarthritis

- Yes
- No

Kallegren and Lawrence score

- II
- III
- IV

Physical function disability

| **Physical Function** | **Likert score disability** | | | | |
|---|---|---|---|---|---|
| Stair use/going up and down a hill | 0 | 1 | 2 | 3 | 4 |
| Rising from sitting | 0 | 1 | 2 | 3 | 4 |
| Standing | 0 | 1 | 2 | 3 | 4 |
| Bending | 0 | 1 | 2 | 3 | 4 |
| Walking | 0 | 1 | 2 | 3 | 4 |
| Getting in / out of a vehicle | 0 | 1 | 2 | 3 | 4 |
| Shopping | 0 | 1 | 2 | 3 | 4 |
| Putting on / taking off shoes | 0 | 1 | 2 | 3 | 4 |
| Rising from bed | 0 | 1 | 2 | 3 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| Lying in bed | 0 | 1 | 2 | 3 | 4 |
| Bathing | 0 | 1 | 2 | 3 | 4 |
| Sitting | 0 | 1 | 2 | 3 | 4 |
| Getting on / off toilet or latrine | 0 | 1 | 2 | 3 | 4 |
| Heavy household duties | 0 | 1 | 2 | 3 | 4 |
| Light household duties | 0 | 1 | 2 | 3 | 4 |
| **Total score** | | | | | |

| **Parameter** | **Pain score on Likert scale** | | | | |
|---|---|---|---|---|---|
| Walking on flat surface | **0** | **1** | **2** | **3** | **4** |
| Going up/down stairs/hill | **0** | **1** | **2** | **3** | **4** |
| At night | **0** | **1** | **2** | **3** | **4** |
| Sitting/lyingdown | **0** | **1** | **2** | **3** | **4** |
| Standing upright | **0** | **1** | **2** | **3** | **4** |
| **Total score** | | | | | |

**Likert scale**: None (0), Mild (1), Moderate (2), Severe (3), and Extreme (4).

Medical history of a joint destroying disease

- Perthes disease
- Slipped upper femoral epiphysis
- Septic arthritis
- Gout

Co-morbidity

……..

Congenital defect……..

WEIGHT……Kg

HEIGHT…….cm

BMI……..

**Appendix 4** Bivariate and multivariate relationships of OA

| Variables | | Age | Sex | Ethnicity | Residence | Occupation | History Of Joint Injury | If Yes Type Of Sport | Participation In Sport | History Of Joint Surgery | Family History Of Osteoarthritis | Body Mass Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | Pearson Correlation | 1 | 0.2 | -0.09 | 0.03 | -0.28 | 0.4 | 0.3 | 0.31 | 0.2 | -0.33 | 0.2 |
| | Sig (2-tailed) | | **0.01** | 0.21 | 0.74 | 0 | 0 | 0 | 0 | **0.01** | 0 | **0.01** |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Sex | Pearson Correlation | 0.2 | 1 | -0.03 | -0.04 | 0.11 | 0.15 | 0.257 | 0.29 | 0.06 | -0.15 | 0.09 |
| | Sig. (2-tailed) | **0.01** | | 0.67 | 0.64 | 0.14 | 0.04 | 0.001 | 0 | 0.44 | **0.05** | 0.24 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Ethnicity | Pearson Correlation | -0.1 | -0.03 | 1 | 0.54 | 0.09 | -0.05 | 0.04 | 0.04 | -0.07 | -0.08 | 0.09 |
| | Sig. (2-tailed) | 0.21 | 0.67 | | 0 | 0.22 | 0.53 | 0.61 | 0.6 | 0.38 | 0.28 | 0.24 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Area Of Residence | Pearson Correlation | 0.03 | -0.04 | 0.54 | 1 | 0.1 | 0.11 | 0.11 | 0.1 | 0.11 | -0.07 | -0.01 |
| | Sig. (2-tailed) | 0.74 | 0.64 | 0 | | 0.18 | 0.14 | 0.16 | 0.18 | 0.15 | 0.38 | 0.87 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Occupation | Pearson Corre | -0.3 | 0.11 | 0.09 | 0.1 | 1 | -0.16 | -0.04 | -0.03 | -0.15 | 0.09 | 0.04 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | latio n | | | | | | | | | | | |
| | Sig. (2-taile d) | 0 | 0.14 | 0.22 | 0.18 | | 0.04 | 0.58 | 0.66 | **0.05** | 0.26 | 0.56 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| History Of Joint Injury | Pearson Correlation | 0.4 | 0.15 | -0.05 | 0.11 | -0.16 | 1 | 0.35 | 0.38 | 0.27 | -0.12 | 0.06 |
| | Sig. (2-taile d) | 0 | 0.04 | 0.53 | 0.14 | 0.04 | | 0 | 0 | 0 | 0.11 | 0.39 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| If Yes Type Of Sport | Pearson Correlation | 0.3 | 0.26 | 0.04 | 0.11 | -0.04 | 0.35 | 1 | 0.83 | 0.1 | -0.13 | 0.05 |
| | Sig. (2-taile d) | 0 | 0 | 0.61 | 0.16 | 0.58 | 0 | | 0 | 0.17 | 0.09 | 0.47 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Particip ation In Sport | Pearson Correlation | 0.31 | 0.29 | 0.04 | 0.1 | -0.03 | 0.38 | 0.83 | 1 | 0.14 | -0.09 | 0.04 |
| | Sig. (2-taile d) | 0 | 0 | 0.6 | 0.18 | 0.66 | 0 | 0 | | 0.06 | 0.22 | 0.61 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| History Of Joint Surgery | Pearson Correlation | 0.2 | 0.06 | -0.07 | 0.11 | -0.15 | 0.27 | 0.1 | 0.14 | 1 | -0.1 | 0.04 |
| | Sig. (2-taile d) | **0.01** | 0.44 | 0.38 | 0.15 | **0.05** | 0 | 0.17 | 0.06 | | 0.17 | 0.58 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Family History Of Osteoar thritis | Pearson Correlation | -0.3 | -0.15 | -0.08 | -0.07 | 0.09 | -0.12 | -0.13 | -0.09 | -0.1 | 1 | -0.15 |
| | Sig. (2- | 0 | **0.05** | 0.28 | 0.38 | 0.26 | 0.11 | 0.09 | 0.22 | 0.17 | | 0.04 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | tailed) | | | | | | | | | | | |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Body Mass Index | Pearson Correlation | 0.2 | 0.09 | 0.09 | -0.01 | 0.04 | 0.06 | 0.05 | 0.04 | 0.04 | -0.15 | 1 |
| | Sig. (2-tailed) | **0.01** | 0.24 | 0.24 | 0.87 | 0.56 | 0.39 | 0.47 | 0.61 | 0.58 | 0.04 | |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Co Morbidity | Pearson Correlation | -0.4 | -0.05 | 0.06 | 0.04 | 0.19 | -0.24 | -0.1 | -0.14 | -0.12 | 0.1 | -0.16 |
| | Sig. (2-tailed) | 0 | 0.54 | 0.39 | 0.58 | **0.01** | 0 | 0.17 | 0.06 | 0.13 | 0.2 | 0.03 |
| | N | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |

**Source: Survey 2015**

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed).