KNOWLEDGE, HEALTH BELIEFS AND ATTITUDES OF OSTEOPOROSIS IN WOMEN AGED 18-52 YEARS AT GATUNDU LEVEL IV AND THIKA LEVEL V HOSPITALS, KIAMBU COUNTY

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Knowledge, Health Beliefs, and Attitudes of Osteoporosis in Women Aged 18-52 Years at Gatundu Level IV and Thika Level V Hospitals, Kiambu County

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DECLARATION

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

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DEDICATION

This research work is, first and foremost, dedicated to the Almighty God for His sufficient grace that enabled me to accomplish this task. Secondly, I dedicate this thesis to my beloved wife, daughter, parents, other family members, and friends whose financial, social, moral, and spiritual support immensely contributed to successful achievement of this noble task. It is my desire to make you proud of your tireless support.

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ACRONYMS AND ABBREVIATIONS

BM	Bone mass
BMD	Bone mineral density
BMI	Body Mass Index
BPs	Bisphosphonates
CI	Confidence interval
CPHR	Centre of Public Health and Research
DEXA	Dual Energy X-ray Absorptiometry
DVO	Dachverband Osteologie
ERC	Ethical Research Committee
ERT	Estrogen replacement therapy
GL4	Gatundu Level four
HB	Osteoporosis Health Belief Scale
HBM	Health Belief Model
HIV	Human immunodeficiency virus
IOF	International Osteoporosis Foundation
ITROMID	Institute of Tropical Medicine and Infectious Diseases
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KAP	Knowledge, attitude plus practice

KEMRI Kenya Medical Research Institute

KNH-UoN Kenyatta National Hospital-University of Nairobi.

MCH Maternal child health

NACOSTI National Commission for Science, Technology, and Innovation

NCD Non-communicable

NIH National Institutes of Health

NIHCDPO National Institutes of Health Consensus Development Panel on Osteoporosis

NOF National Osteoporosis Foundation

OHBS Osteoporosis Health Belief Scale

OKT Osteoporosis Knowledge Test

OSES Osteoporosis Self-Efficacy Scale

pDXA Peripheral Dual Energy X-ray Absorptiometry

QOL Quality of life

RA Rheumatoid arthritis

RCT Randomized controlled trial

RPE Research, Production, and Extension

SD Standard deviations

SERMs Selective estrogen receptor modulators

SPSS Statistical package for Social Sciences software package

TL5	Thika Level five.
TOT	The Times of India
UAE	United Arabs Emirates
USA	United States of America
USDHHS	United States of America Department of Health and Human Services
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Attitude	An individual's way of thinking or feeling; a self-evaluation, either positive or negative, of performing a behavior.
Behavioral Belief	An individual's perception of a behavior and its likely consequences. Behavioral beliefs, along with subjective values, influence attitudes toward a behavior.
Bone formation	Building of new bone cells by osteoblasts to replace the old ones.
Bone resorption	Breakdown and removal of old bone by osteoclasts**.**
Bone mineral density	Measurement of the bone ability to change a beam of radiation for a given bone length or two radiation beams generated by two different sources based on which the bone density can determined and expressed as a scale value for comparison with a standard/normal data in order to diagnose osteoporosis. BMD corresponds to the amount of minerals in an individual’s bone tissue (g/cm2).
Bone remodeling process	Process by which the old, micro-damaged bones are removed and replaced with new, mechanically stronger ones in order to promote and preserve bone strength.
Dietary intake	Food consumed by an individual in terms of types and amount.

Family history of osteoporosis	Occurrence of osteoporosis and/or fractures among relatives of the study subjects.
Fracture risk	The predisposition of contracting a bone fracture based on an individual's BMD and history of fracture.
Knowledge of osteoporosis	General knowledge about the disease, the most affected groups, and the associated risk factors which are assessed using various questions as provided in the questionnaire.
Osteoporosis risk perception	Perceived risk by participants to develop osteoporosis.
Osteoporosis	A disorder characterized by unusual bone density loss and bone tissue deterioration with an increased fracture risk.
Peak bone mass	The optimum amount of bony tissue attained by an individual once the skeleton reaches maturity between mid-twenties and early thirties, and it is usually higher in men than women.
Physical activity	Any kind of bodily movement or activity generated by skeletal muscles that requires energy expenditure for a given time.

ABSTRACT

Osteoporosis refers to a 'silent' systemic skeletal disease characterized with low bone mineral density (BMD), micro-architecture bone deterioration, and increased bone fragility. The disease has serious consequences on individuals, health system, and society. These include high treatment cost and poor health outcomes. The main objective for his study was to determine the knowledge, health beliefs, and attitudes towards osteoporosis among women aged 18-52 years attending Maternal Child Health (MCH) Clinics at Thika level V and Gatundu level IV hospitals. A cross-sectional study design was conducted between June 2017 and February 2018 using interviewer administered questionnaire with five sections of standardized questions. Statistical package for Social Sciences software package (SPSS) Version 20 was used to analyze data. Significant level was set at P <0.05. The mean age of participants was 28.5 years. The most common age groups at both hospitals were 18-22 years (n=118, 27.6%) and 23-27 years (n=114, 26.6%). Most participants (n=268, 62.6%) had basic education versus higher education (n= 151, 35.2 %). Majority of the participants were urban dwellers 163 (38.2%), then peri-urban 134 (31.3%), and rural 131 (30.6%). Women's attitudes towards osteoporosis were good with a mean score of 15.1± 3.9 out of 20. Age was associated with osteoporosis attitudes (p = 0.002) unlike education (p=0.823). The mean knowledge score on the OKT was 5 out of 10. There was significant association between osteoporosis knowledge with family history of osteoporosis (p = 0.004), milk as source of calcium (p < 0.001), osteoporosis risk in men than women (p = 0.004), menopause onset (p = 0.011), and effectiveness of osteoporosis treatment in Kenya (p = 0.009) unlike other risk factors. Health beliefs were moderately strong with an average score of 76.9± 0.4 out of 110 on modified osteoporosis health belief scale (m-OHBS). The OHBS was significantly associated with age (p = 0.002) unlike education level (p = 0.736). Overall, there was a high rating for cues to action, perceived benefits, and self-efficacy, and low rating for perceived barriers, perceived susceptibility, and seriousness among the women. There were moderately strong and significant correlations between osteoporosis health belief and self-efficacy (rho = 0.5789, p < 0.001), health belief and attitude (rho = 0.5364, p < 0.001), and self-efficacy and attitude towards osteoporosis (rho = 0.5935, p < 0.001). However, osteoporosis knowledge was weakly correlated with self-efficacy (rho = 0.1376, p = 0.026) and attitude towards osteoporosis (rho = 0.2038, p = 0.0001). This study recommends health education programs to raise knowledge level on osteoporosis, its risks, and consequences in order to increase the health beliefs and even attitudes, and self-efficacy among the women and the general public in order to promote healthy behaviors for osteoporosis prevention.

CHAPTER ONE

INTRODUCTION

1.1 Background

Osteoporosis is a frequent chronic and debilitating bone condition with serious socioeconomic and health implications on the affected individuals and the society at large. According to Liu *et al.* (2019), osteoporosis is systemic skeletal disease which manifests with low bone mass (BM), microarchitecture bone tissue deterioration and increased bone fragility with consequent vulnerability to fracture. Literally speaking, the term osteoporosis traces its origin from France and Germany, which means 'porous bone' since the disease affects the bone density as well as its quality with consequent bone strength weakening and decreased bone density. As the bones become more porous and fragile, the risk of fractures to occur increases. This results when the bones lose high protein and mineral amounts, especially calcium over prolonged time, leading to low BM as well as low bone strength. Bone Mineral Density (BMD) is the recommended measure for mineral density present in bones based on a special scan. As noted by Schousboe and Ensrud (2015), the precise BMD for an individual with osteoporosis is 2.5 standard deviations (SD) or more below the mean BMD among healthy young adults [i.e., T-score -2.5 or below].

Osteoporosis remains asymptomatic or 'silent' until fractures occur (Cosman *et al.*, 2014) since its development is often slow, steady, and undetectable. That is, the bone disease leads to loss of bones without a clear clue, particularly in adulthood and/or older age. Therefore, most people are not aware when affected by osteoporosis unless they are involved in a sudden fall or get strain which causes bone fracture or collapse of vertebral structure. According to Wilson *et al.* (2015), the bone fracture provides the main and first symptom for this disease. The most vulnerable part of the body to fractures are the arms, ribs, and pelvis as well as the hip, spine together with the wrist. Nonetheless, the most affected body parts are the hip, spine as well as the wrist. Of these, the hip and spinal fractures are the most serious since they may prompt patient hospitalization, major surgery, and other serious consequences such as permanent disability and/or even death.

Osteoporosis is a multifactorial disease. Modifiable or controllable osteoporosis risk factors include sedentary lifestyle and not having a balanced diet. On the other hand, non-modifiable/uncontrollable osteoporosis risk factors are sex, ageing together with family history (Kaur, 2013). According to Brown (2014), bone loss occurs when an individual consumes inadequate calcium levels or suffers from malabsorption or excess excretion of calcium. Shortage of calcium supply may be influenced by inadequate phosphate supply during bone mineralization since it promotes calcium release from the skeleton. Conversely, dietary intake of a balanced calcium to phosphorus amount facilitates building of bone cells. Therefore, this condition can be averted by ensuring consistent intake of bone building minerals such as calcium, magnesium, and phosphorus as well as fluoride and boron; and vitamins, especially vitamin D and K. Moreover, it is important to engage in regular weight bearing activities since they maintain skeleton strength and calcium when needed.

Globally, it is estimated that one osteoporotic fracture occurs in every 3 seconds (Stovall, 2013). It is well established that the universal burden due to low BMD almost increased two-fold (0.12% vs. 0.21%) between 1990 and 2010, and that the low BMD accounted for about a third of all fall-related deaths worldwide (Sanchez-Riera *et al.*, 2014). Studies have shown that women have lower peak bone mass than men and therefore, the risk for women to develop osteoporosis increases with age (Oommen & AlZahrani, 2014). Therefore, the higher peak bone mass implies less likelihood of developing osteoporosis and vice versa. It is noteworthy that individuals with higher peak bone mass have more calcium within their bones to lose before they become weak and contract fracture easily. This is the case with men in general since they usually build up more bone mass which takes longer time to lose it than women do.

Nevertheless, the bone size and density usually remain fairly stable between the age forty and fifty years among women and approximately age sixty in men. Considering the impacts of osteoporosis on the society such as secondary health problems as well as death (Cosman *et al.*, 2014), it is important to perform early diagnosis for an individual's risk level to help prevent bone wear and tear and reduce osteoporosis occurrence through appropriate lifestyle behaviours. These include eating balanced diet to engaging in regular exercise and seeking early treatment, among others.

Notably, osteoporotic fractures risk can be reduced by enhancing peak bone mass during young age, reduction of bone loss reduction following menopause, and prevention of falls through advice such as toning de-ambulatory muscles through exercise, proprioception improvement exercises and equilibrium therapies. Exercise and the associated anabolic effect may stop or rather reverse osteoporosis. It important to emphasize that osteoporosis prevention takes place throughout an individual's life. Although most bone mass develop prior to attaining 30 years of age. However, most people are challenged with retention of the gained bone mass. Therefore, it is important to ensure adequate bone mass development from childhood through adolescents by consuming foods with adequate calcium and vitamin D, and regular engagement in weight-bearing exercises.

1.2 Problem statement

Globally, there are more than 200 million people with osteoporosis, and that one third and one fifth of women and men are susceptible to osteoporotic fractures (International Osteoporosis Foundation [IOF], 2016). As of 2010, there were about 22 million women together with 5.5 million men with 50 to 84 years living with osteoporosis in European region (Hernlund *et al.,* 2013). Although data on national prevalence is lacking in Kenya, a recent study estimated prevalence of postmenopausal women in Kiambu district at 26.4% (Sitati *et al.,* 2020). Osteoporosis reduces quality of life (QOL), limits an individual's long-term ability to engage in social activities, and increases economic burden (Lee, 2014). The main adverse consequences of the disease are fractures, disability, and even death. Therefore, its management requires substantial resources in terms of time and cost after its occurrence. According to Ha and Choi (2013), early diagnosis and appropriate risk management are essential for preventing osteoporotic fractures, hence they should be priority treatment goals for patients with the disease.

Effective management of any disease starts with awareness assessment regarding the disease in the population of interest. Although osteoporosis cannot be cured, its consequences can be averted largely through adoption of healthy behaviors and awareness regarding its risk factors. Knowledge, attitudes, and health believes have

been shown to be among the major contributors to preventive behaviors and thereby provide insight for planning programs for osteoporosis prevention and lifestyle intervention (Gözüm and Çapık, 2014). However, some studies reported moderate knowledge regarding bone health (Al-naggar *et al.,* 2013; Leng *et al.,* 2017) and osteoporosis (Fatima and Cleeta, 2017) in different population groups and countries. Others demonstrated that osteoporosis health beliefs were moderate (Leng *et al*., 2017) to good (Al-naggar *et al.,* 2013). And still some studies identified a gap in knowledge and its application which highlights the need for preventive health education to raise the knowledge level and health beliefs and thereby promote healthy behaviors (Malakeh, & Zakia, 2015).

Since knowledge, attitudes, and health beliefs about osteoporosis and its risk factors play an important role in osteoporosis prevention and management, assessment of these domain would provide important insights for promoting healthy behaviours and lifestyles. However, little is known about osteoporosis and its fragility fractures in Kenya, and how these domains may influence behavior changes towards its prevention. Therefore, this study aimed to determine osteoporosis knowledge, attitudes and health beliefs among women aged 18-52 years attending maternal child health (MCH) clinics at Thika level V and Gatundu level IV hospitals.

1.3 Justification of the study

Osteoporosis is a neglected disease in Kenya since it is not among the priority diseases. Osteoporosis and its fragility fractures have high socio-economic implications which result from prolonged hospitalization, medical treatment, and poor quality of life (Cosman *et al.*, 2014). Other consequences of osteoporosis and the associated fractures include morbidity, functional dependence, chronic complaints, mortality, labor loss, and high treatment costs. Consequently, osteoporosis risk factors have drawn research interest globally (So¨zen *et al.,* 2017; Kim *et al.,* 2020). Despite the importance of knowledge, attitudes, and health beliefs in prevention of osteoporosis, few studies have focused on this area in Kenya. This study is important since it will contribute more knowledge to the current literature on osteoporosis and the associated factors. Additionally, the study will provide current data on knowledge, health beliefs, and

attitudes which critical for informing evidence-based policy formulation and program development for effective prevention of osteoporosis among women in Kiambu county and the country at large. This may include interventional programs for prevention of osteoporotic fractures such as awareness creation on osteoporosis and the associated factors, and its health outcomes.

1.4 Research Questions

This research study was guided by the following research questions:

a) What is the knowledge of osteoporosis among women aged 18-52 years attending Maternal Child Health (MCH) Clinics at Thika level V and Gatundu level IV hospitals, Kiambu County?
b) What are the health beliefs about osteoporosis among women aged 18-52 years attending MCH Clinics at Thika level V and Gatundu level IV hospitals, Kiambu County?
c) What are the attitudes towards osteoporosis among women aged 18-52 years attending MCH Clinics at Thika level V and Gatundu level IV hospitals, Kiambu County?
d) What is the association between knowledge, attitudes, and health beliefs among women aged 18-52 years attending MCH Clinics at Thika level V and Gatundu level IV hospitals, Kiambu County?

1.5 General Objective

To determine the knowledge, health beliefs, and attitudes towards osteoporosis among women aged 18-52 years attending Maternal Child Health (MCH) Clinics at Thika level V and Gatundu level IV hospitals.

1.5.1 Specific Objectives

a) To determine the knowledge of osteoporosis among women aged 18-52 years attending MCH Clinics at Thika level V and Gatundu level IV hospitals, Kiambu County.

b) To determine the health beliefs about osteoporosis among women aged 18-52 years attending MCH Clinics at Thika level V and Gatundu level IV hospitals, Kiambu County.
c) To determine the attitudes towards osteoporosis among women aged 18-52 years attending MCH Clinics at Thika level V and Gatundu level IV hospitals, Kiambu County.
d) To assess the association between knowledge, attitudes, and health beliefs among women aged 18-52 years attending MCH Clinics at Thika level V and Gatundu level IV hospitals, Kiambu County.

1.6 Conceptual Framework

Osteoporosis result from reduced bone mass as well as bone quality due to a decline in bone mass storage and unusually high bone resorption. Additionally, osteoporosis may be aggravated by various factors, broadly classified into modifiable and non-modifiable factors. Non-modifiable factors include age, female gender and osteoporotic family history or predisposition (Umbrella Organization for Osteology/Dachverband Osteologie [DVO], 2014). Modifiable risk factors include malnutrition, sedentary lifestyle, excessive alcohol use, and smoking, inadequate dietary intake of calcium and vitamin D as well as carbonated drinks plus inactive lifestyle (Ahmad, 2014), to name but a few.

People's attitudes towards a disease entails the way they think or feel or behave about the disease and it is largely influenced by their beliefs about it. According to Edberg (2015), attitude about a behavior encompasses the "beliefs about what will happen if he or she performs the behavior" (p.43). Attitudes has affective, behavioural, and cognitive aspects. The cognitive component of attitude refers to knowledge of an individual about something. On the other hand, the affective component comprises feelings and evaluations which influence an individual's standpoint strength for and against something. The behavioural part comprises an individual's action towards a situation or someone else as well as the motivation to ensure changes. Attitudes in general are believed to have a direct bearing on an individual's behaviours. It is

noteworthy that attitudes are formed through lifetime experiences, and they are influenced by beliefs towards something as well as by evaluating such beliefs.

Knowledge is another variable of interest in this study which refers to a justified belief. In this study, the term knowledge is used to mean the awareness or familiarity about osteoporosis. Research has shown that osteoporosis awareness is critical in its prevention (Toh *et al.,* 2015) as it influences an individual's behaviours. There is a body of evidence that people's beliefs, attitudes, and knowledge level about a disease may predict their health behaviors. For instance, recent research has underscored the importance of assessing women's osteoporosis knowledge, attitudes, beliefs, and perceptions to inform effective osteoporosis prevention program development (Gözüm, & Çapık, 2014). Clearly, understanding factors involved in osteoporosis etiology is the starting point for any effort aimed to reduce its burden to the society.

Health Belief Model (HBM) is a conceptual framework that was developed by social psychologists in early 1950s. This framework is widely used to identify factors that affect osteoporosis preventive behaviors, to explain changes in health-related behaviors as well as to guide implementation of behavioral health interventions. The HBM theorists posited that individuals not only increase their perceived sensitivity but also develop positive healthy behaviors by minimizing their perceived barriers when supported and encouraged to modify their unhealthy behaviors (Jeihooni *et al.,* 2015).

Many studies on osteoporosis preventive educational programs have a theoretical basis (Jeihooni *et al.,* 2015; Sanaeinasab *et al.,* 2014; Malak, & Toama, 2014; Wafaa HHAS, & Wafaa GMA, 2014), which was the motivating factor to frame this study in the context of the HBM. Similarly, the IOF (2016) recommends preventive educational programs based on HBM. There is much evidence that the HBM utilization may promote behavior change in the target population by understanding entity of disease, their susceptibility and benefits as well as barriers and cues towards action and self-efficacy during adoption of healthy behaviors (Soleymanian *et al.,* 2014).

According to Safiri *et al.* (2016), the model comprise of various constructs, namely perceived threat which includes: perceived severity of an individual's feelings regarding the seriousness of getting a disease and perceived susceptibility of disease

development; perceived benefits entail an individual's perception about the effectiveness of preventive actions aimed at reducing the disease-related threat; perceived barriers which is an individual's belief regarding the possible adverse aspects as a result of a given health action; modifying variables/measures; cues to action which comprises the internal and external cues and they influence people to take action so as to trigger decision-making process; and Self-efficacy. The perceived susceptibility is the subjective perception that one is vulnerable to developing a disease or health condition (Jeihooni *et al.,* 2015). Based on this understanding, low perceptions of susceptibility, severity, benefits, cues to action, and high perceptions of barriers discourage people from engaging in health seeking or adopting healthy behavior.

These constructs of HBM are used to explain the theoretical relationships between the perceptions towards the disease and the possibility of engaging in preventive behaviors. The HBM is effective in osteoporosis education (Khani *et al.,* 2015). The model aims to predict and influence individual's behavior change vis-à-vis osteoporosis. From the preceding reviews, there is an information gap about osteoporosis health beliefs and HBM-based interventions for primary health care in Kenya. Additionally, the disease is under-recognized and underdiagnosed in the country, yet it has attracted significant attention globally due to its heavy burden on society. In view of this, the researcher was motivated to bridge the existing information gap which would play a vital role in in understanding osteoporosis health beliefs and barriers to its prevention among women and the general population.

In general, the HBM posits that health-related action relies on three main concurrent occurring classes of factors: a) sufficient motivation/ health concern which ensure that the health issues are salient or relevant; b) the belief that an individual is threatened by a serious health issue or perceived threat (i.e. illness or condition); and c) the belief that adherence to recommended health interventions would reduce perceived threat at a subjectively-acceptable cost, in which case the cost is the perceived barriers an individual must overcome so as adhere to health recommendation. This study based was guided by modified HBM as shown in the conceptual framework provided in

Figure 1 below, which presents independent and dependent modifiable variables through recommended and tested interventions to prevent osteoporosis among women.

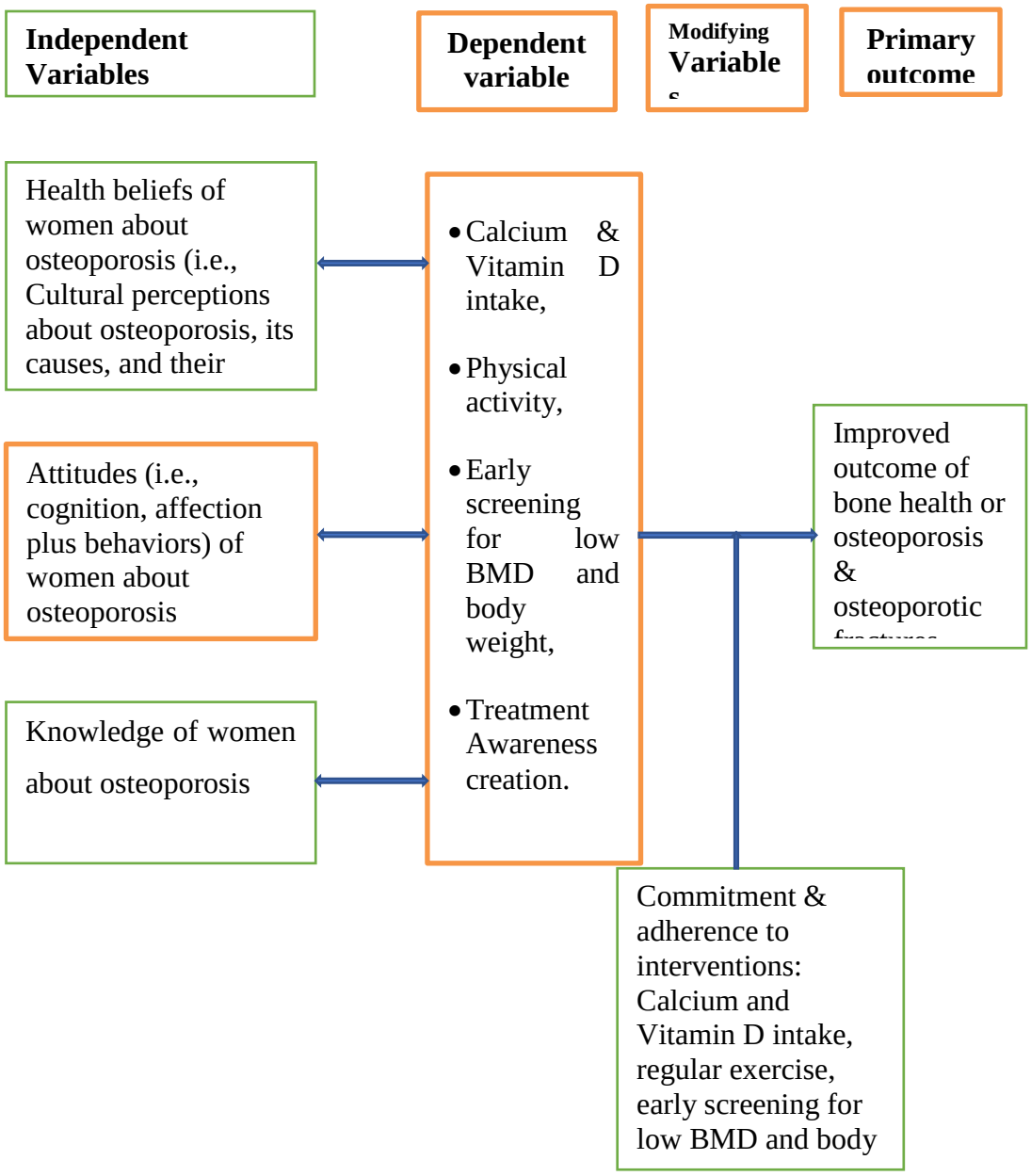

Figure 1.1: Conceptual Framework for osteoporosis prevention among women.

Sources: Developed by Researcher, 2018.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Osteoporosis is characterized by low bone mass and changes in bone architecture both of which result in high risk of bone fragility and fracture risk (Dunnewind *et al.*, 2017; Ensrud, & Crandall, 2017; Fukumoto, & Matsumoto, 2017; Qaseemet al., 2017). According to the National Institutes of Health Consensus Development Panel on Osteoporosis [NIHCDPO] (Lorentzon, & Cummings, 2015), osteoporosis refers to a skeletal disease in which the bone strength is compromised which increases the risk of fragility fracture. Based on the diagnostic criteria by the World Health Organization [WHO], Cosman *et al.* (2015) defined osteoporosis as having a bone mineral density (BMD) which lies above 2.5 SD or below the mean value for a young healthy woman (a T-score of <- 2.5 SD).

2.2 Burden of Osteoporosis

Osteoporosis is one of the chronic diseases since its development occurs over long period of time, slow and progressively, and cannot be transmitted from one person to another through contact (WHO, 2015). Globally, osteoporosis presents a major public health concern since it associated with significant risk of fractures, morbidity, and mortality. The disease causes the bones to become more porous as well as fragile, leading to increased risk of fracture (IOF, 2016). The fragility fractures frequently occur in the hip, vertebrae, and wrist of which the first two types of fractures increase with aging in both genders (IFO, 2016).

Osteoporosis prevalence is projected to rise with increase in aging population (Kuo, & Chen, 2017; Hernlund *et al.*, 2013). As the larger percentage of population ages, its prevalence increases and thereby presents a significant global health problem. The prevalence estimates vary across regions based on data collection type, sources, and nature of population examined. Across the European Union (EU 27), Hernlund *et al.* (2013) reported that about 5.5 million men as well as 22 million women are

osteoporotic cases of which about 6.6% men and 22.1% women with 50 years and above are affected. There are over 10 million Americans living with osteoporosis and another 33.6 million are diagnosed with low hip bone density (National Osteoporosis Foundation [NOF], 2013). Similarly, research estimate that women in the Middle Eastern Region such as Saudi Arabia have up to 44.5% prevalence of osteoporosis (Alqahtani, 2014). Middle East and Africa were reported to be highly prevalent of hypo-vitaminosis D and fractures (Hernlund *et al.*, 2013). Moreover, the NOF (2014a) projected a steady increase in new cases of osteoporosis plus low bone mass by 2030, at 29% higher versus 2010.

Osteoporosis and its fragility fractures have high socio-economic implications which result from prolonged hospitalization, medical treatment, and poor quality of life (Cosman *et al.*, 2015). Other consequences of osteoporosis and the associated fractures include morbidity, functional dependence, chronic complaints, mortality, labor loss, and high treatment costs. For instance, the annual economic impact imposed on the health care system by osteoporosis will be approximately $25.3 billion (NOF, 2014) as of 2025. Despite these adverse effects, the disease is often neglected, underdiagnosed, and undertreated. Moreover, this disease is not yet recognized as one of the major health problems in Kenya despite the rising prevalence of osteoporosis worldwide. Not being aware of osteoporosis and the associated risk factors may result in delayed diagnosis and treatment with consequential high socio-economic burden (Rothmann *et al.*, 2014). Considering the rising prevalence rate of osteoporosis and the associated fragility fractures, it is important to for people to be awareness about its risk factors, prevention, and treatment in order to reduce its burden on the society.

2.2 Classification of Osteoporosis

Osteoporosis is classified into primary and secondary of which the former is the most common form and usually has no clear etiologic mechanism. Primary osteoporosis is further subdivided into postmenopausal (type 1) osteoporosis since it commonly occurs in postmenopausal women consequent to low estrogen levels which leads to an increase in osteoclast activity and elevated bone loss. Additionally, females generally attain less peak bone mass despite longer mean life expectancy than males, which

explains the common occurrence of the disease in postmenopausal women. Senile osteoporosis (type 2) is also known as age-related osteoporosis since it occurs in the elderly people regardless of their gender due to ageing. Secondary osteoporosis has a clearly defined etiologic mechanism which include drugs (e.g., glucocorticoid steroids and chronic heparin therapy), some diseases (e.g., hyperthyroidism, diabetes mellitus, and rheumatoid arthritis), and calcium malabsorption or nutritional deficiencies that accelerate bone loss and disrupt attainment of peak bone mass at maturity (IOF, 2015).

2.3 Metabolism of bones

The bone is a highly specialized supporting body framework with various properties such as rigidity, hardness, and ability for self-regeneration and repair. It is the component of the musculoskeletal device with about two thirds of inorganic material (a mineral bone substance called hydroxyapatite, $Ca_{10}(PO_4)_6Ca(OH)_2$) and one third of organic (mainly collagen) materials. Byrd-Bredbenner *et al.* (2013) noted that the hydroxyapatite, which mainly comprise calcium and phosphorous, confers durability on the bones and ensures they withstand pressures during bending and compression. As noted by Vincent (2013), normal bone tissue density is $2.4 g/cm^3$ and its mechanical properties are influenced by age and individual growth conditions of an organism, among others.

The bones undergo a continuous lifetime modeling (reshaping) process to ensure that they adapt to changes in biomechanical forces. In addition, they undergo remodeling process during which the old, micro-damaged bones are removed (i.e., bone resorption) and replaced with new, mechanically stronger ones (i.e., bone formation or ossification) in order to promote and preserve bone strength. The later takes place at epiphyseal growth plate, between the middle bone segment called the shaft, and the bone end called the epiphysis (Byrd-Bredbenner *et al.*, 2013; Widmaier *et al.*, 2014). According to Widmaier *et al.* (2014), the epiphyseal growth plate proliferates cartilage actively which leads to growth of the bone towards its structural ends. By contrast, the bone resorption takes place on the pre-existing bones' surfaces and degrades bone while moving midway (Gropper, & Smith, 2013). The process involves break down of

the bones by osteoclasts and release minerals during which calcium is consequentially transferred from the bone into the plasma (Byrd-Bredbenner *et al.,* 2013).

This implies that the bone remodeling process promotes normal bone homeostasis (Sims, & Martin, 2014). Both bone maintenance and minerals homeostasis are regulated by various hormones, including the growth hormone and thyroid hormones to sex hormones and adrenocorticoid hormones as well as 1, 25-dihydroxyvitamin D, calcitonin plus parathyroid hormone (Byrd-Bredbenner *et al.,* 2013).

2.3.1 Pathophysiology of bones

The skeletal system undergoes constant regeneration through bone formation and bone resorption processes. As one grows, the bone is made and constantly reshaped to perform its function. During growth, the bone formation process supersedes the bone resorption in middle-aged and elderly people (Ngozi *et al.,* 2017). A shift of the balance between the two processes such that bone resorption exceeds bone formation leads to osteoporosis. This results in an increase in skeletal size and density. Studies have shown that girls and boys attain up to 90 % peak bone mass by 18 and 20 years respectively, explaining why childhood provides the absolute best opportunity for investing in healthy bone development through intake of proper diet as well as exercise (National Institutes of Health (NIH) Osteoporosis and Related Bone Diseases National Resource Center, 2015). It is noteworthy that although it is natural for human beings to lose bones as they age, achieving greater peak bone mass during childhood is more protective against osteoporosis and fragility fractures in later life. Therefore, since the bone density reduces with age, it is important to acquire peak bone mass within the first years of life and bone retention during middle-age in order to reduce osteoporosis risk (Bollenbacher, 2014).

A balance between these two processes is essential for healthy bones and vice versa. Loss of bones and osteoporosis development occurs when bone remodeling process is skewed towards resorption than formation process. It is well established that rapid skeletal system development takes place from early childhood to late adolescence (Stagi *et al.,* 2013) with the highest bone mineral density accumulation during adolescence.

2.3.2 Pathophysiology of Osteoporosis

The rate of osteoporosis development is influenced by the underlying homeostatic mechanism. Type 1 (postmenopausal) osteoporosis occurs during the accelerated bone loss phase due to estrogen or testosterone deficiency. The loss of bone mass is rapid among the most at-risk women to bone loss during 3 to 5 years following menopause as a result of estrogen decline (Brown *et al.*, 2014). Good dietary intake is critical for reduction of bone loss rate.

Research has shown that normal bone remodeling (bone renewal) essential for healing of fractures, adaptation of skeleton to mechanical use, calcium homeostasis (Dallas *et al.,* 2013), and maintaining bone strength (Bouxsein, 2013). By contrast, the occurrence of an imbalance between bone formation and bone resorption in favour of the later leads to several bone diseases, osteoporosis included. A bone fracture (i.e., a broken bone) may be caused by either a high force impact/stress or minimal trauma injury due to certain medical conditions which leads to weakening of the bones as in the case bone cancer, osteogenesis imperfect, and osteoporosis, which is the focus of the current thesis. Therefore, a homeostatic balance between the two processes is necessary for prevention of osteoporosis. Moreover, the most important bone property is its resistance to damages through self-repair and adaptation to environmental conditions both of which are physiologically regulated through bone remodeling. It is noteworthy that both the bone formation and bone resorption are two lifetime stages of bone renewal process (i.e., remodeling or metabolism) which lasts for about 4 to 6 months.

In general, bone remodeling process entails a sequential stepwise process in which resorption (osteoclast-mediated process) is followed by bone formation (osteoblast-mediated process) (Sims, & Martin, 2020). This process is responsible for maintaining a healthy skeleton through continuous removal of older bones and replacement with new ones. However, bone loss occurs once an imbalance prevails between these stages, leading to more bone removal compared to replacement. This anomaly is common during the onset of menopause and with aging. Therefore, it is imperative to gain better

knowledge about the bone remodeling process as the basis for prevention of osteoporotic fractures and other bone-related diseases.

2.4 Risk factors for osteoporosis and fragility fractures

Aetiology of osteoporosis is associated with genetic, environmental as well as lifestyle factors. According to Cosman *et al.* (2015), increasing age, being female, postmenopausal status, hypogonadism or premature failure of ovaries, low body weight, parental hip fracture history, ethnicity (whites are more predisposed than blacks), previous clinical/ morphometric vertebral fracture, past fracture resulting from minimal trauma/previous osteoporotic fracture, rheumatoid arthritis, smoking, excessive alcohol use, (at least 3 drinks daily), low BMD, vitamin D deficiency, low calcium intake, hyperkyphosis, falling, immobilization, and prolonged use of some medications, particularly glucocorticoids, anticoagulants, and anticonvulsants to aromatase inhibitors and cancer chemotherapeutic agents plus gonadotropin-releasing hormone agonists elevate the risk of osteoporosis fractures. Of these, the non-controllable osteoporosis risk factors are age, sex, menopause, genetic predisposition and race, family history of fracture, hormone levels, and pregnancy number. Controllable risk factors include malnutrition, sedentary lifestyle, excessive alcohol use, and smoking as well as inadequate calcium plus vitamin D consumption, carbonated drinks, and inactive lifestyle (Ahmad *et al.,* 2014), to name but a few. Further, reduction in estrogen level in women during their lifetime and low sunshine exposure are major contributing factors (Parker *et al.,* 2014).

Studies have shown a link between osteoporosis and increasing age, female gender, postmenopausal age, hypogonadism and premature ovarian failure, low *Body Mass Index* [BMI], ethnicity (individuals of white ethnic background are more at risk than blacks), rheumatoid arthritis (RA), low BMD, vitamin D deficiency, insufficient intake of dietary calcium, hyperkyphosis, smoking, alcohol abuse, physical inactivity or immobilization, and prolonged use of some medications (e.g. glucocorticoids and anticoagulants to anticonvulsants, aromatase inhibitors, and cancer chemotherapeutic drugs as well as gonadotropin-releasing hormone agonists) (Ensrud, & Crandall, 2017; Qaseemet *al.,* 2017; Ramírez *et al.,* 2017; Tawaratsumida *et al*., 2017).

Among the lifestyle factors that contribute to poor bone health and osteoporosis are sedentary lifestyle, low sun exposure, and inadequate physical activity (Mithal *et al.,* 2014). Physical exercise such as weight-bearing exercise, not only improve but also maintain muscle to bone strength plus body balance (Meeta *et al.,* 2013). Therefore, it is important to engage in weight-bearing plus muscle-strengthening exercises regularly. Since the bone density reduces with age and thereby increases osteoporosis risk, it is critical to achieve optimal peak bone mass within the first thirty years of life and bone retention during middle-age to protect oneself against this disease (Bollenbacher, 2014) through adoption of osteo-protective activities and behaviours. For instance, engaging youths in health promotion activities and health lifestyle practices through interactive platforms and formal and informal education is a big step towards this goal. Simply stated, effective strategies are needed to prevent the condition (IOF, 2017; Çalık, & Çalık, 2014; Altın, & Karadeniz, 2014). Clearly, understanding factors involved in osteoporosis etiology is fundamental for osteoporosis burden reduction in the society.

2.5 Osteoporosis knowledge, attitudes, and health beliefs.

A similar study was conducted by Sabaa *et al.* (2018) evaluated university students' knowledge, attitude plus practice (KAP) about osteoporosis for identification of key socio-demographic factors that influence the osteoporosis KAP within United Arabs Emirates (UAE). A descriptive cross-sectional design was conducted among 400 subjects (medical and nonmedical students) from Ajman University using a self-administered questionnaire. Out of 400 subjects, 50 % were male, 90.5% single, 17% UAE nationality while 10.8% complained of a bone disease. On a 0 to 100 scale, osteoporosis KAP scored 69% at 95% confidence interval (CI) on average [medical (68%), nonmedical students (71%)]. After statistical modeling, gender emerged as a strong predictor of osteoporosis KAP among university students. Overall, the subjects had a satisfactory osteoporosis KAP level despite poor scoring for certain KAP items. This suggest that educational programs are needed to address these poorly underscored items.

2.5.1 Osteoporosis knowledge

Knowledge and awareness contribute significantly to osteoporosis prevention (Sayed-Hassan, & Bashour, 2013). Some authors identified a gap in knowledge and its application which highlights the need for preventive health education to improve knowledge level and promote healthy behaviors (Barzanji *et al.,* 2013). In Pakistan, Sayaf *et al.* (2018), reported good osteoporosis knowledge score in only 8.0% of participants whereas 49.0% of the subjects had poor knowledge score. In South Africa, Alghamdi, & Mohammed (2018), evaluated osteoporosis awareness and knowledge among 141 health professionals. The study found that 127 (90.1%) subjects had good knowledge compared to 14 (9.9%) who had poor knowledge (p-value< 0.01). Elsewhere, some studies reported moderate knowledge regarding bone health (Al-naggar *et al.,* 2016; Leng *et al.,* 2017) and osteoporosis (D'Silva, & Pinto, 2017) in different population groups. In Kenya, a study by Sitati *et al.,* (2021) found limited osteoporosis knowledge among the study subjects in Kiambu district since only 115 (45.2%) women scored correctly above average on osteoporosis knowledge aspects. Other authors reported a gap in knowledge and its application which highlights the need for preventive health education to improve knowledge level and promote healthy behaviors (Barzanji *et al.,* 2013).

2.5.2 Osteoporosis health beliefs

Healthy behaviors and lifestyle predict low osteoporosis and fragility fractures risk (Sayed-Hassan *et al.,* 2013). In Saudi Arabia, Al-Otaibi (2015) assess 288 women aged 20-40 years with and without family history for interrelationships between osteoporosis knowledge, health beliefs, and life habits. The study revealed that both groups consumed inadequate daily calcium and were significantly different. The perceptions of susceptibility and severity were lower among those without family history versus those with family history with significant difference between them (p = 0.02 versus 0.00 respectively). There was lower mean score of barriers to taking calcium and exercise in family history group and the two groups differed significantly (p = 0.017 versus 0.013 respectively). The study found statistically significant correlation between consumption of calcium with perceptions of susceptibility,

severity, benefits of calcium consumption and exercise, and perception of barriers to in family history group among the Saudi women.

A recent study by Chan *et al.* (2019) demonstrated a positive association between osteoporosis health beliefs with physical activity as well as consumption of dairy products and calcium ($p < 0.05$). In another study, Aslan, & Kilis (2017) reported osteoporosis health belief mean score of 139.99±14.79. Women had higher susceptibility, seriousness, barriers to exercise, and calcium consumption versus their male counterparts ($p<0.001$). In their study, Leng *et al.,* (2017) demonstrated moderate osteoporosis health beliefs among the subjects (18) whereas a study by Al-naggar *et al.* (2016) found good osteoporosis health beliefs among the study subjects. In Kenya, Sitati *et al.,* (2021) found that low perceived osteoporosis susceptibility 49 (19.3%) and moderate perceived osteoporosis seriousness 149 (59.2%) among women in in Kiambu district.

2.5.3 Osteoporosis attitudes

Research has shown the importance assessing women's osteoporosis knowledge, attitudes, beliefs, and perceptions in providing insight for developing effective health programs to minimize this problem (Gözüm, & Çapık, 2014). In their study to determine knowledge and attitudes in Malaysian post-menopausal women on achieving bone health during menopausal transition period, Hatta *et al.,* (2019) found no significant differences between participants' attitude and bone health. A cross-sectional study that focused on Knowledge, attitude, and practice about osteoporosis among 400 subjects in south-western Saudi Arabia reported positively advisable osteoporosis attitudes as a protective measure for themselves 90.8% as well as consulting with their physicians regarding osteoporosis at 83% (Tripathi *et al.,* 2019).

2.5.4 Association of knowledge, health beliefs, and attitudes of osteoporosis

Chin *et al.* (2018) investigated association between bone health with osteoporosis knowledge, beliefs plus practices in 367 Chinese (182 men, 185 women) with 40 years and above using a cross-sectional study. Data collection was done using a questionnaire about osteoporosis knowledge, beliefs plus practices and scanning for

bone mineral density by use of a dual-energy X-ray absorptiometry (DEXA). The subjects had moderate knowledge, high health beliefs level about osteoporosis, and poor osteo-protective practices. Osteoporosis knowledge and health beliefs significantly varied on the basis of participant's demographic characteristics ($p < 0.05$). There was also a positive correlation between osteoporosis knowledge with beliefs, coffee, and tea intake ($p < 0.05$) unlike other lifestyle practices. A positive association was also observed between osteoporosis health beliefs and physical activity as well as dairy products and calcium consumption ($p < 0.05$). However, there was no association between bone health and osteoporosis knowledge, beliefs plus practices ($p > 0.05$). Formulation of osteoporosis prevention program targeting Malaysians Chinese are needed to improve the participants' knowledge, health beliefs as well as practice, particularly for men.

A cross-sectional survey was conducted by Noordeen *et al.* (2014) assessed the knowledge and HBs of osteoporosis among students aged 16-18 year in Malé, Republic of Maldives; and also explored their preferred health information sources. The response rate was 95% (473/500), leading to 464 (93% or 464/500) suitable questionnaires for analysis. Moreover, 60% (n=281) participants had neither heard nor read anything on osteoporosis. The knowledge score of risk factor was 7.05 out of 19 points. Over 50% participants had low concern about getting osteoporosis out of which 71% did not consider themselves susceptible to osteoporosis. The internet and health practitioners' talks were the preferred educational modes and information sources. The findings indicated that the participants had low osteoporosis knowledge level and low perceived osteoporosis threat which implies that the study population was not likely practicing healthy behaviours for osteoporosis prevention. Therefore, the results highlight the need for education programmes aimed at improving the participants' health education needs, particularly through the internet and face-to-face sessions.

Kalkım, & Dağhan (2017) examined the effect associate d with an osteoporosis Health Belief Model-based preventive program among women aged 30 to 45 years who are vulnerable to the condition in western Turkey using a randomized controlled trial (RCT) of 37 subjects in interventional group and 36 subjects in a control group. Data collection was done using a socio-demographic questionnaire, Osteoporosis

Knowledge Test (OKT), Osteoporosis Health Belief Scale (OHBS), Osteoporosis Self-efficacy Scale (OSES), and monitoring forms for estimating daily calcium intake, and weekly exercise uptake. The intervention program involved education and counseling programs for 4- and 24-weeks respectively. Data collection was done pretest, 15-days post-test following completion of the education program, and first and second follow-ups after 3 and 6 months respectively. Statistical analysis was done using Mann Whitney U, chi-square, Friedman, Bonferroni, two means and Wilcoxon signed-rank tests. The findings showed significant increase in the mean score between the interventional group versus the control group for all the scales and their subscales (OKT, OHBS, and OSES and their respective sub-scales as well as calcium intake and exercise on as the daily and weekly basis respectively ($p < .001$). The study concluded that the nurse-led osteoporosis Health Belief Model-based preventive educational and counseling program was effective.

A similar cross-sectional study by Grace (2014) primarily focused on describing osteoporosis knowledge, beliefs together with behaviors among postmenopausal African American women from a large church within Baltimore-Washington area, USA. The study also explored correlations between theoretical constructs of HBM and osteoporosis preventive behavior key of which were calcium consumption and physical exercise. Overall, the women demonstrated greater osteoporosis knowledge level but with less knowledge about osteoporosis prevention through exercise. They also indicated that they used diet for osteoporosis prevention and recurrently engaged in physical activity. Despite their general osteoporosis knowledge, they were confronted by a moderate set of barriers to exercise. The study also reported a significant correlation between age, number of post-menopause months, and education, and dependent variables (knowledge, beliefs, attitudes plus barriers to practice bone health activities). There was a negative significant correlation between physical activity engagement for osteoporosis prevention and age and number of post menopause years. That is, the women continued to use less exercise for osteoporosis prevention with increasing post menopause months. This suggests the need to educate the postmenopausal women on the role of exercise in their life.

Evelyn *et al.* (2014) focused their cross-sectional study on how osteoporosis preventive health behaviors are associated with knowledge, self-efficacy plus health beliefs 263 in Chinese cases living with Human immunodeficiency virus [HIV]. The participants' mean age was 38.4±9.8 years and mean BMI was 21.6±2.6 kg/m2. There were 76% men while the rest were women. Around 30% participants undertook low physical activity. Intake of calcium and vitamin D sources ranged from multiple times a month to weekly. Osteoporosis knowledge was universally low while self-efficacy and practicing preventive behaviors were directly correlated. Women and individuals with lower education perceived greater barriers to adopting preventive behaviors. Adjusting multivariate logistic regression for age, sex plus BMI demonstrated direct correlation between intake of calcium and vitamin D with knowledge plus self-efficacy; and with physical activity and manual labor occupation, perceived exercise-related barriers, and health motivation. HBM is one of the behavioral frameworks that may be used to provide insight about adoption and maintenance osteoporosis preventive behaviors in this population.

Knowledge, attitudes, and health believes predict preventive behaviours of an individual (Gözüm, & Çapık, 2014). This was partly confirmed by Puttapitakpong *et al*. (2014) who assessed 430 Thai women between 20-35 years for inter-correlations in knowledge, attitude plus osteoporosis preventive behaviors. The study found a mean age of 29.4 ± 4.6 years. 49.5% participants had heard of osteoporosis with 95.3% (n = 203/213) from television and 72.8% (n = 155/213) from internet. Majority (85.2%) of them had certain knowledge while 53.3% had positive attitude about osteoporosis. Nevertheless, 80% lacked appropriate osteoporosis behaviors. Attitudes was significantly correlated with osteoporosis behaviors (adjusted odd ratio = 3.3 with 95% confidence interval of 1.9-5.7), educational level (adjusted odd ratio = 2.2 with 95% confidence interval of 1.4-3.4) as well as knowledge (adjusted odd ratio = 3.5 with 95% confidence interval of 1.8-6.8). Regardless of their knowledge about osteoporosis, the young women seemingly lacked appropriate behaviors for osteoporosis prevention. Having the right osteoporosis attitude may predict osteoporosis preventive health practices.

In Canada, Lorbergs, & Holland (2016) examined attitudes and perceptions of women about osteoporosis prevention in order to inform the development of improved exercise and education interventions at community level. The study reported that the participants associated their nutritional and exercise behavioural aspects with healthy bone maintenance despite that most of them indicated low osteoporosis risk perceptions. The results also showed that they did not adopt osteoporosis preventive, yet they considered its outcomes more severe than its risk. The study concluded that the women lacked knowledge regarding the relevance of exercise in maintaining healthy bones and osteoporosis risk factors.

In general, the findings from most of the reviewed studies suggests that the osteoporosis knowledge, health beliefs, and attitudes may be interrelated and affect an individual's health behaviors. However, most of the studies identified a gap with one or more of these domains due to lack of adequate evidence on their influence on behavior change or their interrelationships and how they influence each other. Furthermore, the findings highlight the need for further research to ascertain the role of these domains and how they influence each other which is the main focus of this study. Since osteoporosis is still an incurable disorder, it was anticipated that the current would fill the identified gaps and provide current insight to inform development of preventive interventions to improve the bone health. This is easily achievable with supportive public health policies that underpin promotion of bone health and osteoporosis risk reduction.

2.6 Prevention and management of osteoporosis

2.6.1 Diagnosis of osteoporosis

Osteoporosis occurs silently without clear symptoms and evidence unless a fracture occurs, which is why it is important to perform DEXA screening which is the gold standard device for accurate measurement of BMD for early diagnosis to avert fractures (Kuo, & Chen, 2017). The DEXA scan is noninvasive, very comfortable for patients and poses minimal radiation risks during examination. The BMD measurements are often expressed in terms of T-scores, indicating the SD number by which an individual's BMD deviates from the average value of young healthy

individuals (Hernlund *et al.,* 2013). According to the WHO report by Cosman *et al.* (2015), normal BMD is classified as the T-score above 1 SD, osteopenia as the T-score from -1.0 to -2.5 SD, and osteoporosis as the T-score below -2.5 SD. Individuals who test positive for either osteopenia or osteoporosis are advised take appropriate measures to avert or minimize osteoporosis consequences.

2.6.2 Prevention of osteoporosis

Osteoporosis is commonly known as a *pediatric* disorder with *geriatric* consequences because it is best prevented among the youth during childhood and adolescence. This is BMD build up is most achieved efficiently during this age despite its frequent occurrence individuals with over 50 years old. Stated differently, low BMD during youth increases osteoporosis occurrence and its risk during later stages of life and vice versa. Therefore, it is important to initiate and maximize bone health behaviours during youthful stage so as to curb osteoporosis in advanced stages life despite that it is not typically diagnosed in early stages of life.

Osteoporosis is a preventable disease if healthy dietary intake and lifestyle are observed. It is argued that modifying nutritional habits, adequate consumption of calcium and vitamin D, and engaging in more physical activity provide the best preventive approach for osteoporotic complications (Costa *et al.,* 2013). Therefore, its prevention should employ strategies that promote optimal skeletal peak bone mass during growth, maintenance of bone mass in adulthood, and avoidance of bone density loss with ageing. These include adequate calcium and vitamin D consumption, avoiding falls and reducing factors that may cause tripping (e.g., slippery floors, obstacles, and dim light) and bumping into objects that may lead to falls. Notably, vitamin D may be easily obtained through exposure to sunlight for about 15 minutes daily or consumption of foods such as fatty fish like salmon, fish oil, and egg yolks to fortified milk and other food products **(**The Times of India [TOI], 2015**).**

2.6.3 Treatment of osteoporosis

Osteoporosis treatment primarily aims to minimize the risk of fragility fractures (Kim *et al.,* 2017) and prevent fractures. This can be achieved through various treatment and prevention strategies. Pharmacological treatment agents are categorized into antiresorptive agents (i.e., decrease bone resorption) and anabolic agents (i.e., increase skeletal formation (Minisola *et al.,* 2017). Antiresorptive drugs range from bisphosphonates [BPs] (e.g., Alendronate, risedronate, ibandronate plus zoledronic acid), peptide hormones (e.g., teriparatide [the 1, 3,4 amino acid fragment of parathyroid hormone] and calcitonin), postmenopausal estrogen replacement therapy [ERT] for menopausal women together with selective estrogen receptor modulators, abbreviated SERMs (e.g., raloxifene) for postmenopausal women, denosumab, and strontiumranelate. These group of drugs act by reducing bone remodeling (resorption and formation) rates, leading to increased BMD to a certain point result of coupling the two processes (Minisola *et al.,* 2017). On the other hand, anabolic treatment agents act by stimulating bone formation and partial bone resorption. Examples of these agents include teriparatide and romosozumab. Notably, treatment of osteoporosis complications and lost bone replacement are difficult, expensive, and may take a longer than expected.

CHAPTER THREE

MATERIALS AND METHODS

This chapter focuses on methods and procedures that were used to implement the study. These include, the data collection tools and methods, data management, and analysis.

3.1 Study design and Sampling

3.1.1 Study site

The study took place at Thika level V and Gatundu level IV hospitals both of which are government health facilities located in Kiambu County, the central region of Kenya. The selection of these health facilities was done by convenience non-probability sampling since this research work was nested in an ongoing study funded by Jomo Kenyatta University of Agriculture and Technology.

3.1.1.1 Thika level V Hospital

Thika Level V Hospital is a government hospital found in Kiambu County within Thika town, which is about 50 km north-east from Nairobi. This health facility was initiated in 1941 as a cottage clinic with a view to provide health care services to native Africans plus Asians residents around Thika town. It was not until 30th November 2007 that the facility was upgraded to a Level V hospital. To date, the hospital has grown to referral facility and provides services about five million patients across Nairobi, Kirinyaga, Machakos as well as Murang'a counties. With its 300-bed capacity as well as seven inpatient wards**,** the facility provides various services such as in-patient plus out-patient care, surgical, and gynaecological to obstetric as well as paediatric services. Other services offered at the hospital are specialized care, health promotion services, and rehabilitative services to imaging services, and funeral home services.

3.1.1.2 Gatundu level IV hospital

Gatundu Level IV Hospital is located Kiambu County within Gatundu town, approximately 29 Kilometers west from Thika. The hospital was initially established in 1966 to provide health care services to the residents of Gatundu South Constituency and the surrounding region. Since then, both operational and infrastructural capacity have been upgraded to meet the needs of about 500,000 patients annually. With a bed capacity of 300, the hospital provides various inpatient and outpatient medical services to the people in its catchment area, including surgery, intensive care unit (ICU), comprehensive care, orthopaedics, paediatrics, and dialysis, among others.

Figure 2.1: Kiambu County Map

Source: Google map

3.1.2 Study design

This study used a descriptive cross-sectional study design to assess osteoporosis knowledge, health beliefs, and attitudes among 428 women aged 18-52 years attending Maternal Child Health (MCH) Clinics at Thika level V and Gatundu level IV hospitals. The researcher aimed to obtain reliable data based on which a robust conclusion and new hypotheses would be generated which is achievable by the cross-sectional studies (Zangirolami-Raimundo et al., 2018). The study was conducted between June 2017 and February 2018 using four closed-ended interviewer-administered standardized questionnaires.

3.1.3 Target Population

This study targeted women aged 18 to 52 years attending the MCH Clinics at the two hospitals. The choice of the age range of the study subjects was guided by the fact that these women are either within the peak bone mass period (by the third decade of life) or before menopause status during which they could be targeted for health education program on osteoporosis prevention and its risk reduction.

3.1.4 Eligibility criteria

All the study subjects had to fulfill the following selection criteria:

3.1.4.1 Inclusion criteria

a) All women aged between 18 and 52 years attending Maternal Child Health (MCH) Clinics at Thika level V and Gatundu level IV hospitals.
b) All the selected subjects who consented to participate in the study.
c) All qualifying subjects who did not have previous history of osteoporosis or those who had not been diagnosed with osteoporosis based on the prescreening interview.

3.1.4.1 Exclusion criteria

Potential participants who possessed the following characteristics were excluded from the study:

a) All women aged between 18 and 52 years attending other clinics at Gatundu level IV and Thika level V hospitals.
b) All the selected subjects who did not consent to participate in the study.

d) All women who were below 18 years and those above 52 years attending MCH Clinics at the hospitals.
e) All qualifying subjects who had previous history of osteoporosis or those who had been diagnosed with osteoporosis.

3.1.5 Sampling procedure and sample size determination

3.1.5.1 Sampling procedure

This study used simple random sampling technique to select the study subjects as described (Salazar *et al.,* 2015). This involved numbering of small pieces of papers from 1 to 428, cut and folded for distribution. Similar number of papers without numbers shall also be cut and folded for distribution. Both numbered and non-numbered papers were mixed and presented to non-osteoporotic women aged 18-52 years to select one piece of paper. All the subjects who selected numbered papers were sampled out for participation unlike those that picked non-numbered pieces of papers.

3.1.5.2 Sample size determination

Sample size estimation was based on the stated objectives and research questions using Fisher *et al.* (1998) formula at permissible error of 5% and prevalence of 50% subject with a non-response value of (10-1) %.

$$n = \frac{Z^2\ \alpha/2pq}{d^2}$$

Where n = number of subjects, Z α/2= Standard error from mean corresponds to 95% confidence interval =1.96, and the standard normal deviate of d (0.5) = the proportion of women at risk of osteoporosis.

q = 1-p=1-0.5=0. 5

d (0.05) = Permissible error in the estimate of P

Thus, with permissible error of 5%, the sample size was:

$$n = \frac{(1.96)\ 2 \times .5 \times .5}{(0.05)\ 2}$$

n = 384.16

n ≈ 384

To account for non-response rate, a value of [385(10-1)/100] % =34.56≈ 35 subjects was added to the minimum sample size of the subjects to make 419 subjects. However, this number was exceeded by 9 subjects during data collection, making a total of 428 subjects to optimize the sample size and to increase the power of the study.

3.2 Data collection and management

3.2.1 Pretesting research tools

Pretesting the research questions was done at MCH clinics in Kiambu County Referral Hospital to ensure that the pretested subjects are excluded from the main data collection to avoid biasness. The choice of this facility was informed the fact that it was a district hospital with nearly same catchment of patients and of similar background to those at the study sites.

Prior to the pretest study, the researcher trained two research assistants with diploma in nursing for two days to ensure that they were clear with the study purpose, the research variables and overall research tools, and the terms as well as the procedures to be adhered during the study. This was followed by pretesting the research tools

using 10% of the total sample size of 419 (i.e., 41.9 ≈ 42) as recommended by Mugenda and Mugenda (2003) that pretesting size ranges from 1-10% of the sample size (n=419). The pretest was aimed at achieving appropriate and clear research questions for collecting reliable and valid data. This was achieved by checking for question sequencing, wording, clarity, and other relevant requirements for effective implementation of the study such as feasibility, methods as well as time for interviews. Following the pretest, necessary adjustments were done before the main field exercise to ensure collection of valid and reliable data.

3.2.2 Data collection

Quantitative data on socio-demographic characteristics, osteoporosis knowledge, health beliefs, and attitudes was collected using an interviewer administered questionnaire. All the data from the participants was recorded for analysis.

3.2.3 Data entry

All the collected data was checked for consistency followed by double entry into a computer database to ensures data quality before analysis. After further checks of range and consistency, the duplicate databases were merged and revalidated, and any errors was corrected by reference to the primary data. This was followed by exporting the data into a Statistical package for Social Sciences (SPSS) version 20. Data backup was kept in hardware disk and finally kept in lockable drawers for confidentiality.

3.2.4 Data Analysis

Data was coded, processed, and analyzed using SPSS program (Version 20) for windows. Descriptive statistics was used to summarize continuous variables into mean, Standard Deviation (±SD), and mode, and categorical variables into percentages and frequencies. Pearson correlation coefficient was used to examine the association between the sub scales (i.e., osteoporosis knowledge, health beliefs, and attitudes). Further analysis of interrelationships between osteoporosis knowledge, attitudes, and health beliefs was done starting with simple linear regression model followed by

multiple linear regression model. A p value of less than 0.05 was considered significant.

3.3 Ethical consideration

Upon approval of the proposal by School of Public Health and Postgraduate School at Jomo Kenyatta University of Agriculture and Technology [JKUAT] (Appendix 5), Ethical clearance was sought from Kenyatta National Hospital-University of Nairobi Ethical Research Committee [KNH-UNERC] (Appendix 6). Research permit was granted by the National Commission for Science, Technology, and Innovation [NACOSTI] (Appendix 7). Clearance at the facilities was sought from relevant hospital management authorities at Gatundu level IV (Appendix 7) and Thika level V (Appendix 8) hospitals after securing authorization from the Kiambu County authorities. Finally, voluntary participation was sought by informed consent from the selected the selected participants at the two hospitals. This included an explanation on the purpose of the study, and potential benefits of the study to the individual and the greater society. Code numbers rather than names of the candidates were used to identify candidates in order to maintain confidentiality and anonymity. All the participants were requested to sign the consent form prior to data collection as a requirement for ethical research procedure. Any additional information about the study was provided to all the during the interview sessions.

3.4 Dissemination

The findings from this study were disseminated through publication in two international peer review journals and through presentation at the 2018 International Conference on Health at the College of Health Sciences, University of Nairobi, Kenyatta National Hospital Campus, Nairobi, Kenya. The goal was to ensure that the findings are widely accessed by policy makers and program managers to guide them on development of evidence-based osteoporosis interventions.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the findings of the analysis of the knowledge, attitudes, and health beliefs about osteoporosis in women attending Gatundu level IV and Thika level V hospitals in Kiambu County. The sociodemographic characteristics of the participants are described followed by findings for each specific objective: knowledge of osteoporosis; health beliefs about osteoporosis; attitude towards osteoporosis; and association between knowledge, attitudes and health beliefs among women attending MCH clinic.

4.2 Characteristics of participants

The study assessed a total of 428 women aged between 18-52 years attending MCH clinics at Gatundu Level IV (n = 213, 49.8%) and Thika Level V (n = 215, 50.2%) hospitals. All the women completed the osteoporosis knowledge, attitude, health behaviours, and self-efficacy questionnaire. The mean age of all participants was 28.5 years. The most common age groups at both hospitals were 18-22 years with 118 (27.6%) participants followed by 23-27 years accounting for 114 (26.6%) as shown in Table 4.1. There were 197 (46%) women who reported that they had attained secondary level education. The other commonly reported educational levels were tertiary 126 (29.4%) and primary 71 (16.6%) levels of education. Approximately two thirds of participants in the study were married 282, (65.9%), Table 4.1. Overall, 418 (97.7%) participants were Christians.

Majority of the participants 163 (38.2%) reported that they resided in an urban setting while among the remaining participants, there was a similar distribution of peri-urban 134 (31.3%) and rural 131 (30.6%) residents (Table 4.1). Out of all the participants, 279 (65.2%) reported that they lived in permanent type of housing, followed by 73 (17.1%) in semi-permanent, and 74 (17.3%) in temporary housing. Most of the participants were self-employed 161 (37.6%), 97 (22.7%) were unemployed, and

57(13.3%) were students. The participants' distribution by residence, housing type, and occupation is shown in Table 4.1.

Table 4.1: Demographic characteristics of participants

	Frequency (n)	Percent (%)
Age group		
18-22 years	118	27.6
23-27 years	114	26.6
28-32 years	79	18.5
33-37 years	59	13.8
38-42 years	27	6.3
43-47 years	17	4.0
48-52 years	14	3.3
Marital status		
Married	282	65.9
Single	133	31.1
Separated, divorced, or widowed	13	3.0
Level of education		
None	9	2.1
Primary	71	16.6
Secondary	197	46
Tertiary	126	29.4
Post-tertiary	25	5.8
Religion		
Christian	418	97.7
Muslim	3	0.7
Other/ Not stated	7	1.6
Residence		
Urban	163	38.1
Peri-urban	134	31.3
Rural	131	30.6
Type of housing		
Temporary	74	17.3
Semi-permanent	73	17.1
Permanent	279	65.2
Occupation		
Unemployed	97	22.7
Self-employed	161	37.6
Farmer	63	14.7
Student	57	13.3
Formal wage employment	49	11.4
Retired	1	0.2

4.3 Knowledge of osteoporosis among women attending MCH clinic

Women's knowledge of osteoporosis was assessed using 10 items in the modified OKT. The possible range in the OKT was between 0 and 10 and the OKT score mean was 5.0 (SD 1.8) with the OKT scores range from 1 to 10. The distribution of correct responses of OKT items is shown in Figure 4.1 with a mode of 5 out of ten items being correctly responded to by 21.3% of participants.

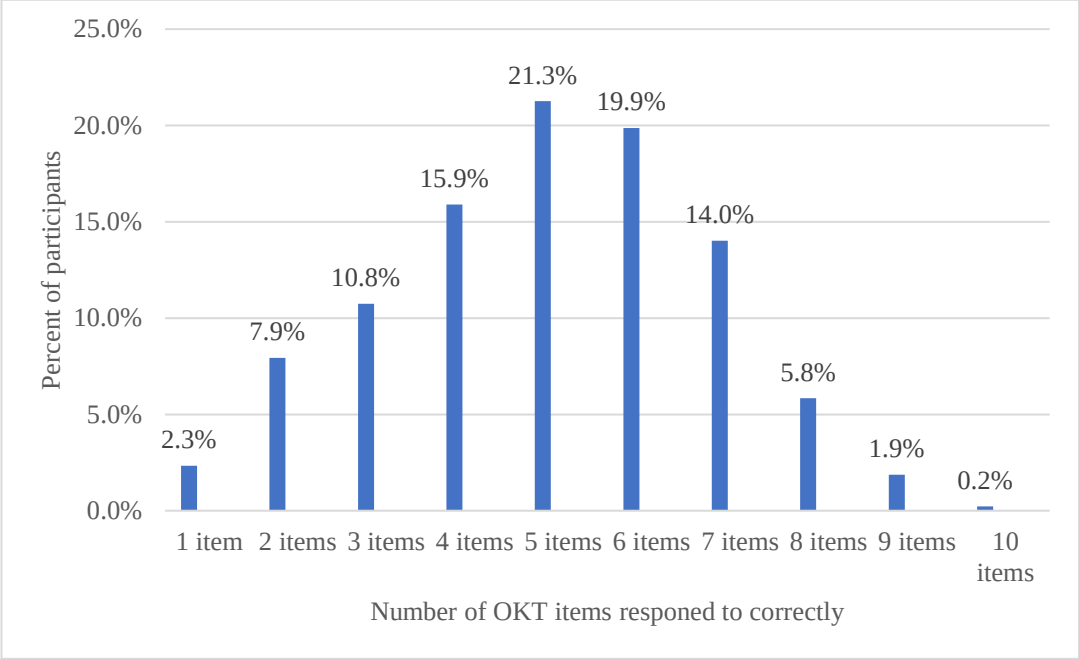

Figure 4.1: Distribution of correct responses to OKT items among the participants

4.3.1 Knowledge of osteoporosis stratified by age.

There was a significant association between the mean OKT scores with participants' age ($p = 0.016$), indicating that age was a significant factor for mean OKT. The mean OKT scores ranged between 4.8 (SD 2) and 6 (SD 1.9) for the different age groups as shown in Table 4.2 below.

Table 4.2: Overall knowledge score stratified according to age

	Range	18-22 years	23-27 years	28-32 years	33-37 years	38 years and above	P
		n = 118	n = 114	n = 79	n = 59	n = 58	
Osteoporosis knowledge score	0-10	4.8 (SD±2.0)	5.0 (SD±1.8)	5.1 (SD±1.7)	5.1 (SD±1.6)	6.0 (SD±1.9)	0.016
Osteoporosis risk and presentation knowledge subscale	0-8	3.7 (SD±1.9)	3.7 (SD±1.6)	3.7 (SD±1.6)	3.8 (SD±1.4)	4.6 (SD±1.8)	0.168
Calcium and dietary knowledge subscale	0-2	1.2 (SD±0.6)	1.3 (SD±0.6)	1.4 (SD±0.5)	1.3 (SD±0.5)	1.4 (SD±0.5)	0.296

Each of the ten OKT items' responses was stratified by respondents' age are presented in Table 4.3. At least half of participants in each age group either agreed or strongly agreed that that: osteoporosis increases the risk of bone fractures development (57.6 to 75.9%); manifests with symptoms such as pain before fractures develop (56.1 to 67.2%); and any physical activity is important in prevention osteoporosis (67.8 to 82.8%). Participants' age showed a significant association with knowledge on the link between osteoporosis family history and osteoporosis development risk ($p = 0.004$), milk as a dietary source of calcium ($p < 0.001$), and effectiveness of osteoporosis treatment in Kenya ($p = 0.041$). These findings suggest that age affects participants' knowledge regarding family history of osteoporosis, milk as a dietary source of calcium, and effectiveness of osteoporosis treatment predict osteoporosis.

Table 4.3: Responses indicating agreement or strong agreement stratified by age

	18-22 years n = 118	**23-27 years** n = 114	**28-32 years** n = 79	**33-37 years** n = 59	**38 years and above** n = 58	**Mean** N=428	**P**
	%	%	%	%	%	%	
Osteoporosis increases the risk of developing bone fractures	57.6	64	67.1	62.7	75.9	65.46	0.199
Osteoporosis commonly manifests with symptoms such as pain before fractures develop	57.6	56.1	64.6	62.7	67.2	61.67	0.544
Osteoporosis affects men more than women	36.4	43.9	35.4	35.6	44.8	39.22	0.562
Osteoporosis equally affects most children and the elderly	28.8	24.6	16.5	23.7	32.8	25.28	0.209
Engaging in any physical activity is important in preventing osteoporosis	73.7	78.9	82.3	67.8	82.8	77.1	0.19
Individuals with a family member with osteoporosis have a higher risk of developing osteoporosis	29.7	28.9	45.6	37.3	53.4	38.98	0.004
Milk is a good source of calcium to the body	80.5	92.1	97.5	0	94.8	72.98	<0.001
Use of calcium supplements alone may prevent bone loss	37.3	37.7	41.8	40.7	46.6	40.82	0.78
The onset of menopause is associated with the risk of osteoporosis	31.4	33.3	43	27.1	36.2	34.2	0.328
Osteoporosis treatment is not effective in Kenya	42.4	38.6	35.4	22	25.9	32.86	0.041

4.3.2 Knowledge of osteoporosis stratified by education level.

Similarly, the mean OKT score was not significantly associated with level of education ($p = 0.109$). This suggests that education was not a significant factor for knowledge. The participants with no formal education scored 4.3 (SD 2.5) while those with tertiary education had a mean of 5.7 (SD 1.9) (Table 4.4).

Table 4.4: Overall knowledge score stratified according to education level

	Range	None	Primary	Secondary	Tertiary	Post-tertiary	P
		n = 9	n = 71	n = 197	n = 126	n = 25	
Osteoporosis knowledge score	0-10	4.3 (SD±2.5)	4.8 (SD±1.7)	4.9 (SD±1.8)	5.7 (SD±1.9)	4.8 (SD±1.3)	0.109
Osteoporosis risk and presentation knowledge subscale	0-8	3.3 (SD±1.5)	3.5 (SD±1.6)	3.7 (SD±1.7)	4.4 (SD±1.8)	3.3 (SD±1.4)	0.052
Calcium and dietary knowledge subscale	0-2	1.0 (SD±1.0)	1.4 (SD±0.5)	1.3 (SD±0.6)	1.3 (SD±0.5)	1.5 (SD±0.5)	0.57

Table 4.5 shows the proportion of women who either agreed or strongly agreed with each of the ten items in the OKT according to education level. At least half of women in each education level agreed or strongly agreed that: an increase in osteoporosis risk causes an increases bone fractures development risk (54.9 to 76%); any physical activity is important in prevention osteoporosis (55.6 to 80%); and milk is a good dietary calcium source (66.7 to 96%).

There was a significant association between education level and responses to the knowledge items on: osteoporosis risk in men compared to women ($p = 0.004$); relationship between menopause onset and risk of osteoporosis ($p = 0.011$); and whether osteoporosis treatment provided in Kenya is effective ($p = 0.009$). This indicates that education affects these knowledge items.

Table 4.5: Responses for agreement or strong agreement stratified by education level

	None	Primary	Secondary	Tertiary	Post-tertiary	Mean	P
	n = 9	n = 71	n = 197	n = 126	n = 25	N=428	
	%	%	%	%	%	%	
Osteoporosis increases the risk of developing bone fractures	55.6	54.9	64	68.3	76	63.76	0.251
Osteoporosis commonly manifests with symptoms such as pain before fractures develop	44.4	56.3	58.4	65.9	68	58.6	0.41
Osteoporosis affects men more than women	11.1	25.4	38.1	50	44	33.72	0.004
Osteoporosis equally affects most children and the elderly	11.1	19.7	26.4	24.6	40	24.36	0.272
Engaging in any physical activity is important in preventing osteoporosis	55.6	73.2	77.7	79.4	80	73.18	0.48
Individuals with a family member with osteoporosis have a higher risk of developing osteoporosis	55.6	45.1	37.6	33.3	16	37.52	0.066
Milk is a good source of calcium to the body	66.7	88.7	91.4	93.7	96	87.3	0.059
Use of calcium supplements alone may prevent bone loss	44.4	45.1	40.1	38.1	32	39.94	0.792
The onset of menopause is associated with the risk of osteoporosis	77.8	40.8	27.9	37.3	32	43.16	0.011
Osteoporosis treatment is not effective in Kenya	0	26.8	32.5	45.2	40	28.9	0.009

4.3.2 Knowledge of osteoporosis stratified by other demographic factors.

The mean knowledge score for osteoporosis was significantly associated with residence (p = 0.013), marital status (p = 0.038), and occupation (p = 0.005) as shown in Table 4.6.

Table 4.6: Association of demographic factors with knowledge

	Mean Knowledge score (SD)	**P value**
Religion		
Christian	5.1(SD±1.8)	0.556
Other	4.0(SD±.)	
Marital status		
Single	5.3(SD±2.0)	0.038
Married	5.1(SD±1.7)	
Separated/ divorced or widowed	3.3(SD±1.6)	
Residence		
Urban	4.8(SD±2.0)	0.013
Peri-urban	5.6(SD±1.7)	
Rural	4.9(SD±1.8)	
Housing type		
Temporary	5.3(SD±1.8)	0.629
Semi-permanent	4.9(SD±1.5)	
Permanent	5.1(SD±1.9)	
Occupation		
Unemployed	4.5(SD±1.8)	0.005
Self-employed	5.5(SD±1.7)	
Farmer	4.9(SD±1.7)	
Student	5.9(SD±1.9)	
Formal wage employment	4.8(SD±2.0)	
Retired*	4.0	

* SD not calculated because only a single participant was found in the category

4.4 Health beliefs about osteoporosis among women

The health beliefs about osteoporosis among women was assessed based on 22 items on the modified osteoporosis health belief scale (m-OHBS). The OHBS scores ranged

from 22 (for strong disagreement) with all belief items to 110 (for strong agreement) with all items.

4.4.1 Health beliefs about osteoporosis stratified by age.

The mean OHBS score was 76.9 (SD 10.4) out of 110. Table 4.7 shows a significant association between OHBS and age (p = 0.002), suggesting that age affected OHBS. The mean score for health belief was lowest (74.2) in the youngest age group (18-22 years).

Table 4.7: Overall health belief score stratified according to age

	18-22 years	**23-27 years**	**28-32 years**	**33-37 years**	**38 years and above**	**P**
	n = 118	n = 114	n = 79	n = 59	n = 58	
Osteoporosis health belief score	74.2 (SD±7.3)	79.0 (SD±8.3)	81.1 (SD±9.1)	77.6 (SD±14.7)	80.4 (SD±7.2)	0.002

Eight out of the 22 individual items contained in the modified OHBS showed a significant association with participant's age (Table 4.8). The beliefs that were associated with age were: osteoporosis always makes one crippled (p = 0.011); developing osteoporosis would cost the individual heavily (p = 0.008); adequate calcium intake prevents osteoporotic related problems (p = 0.047) and reduces risk of bone fractures (p = 0.018); regular exercise should be done only by individuals who are strong enough (p = 0.004) and have access to a gym (p = 0.014); and that the respondent was used to taking balanced diet (p = 0.017).

Table 4.8: Responses for agreement or strong agreement stratified by age

	18-22 years	23-27 years	28-32 years	33-37 years	38 years and above	Mean %	P
	n = 118	n = 114	n = 79	n = 59	n = 58		
Everybody is at risk of developing osteoporosis	61	70.2	69.6	62.7	74.1	67.52	0.342
I am more likely to get osteoporosis if any of parents has osteoporosis	22	21.9	30.4	25.4	37.9	27.52	0.136
Having osteoporosis always makes one to be crippled	29.7	43	46.8	35.6	55.2	42.06	0.011
Developing osteoporosis would cost me heavily	60.2	68.4	79.7	67.8	82.8	71.78	0.008
Thinking about osteoporosis depresses and scares me	53.4	57.9	67.1	55.9	72.4	61.34	0.086
Developing osteoporosis is a very serious matter	72	78.1	78.5	72.9	86.2	77.54	0.274
Engaging in regular exercise prevents osteoporotic related problems	83.9	85.1	88.6	81.4	82.8	84.36	0.797
Regular exercise helps to build strong bones	93.2	88.6	92.4	88.1	91.4	90.74	0.686
Regular exercises improve my body outlook	86.4	88.6	83.5	86.4	87.9	86.56	0.891
Engaging in regular exercises reduces development of bone fractures	56.8	56.1	64.6	57.6	50	57.02	0.551
Adequate calcium intake prevents osteoporotic related problems	62.7	78.1	79.7	72.9	74.1	73.75	0.047
Adequate calcium consumption reduces the risk of bone fractures	58.5	71.9	74.7	71.2	81	71.46	0.018
One should engage in regular exercise only if one is strong enough	33.1	43	49.4	50.8	62.1	47.68	0.004

One should exercise if she/he has access to a gym or a place for exercise	41.5	50	53.2	55.9	69	53.92	0.014
Regular exercise is a difficult new habit for me to start	24.6	25.4	38	39	20.7	29.54	0.045
Engaging in regular exercise is uncomfortable for me	11	20.2	16.5	13.6	12.1	14.68	0.343
Regular exercise upsets my daily routine	16.9	17.5	30.4	23.7	20.7	21.84	0.169
I am used to taking a well-balance diet	76.3	77.2	79.7	67.8	56.9	71.58	0.017
I am updated with new health information	70.3	73.7	82.3	69.5	75.9	74.34	0.358
One should do his/her best to establish health related problems early	89	93	94.9	89.8	87.9	90.92	0.489
One should attend regular medical check-up with or without sickness	90.7	88.6	88.6	81.4	89.7	87.8	0.474
One should adhere to health recommendations	89	96.5	97.5	89.8	89.7	92.5	0.06

4.4.2 Health beliefs about osteoporosis stratified by education level.

There was no association between OHBS and the education level of participants (p = 0.736), suggesting that education is not effective on OHBS. The mean OHBS score ranged from 76.4 in participants with tertiary education to 79.7 in those with no formal education (Table 4.9).

Table 4.9: Overall health belief score stratified according to education level

	None	**Primary**	**Secondary**	**Tertiary**	**Post-tertiary**	**P**
	n = 9	**n = 71**	**n = 197**	**n = 126**	**n = 25**	
Osteoporosis health belief score	79.7 (SD±10.7)	78.9 (SD±7.9)	78.1 (SD±10.0)	76.4 (SD±9.5)	76.7 (SD±7.6)	0.736

The responses of women for seven of the 22 items in the OHBS showed a significant association with education level (Table 4.10). These health belief items that were associated with education level included: I am more likely to get osteoporosis if any of parents has osteoporosis ($p = 0.001$); Having osteoporosis always makes one to be crippled ($p = 0.001$); Developing osteoporosis is a very serious matter ($p = 0.004$); One should engage in regular exercise only if one is strong enough ($p < 0.001$); One should exercise if she/he has access to a gym or a place for exercise ($p < 0.001$); Regular exercise upsets my daily routine($p = 0.015$) and One should adhere to health recommendations ($p = 0.023$). This implies that these belief items are influenced by education.

Table 4.10: Responses for agreement or strong agreement stratified by education level

	None	**Primary**	**Secondary**	**Tertiary**	**Post-tertiary**	**Mean**	**P**
	n = 9	**n = 71**	**n = 197**	**n = 126**	**n = 25**	**N=428**	
Everybody is at risk of developing osteoporosis	55.6	67.6	64.5	70.6	72	66.06	0.708
I am more likely to get osteoporosis if any of parents has osteoporosis	77.8	31	27.9	19.8	12	33.7	0.001
Having osteoporosis always makes one to be crippled	55.6	49.3	46.7	31	12	38.92	0.001
Developing osteoporosis would cost me heavily	55.6	74.6	67	74.6	64	67.16	0.383
Thinking about osteoporosis depresses and scares me	66.7	67.6	57.4	61.9	48	60.32	0.387
Developing osteoporosis is a very serious matter	66.7	87.3	81.2	67.5	64	73.34	0.004
Engaging in regular exercise prevents osteoporotic related problems	77.8	81.7	83.8	86.5	92	84.36	0.682

Regular exercise helps to build strong bones	88.9	83.1	91.9	93.7	92	89.92	0.154
Regular exercises improve my body outlook	88.9	84.5	84.3	90.5	92	88.04	0.476
Engaging in regular exercises reduces development of bone fractures	66.7	50.7	61.4	54	56	57.76	0.472
Adequate calcium intake prevents osteoporotic related problems	55.6	62	75.1	74.6	84	70.26	0.095
Adequate calcium consumption reduces the risk of bone fractures	44.4	67.6	69	73.8	72	65.36	0.408
One should engage in regular exercise only if one is strong enough	55.6	69	47.2	32.5	20	44.86	<0.001
One should exercise if she/he has access to a gym or a place for exercise	88.9	71.8	54.3	36.5	36	57.5	<0.001
Regular exercise is a difficult new habit for me to start	22.2	38	27.4	23	44	30.92	0.084
Engaging in regular exercise is uncomfortable for me	11.1	21.1	11.2	17.5	16	15.38	0.278
Regular exercise upsets my daily routine	22.2	35.2	19.8	17.5	8.0	20.54	0.015
I am used to taking a well-balance diet	44.4	69	77.2	71.4	76	67.6	0.176
I am updated with new health information	66.7	74.6	77.2	69	76	72.7	0.566

One should do his/her best to establish health related problems early	66.7	90.1	90.9	92.1	0	67.96	0.053
One should attend regular medical check-up with or without sickness	88.9	84.5	86.8	90.5	0	70.14	0.256
One should adhere to health recommendations	66.7	91.5	93.4	92.9	0	68.9	0.023
Mean % per age group	53.53	71.14	69.33	66.74	24.77		

4.4.3 Health beliefs about osteoporosis stratified by other demographic factors.

The mean health belief score was not significantly associated with religion (p = 0.849), marital status (p = 0.341), residence (p = 0.187), type of housing (p = 0.18) or occupation (p = 0.179) as shown in Table 4.11.

Table 4.11: Association of demographic factors with health beliefs

	Mean Health beliefs score (SD)	P value
Religion		
Christian	77.8(SD±9.5)	0.849
Other	76.0(SD±.)	
Marital status		
Single	76.6(SD±7.5)	0.341
Married	78.3(SD±10.3	
Separated/ divorced or widowed	80.7(SD±8.1)	
Residence		
Urban	76.2(SD±8.7)	0.187
Peri-urban	79.2(SD±7.6)	
Rural	77.9(SD±11.2)	
Housing type		
Temporary	78.6(SD±8.6)	0.18
Semi-permanent	75.2(SD±7.5)	
Permanent	78.4(SD±9.9)	
Occupation		
Unemployed	76.9(SD±7.8)	0.179
Self-employed	79.7(SD±8.6)	
Farmer	75.8(SD±12.5)	
Student	76.3(SD±8.2)	

Formal wage employment	79.1(SD±10.2)
Retired	89.0*
* SD not calculated because only a single participant was found in the category	

4.5 Attitudes towards osteoporosis among women

The attitudes of osteoporosis were assessed using 4 items.

4.5.1 Attitudes towards osteoporosis stratified by age

The mean attitude score was 15.1 (SD 3.9) out of a possible maximum score of 20. The attitude score increased with increasing age from 14.2 in 18-22 years to 17.3 at 38 years and above. Table 4.12 shows that attitude score towards osteoporosis was significantly associated with age (p = 0.002). This suggests that age is a significant factor on attitudes.

Table 4.12: Overall attitudes towards osteoporosis stratified by age

	18-22 years	**23-27 years**	**28-32 years**	**33-37 years**	**38 years and above**	**P**
	n = 118	n = 114	n = 79	n = 59	n = 58	
Attitude on osteoporosis	14.2 (SD±3.3)	14.7 (SD±4.6)	16.0 (SD±2.6)	15.9 (SD±3.9)	17.3 (SD±2.6)	0.002

Responses to attitude items on whether women have a higher osteoporosis risk than men (p =0.003) and whether osteoporosis transmission from one individual to another is possible (p = 0.047) showed a significant association with participants' age (Table 4.13).

Table 4.13: Participants attitudes towards osteoporosis stratified by age

	18-22 years	23-27 years	28-32 years	33-37 years	38 years and above	P
	n = 118	n = 114	n = 79	n = 59	n = 58	
Everybody in Kenya is at risk of developing osteoporosis.	56.8	64	64.6	64.4	77.6	0.119
Women are at higher risk of osteoporosis than men	37.3	47.4	55.7	52.5	67.2	0.003
Osteoporosis cannot be transmitted from one individual to another	73.7	72.8	83.5	72.9	89.7	0.047
Osteoporosis can be prevented and managed by screening for osteoporosis	72.9	78.9	75.9	67.8	69	0.462

4.5.2 Attitudes towards osteoporosis stratified by education level

There was no significant association between attitudes towards osteoporosis and the education level of women (p = 0.823) as shown in Table 4.14. This implies that education was not a predictor for osteoporosis attitudes.

Table 4.14: Overall attitudes towards osteoporosis stratified by education level

	None	Primary	Secondary	Tertiary	Post-tertiary	P
	n = 9	n = 71	n = 197	n = 126	n = 25	
Attitude/ perceptions on osteoporosis	15.3 (SD±2.1)	15.7 (SD±2.9)	15.2 (SD±4.3)	14.8 (SD±3.2)	16.2 (SD±3.1)	0.823

Education level was not significantly associated with any of the four attitude items for osteoporosis (Table 4.15). As mentioned before, none of these items predicted osteoporosis attitudes among the participants according to their education level.

Table 4.15: Participants' attitudes towards osteoporosis stratified by education level

	None	Primary	Secondary	Tertiary	Post-tertiary	P
	n = 9	n = 71	n = 197	n = 126	n = 25	
Everybody in Kenya is at risk of developing osteoporosis.	88.9	66.2	64	59.5	72	0.36
Women are at higher risk of osteoporosis than men	55.6	63.4	46.7	47.6	40	0.121
Osteoporosis cannot be transmitted from one individual to another	66.7	78.9	80.2	76.2	60	0.2
Osteoporosis can be prevented and managed by screening for osteoporosis	66.7	60.6	76.1	78.6	72	0.067

Table 4.16 shows that the mean score for attitude towards osteoporosis was not significantly associated with religion ($p = 0.833$), marital status ($p = 0.471$), residence ($p = 0.769$), type of housing ($p = 0.777$) or occupation ($p = 0.301$).

Table 4.16: Association of demographic factors attitudes

	Mean Attitude score (SD)	P value
Religion		
Christian	15.2(SD±3.7)	0.833
Other	16.0(SD±.)	
Marital status		
Single	14.8(SD±4.0)	0.471
Married	15.4(SD±3.6)	
Separated/ divorced or widowed	15.5(SD±2.8)	
Residence		
Urban	15.0(SD±4.0)	0.769
Peri-urban	15.4(SD±3.5)	
Rural	15.3(SD±3.6)	
Housing type		
Temporary	15.7(SD±4.3)	0.777
Semi-permanent	15.0(SD±3.1)	
Permanent	15.2(SD±3.8)	
Occupation		
Unemployed	14.3(SD±4.2)	0.301
Self-employed	15.9(SD±2.7)	
Farmer	15.3(SD±4.6)	
Student	14.9(SD±1.9)	
Formal wage employment	15.7(SD±4.9)	
Retired*	16.0	

* SD not calculated because only a single participant was found in the category

4.6 Osteoporosis self-efficacy scale (OSES)

Participants highly rated OSES with at least 50% of participants agreeing or strongly agreeing with all OSES items according to age group, except for the statement on exercise difficulty and its benefit to the body for which between 48.3 and 59.5% of participants agreed or strongly agreed depending on age group (Table 4.17). Only a single item (my diet should include calcium rich foods) was significantly associated with age ($p = 0.039$), implying that age affected this osteoporosis self-efficacy factor.

Table 4.17: Participants' responses of osteoporosis self-efficacy scale according to age

	18-22 years	23-27 years	28-32 years	33-37 years	38 years and above	Mean %	P
	n = 118	n = 114	n = 79	n = 59	n = 58		
It is good to begin a new exercise program if not currently engaged in one	87.3	83.3	88.6	84.7	87.9	86.36	0.819
It is good to commit some time to exercise regularly	80.5	86.8	86.1	81.4	86.2	84.2	0.638
The more difficult the exercises are, the better for the body	48.3	53.5	59.5	59.3	53.4	54.8	0.526
My diet should include calcium rich foods	79.7	91.2	92.4	83.1	87.9	86.86	0.039
It is good to obtain calcium rich foods	83.9	91.2	92.4	89.8	93.1	90.08	0.214
Work that involves movement and physical activities are good for health	88.1	92.1	91.1	93.2	94.8	91.86	0.595

Participants' education level showed significant association with three OSES items: It is good to begin a new exercise program if not currently engaged in one ($p = 0.022$); It is good to commit some time to exercise regularly ($p < 0.001$); and the more difficult the exercises is, the better for the body ($p = 0.02$) (Table 4.18).

Table 4.18: Participants' responses of osteoporosis self-efficacy scale based on education level

	None	Primary	Secondary	Tertiary	Post-tertiary	Mean %	P
	n = 9	n = 71	n = 197	n = 126	n = 25		
It is good to begin a new exercise program if not currently engaged in one	88.9	78.9	83.2	92.9	96	87.98	0.022
It is good to commit some time to exercise regularly	88.9	70.4	81.7	92.1	0	66.62	<0.001
The more difficult the exercises are, the better for the body	66.7	60.6	59.4	42.1	48	55.36	0.02
My diet should include calcium rich foods	66.7	81.7	87.8	86.5	0	64.54	0.068
It is good to obtain calcium rich foods	0	85.9	90.4	88.1	96	72.08	0.468
Work that involves movement and physical activities are good for health	0	85.9	91.4	92.1	0	53.88	0.202
Mean %	51.87	77.23	82.32	82.3	40		

4.7 Association between osteoporosis knowledge, attitude, and health beliefs

Table 4.19 shows the correlation coefficients between osteoporosis knowledge, health belief, self-efficacy, and attitude. There were moderately strong and significant correlations between osteoporosis health belief and self-efficacy (rho = 0.5789, $p < 0.001$), health belief and attitude (rho = 0.5364, $p < 0.001$), and self-efficacy and attitude towards osteoporosis (rho = 0.5935, $p < 0.001$). Osteoporosis knowledge was

weakly correlated with self-efficacy (rho = 0.1376, p = 0.026) and attitude towards osteoporosis (rho = 0.2038, p = 0.0001). This implies that osteoporosis health beliefs, attitudes, and self-efficacy were interrelated and influenced each other strongly unlike knowledge.

Table 4.19: Correlation coefficients for knowledge, health beliefs, attitudes, and self-efficacy

		Osteoporosis knowledge test (OKT)	Osteoporosis health belief scale (OHBS)	Osteoporosis self-efficacy scale (OSES)	Attitude towards osteoporosis
Osteoporosis knowledge test (OKT)	rho	1			
Osteoporosis health belief scale (OHBS)	rho	0.0771	1		
	P value	0.6687			
Osteoporosis self-efficacy scale (OSES)	rho	0.1376*	0.5789*	1	
	P value	0.026	<0.001		
Attitude/ perception towards osteoporosis	rho	0.2038*	0.5364*	0.5935*	1
	P value	0.0001	<0.001	<0.001	

Linear regression model presented in table 4.20 showed that health belief scale did not predict osteoporosis knowledge (p = 0.111). This implies that there was no relationship between osteoporosis health beliefs and knowledge and thereby did not affect each other.

Table 4.20: Predictive effect of health belief scale on osteoporosis knowledge test

	Coefficients	Std. Error	t	P value	95% CI	
Osteoporosis health belief scale (OHBS)	0.01	0.01	1.6	0.111	0.00	0.03
Constant	4.00	0.66	6.09	<0.001	2.71	5.29

Further linear regression model analysis revealed that osteoporosis self-efficacy was a significant predictor of scores on the OKT as shown in Table 4.21 below. This is

because an increase in osteoporosis knowledge by 0.05 units increased each unit of osteoporosis self-efficacy and this increase was statistically significant (p = 0.004).

Table 4.21: Predictive effect of self-efficacy scale on osteoporosis knowledge test

	Coefficients	Std. Error	t	P value	95% CI	
Osteoporosis self-efficacy scale (OSES)	0.05	0.02	2.87	0.004	0.02	0.09
Constant	3.81	0.43	8.77	<0.001	2.96	4.67

Similarly, attitudes towards osteoporosis were associated with osteoporosis knowledge (p <0.001). This is because there was an increase in osteoporosis knowledge test by 0.1 for each unit increase in attitudes scores towards osteoporosis which was also was statistically significant (Table 4.22).

Table 4.22: Predictive effect of attitudes towards osteoporosis-on-osteoporosis knowledge test

	Coefficients	Std. Error	t	P value	95% CI	
Attitudes	0.10	0.02	4.3	<0.001	0.05	0.14
Constant	3.58	0.35	10.26	<0.001	2.90	4.27

Multivariable linear regression analysis of health belief, self-efficacy, and attitudes versus osteoporosis knowledge found that only attitudes were significantly effective on knowledge (p = 0.001). In the model adjusting for effect of health belief and self-efficacy, a unit change in score in attitude resulted change of 0.1 in the knowledge score of women (Table 4.23).

Table 4.23: Predictive effect of attitude, health beliefs, and self-efficacy on OKT score

	Coefficients	Std. Err.	t	P value	95% CI	
Osteoporosis health belief scale (OHBS)	-0.01	0.01	-1.05	0.293	-0.03	0.01
Osteoporosis self-efficacy scale (OSES)	0.02	0.02	0.81	0.42	-0.03	0.07
Attitudes towards osteoporosis	0.10	0.03	3.36	0.001	0.04	0.16
Constant	3.96	0.65	6.1	<0.001	2.68	5.24

4.8 Summary of results and interpretation

This study found mean knowledge score of 5 out of 10 on the OKT. This reflects moderate osteoporosis knowledge level among the women. There was no significant association between the mean OKT scores with participants' age ($p = 0.08$) and level of education ($p = 0.109$). However, both age and education level were significantly associated with certain knowledge items. Four key areas of poor knowledge were the age-related osteoporosis risk; the onset of menopause and increased risk of osteoporosis; effect of family history of osteoporosis on risk; and gender differences associated with osteoporosis risk.

Health beliefs were moderately strong, and women scored an average of 76.9 out of a total score of 110. In addition, health belief scores generally increased with increasing age. The mean OHBS scores were significantly associated with age ($p = 0.002$) unlike education level. Some health belief items were associated with both age and education level. There was significant association between education level with 3 Self-efficacy items and only item of SES with age.

The attitudes towards osteoporosis were positively represented by a mean score of 15 out of 20. There was significant association between age and osteoporosis attitudes score ($p = 0.002$) unlike education level. Some attitudes items were significantly associated with age. However, none of them were significantly associated with education level.

The findings revealed a moderately strong and significant correlations between osteoporosis health belief and self-efficacy (rho = 0.5789, $p < 0.001$), health belief and attitude (rho = 0.5364, $p < 0.001$), and self-efficacy and attitude towards osteoporosis (rho = 0.5935, $p < 0.001$). However, osteoporosis knowledge was weakly correlated with self-efficacy (rho = 0.1376, $p = 0.026$) and attitude towards osteoporosis (rho = 0.2038, $p = 0.0001$). Since the participants had moderate OKT scores which is not adequate, this study recommends that awareness of osteoporosis be raised among the women, particularly the younger women with lowest OKT scores.

CHA PTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Introduction

This study assessed the osteoporosis knowledge, attitudes and health beliefs among women aged 18-52 years at MCH clinics in Thika level V and Gatundu level IV hospitals in Kiambu County of central region of Kenya. The study was framed based on the HBM model since it is used to predict the possibility of health behavioural changes among individuals and to explain why some people adopt preventive behaviours while others do not. Therefore, the osteoporosis health behavior scale (OHBS) is used to identify individuals at risk of osteoporosis in order to initiate preventive actions. The findings for this study are discussed based on each research objective in the sections below.

5.1.2 Knowledge of osteoporosis

This study found that the participants in the two facilities shared similar socio-demographic and economic characteristics except for occupation in which they were engaged and area of residence. This implies that their differences in osteoporosis knowledge are not likely to be attributed to differences in socio-demographic and economic characteristics. There was a mean OKT score of 5 ± 1.8 with a mode of 5 out of ten items (21.3%) being correctly responded to. This indicates that the participants had moderate osteoporosis knowledge. Previous studies found relatively higher mean (33.2 ± 8) and median (34) scores out of 100 (Muhammad *et al*., 2017). Another similar study reported mean of 34.8 ± 10 and median 35 out of 100 (de Silva *et al.,* 2014).

Based on age, at least 67.8% participants positively agreed that any physical activity is important in prevention osteoporosis. This suggests that the women had good knowledge about the importance of physical activity in osteoporosis prevention. Consistent to this finding, de Silva *et al.* (2014) reported that better knowledge about

weight bearing exercises is protective against osteoporosis. This is because physical activity can stimulate bone formation process by mechanically straining the skeleton and thereby improves or maintains BMD, mobility, physical functioning, and muscle strength. There were at least 57.6% participants who positively agreed that osteoporosis elevates bone fractures development risk. This supports the view the condition weakens the bones, leading to greater fragility fractures risk (IOF, 2015). At least 56.1% positively agreed that osteoporosis commonly manifests with symptoms such as pain before fractures develop. Pain, fractures, and physical disability are the common clinical manifestations of osteoporosis. Consequently, the affected individuals become dependent and may end in long-term care.

Family history ($p = 0.004$), milk as source of calcium ($p < 0.001$), and treatment effectiveness ($p = 0.041$) were significantly associated with osteoporosis knowledge. This supports previous findings that osteoporosis is associated with previous fractures or family history-related fractures, and lack of adequate calcium and Vitamin D consumption, among other factors (Andersen, & Laurberg, 2014; Pervaiz *et al.*, 2013). Therefore, having a diet rich in calcium is a very important preventive measure for osteoporosis (Hosking *et al.*, 2015) since it is essential for proper bone development and strength. On the other hand, osteoporosis treatment may involve pharmacologic and non-pharmacologic methods. Notably, effective osteoporosis treatment requires early diagnosis and patient education on about their prescribed medications and correct administration for pharmacologic treatment or non-pharmacologic measures for managing low bone mass and osteoporosis. Therefore, health care system can adopt education and self-care support for osteoporosis prevention and management.

Based on education level, at least 88.7% participants with formal education positively agreed that milk serves as a good calcium source to the body versus 66.7% with informal education. This comparable previous study that 70.1% of the participants accurately opened that adequate calcium could be obtained from taking two glasses of milk daily (Hala *et al.,* 2015). At least 73.2% participants with formal education positively responded that any physical activity plays an important role in osteoporosis prevention. Similarly, Muir *et al.* (2013) found that physical activity increases the BMD which promotes the bone strength and reduces osteoporosis risk. More than

54.9% participants positively opened that osteoporosis risk increases bone fractures development risk. According to Palacios *et al.* (2014), osteoporosis causes fragility fractures, leading to decreased physical as well as social functions. Evidently, osteoporotic fractures impose heavy burden on the society in terms of high treatment costs, disability, morbidity, and mortality.

Education level was significantly associated with knowledge item of osteoporosis risk in men versus women ($p = 0.004$) consistent with findings by Abushaikha, & Omran (2010). Moreover, there was a relationship between menopause onset and risk of osteoporosis ($p = 0.011$) which is consistent with Tian *et al.* (2017) report that menopause age and education level were significantly associated with postmenopausal osteoporosis risk in women among other factors.

Finally, this study also found significant association between whether osteoporosis treatment provided in Kenya is not effective ($p = 0.009$). The findings suggest that effective treatment may be lacking in the country to promote prevention of osteoporosis. This could be due to lack, inadequate or delayed osteoporosis diagnosis as a result of low suspicion index and limited access to central DEXA machines which are only few in Kenya. Gheita & Hammam. (2018) demonstrated a lack of preventive and management guidelines in Middle East as well as North Africa region. Although our study did not find significant association between osteoporosis knowledge and education level, the findings indicate that osteoporosis knowledge has a critical role to play in preventive behavior. In addition, an individual's educational level can change the perception towards health and/or illness towards improvement.

Overall, this study showed that the women had moderate osteoporosis knowledge test score with a mean score of 5 out of 10 (approximately 50%) in the two hospitals. A similar study by Sitati et al. (2021) reported mean osteoporosis knowledge score of 8.6 ±1.8 among postmenopausal women within Kiambu County. These findings confirm findings by de Silva *et al.* (2014) that most participants had a modest osteoporosis knowledge. However, there was no difference in knowledge level among the participants at Thika level V and Gatundu level IV hospital.

5.1.3 Health beliefs of osteoporosis

This study found a mean OHBS score of 76.9 (SD 10.4) out of 110. Stratified by age, the mean score for health belief generally increased across the age groups with the highest among the age group 28-32 years (81.1±9.1) and the lowest among those aged 18-22 years (74.2 ±7.3). The findings from the current study suggest that the age factor may predict osteoporosis beliefs and may be attributed to the fact that the condition is mainly considered to be associated with ageing process. Therefore, the disease is believed to be an important health problem for the middle-aged and elderly people more than the young ones. The belief that "regular exercise helps to build strong bones" was the most frequently rated with an overall mean of 90.74% versus "I am more likely to get osteoporosis if any of my parents has osteoporosis" as the least frequently rated at a mean of 14.6%. Engaging in physical activity increases the BMD which promotes the bone strength and reduces osteoporosis risk (Muir *et al.,* 2013). On the other hand, genetic factors like osteoporosis family history heightens the risk for osteoporosis development (DVO, 2014). Conversely, Sitati *et al*. (2021) reported moderate perceived benefits of exercising plus calcium intake; perceived osteoporosis seriousness; and health motivation among postmenopausal women in the same County. Therefore, having and making use of knowledge on osteoporosis risk factors is likely to promote positive beliefs about osteoporosis and its prevention.

Stratified by education level, this study reported mean OHBS score range from 76.4±7.6 in participants with tertiary education to 79.7±10.7 in those with no formal education. Our findings suggest that the less educated women had better knowledge about osteoporosis than those more educated, which is inconsistent with previous reports (Wastesson *et al.,* 2013; Etemadifar *et al.,* 2013). Despite that education predicts osteoporosis, our findings may suggest that the highly educated women were not knowledgeable about osteoporosis and therefore could not translate it into relevant context or preventive practices. The practice implication for this finding is that action is needed to sensitize the public about osteoporosis risk factors as a way to promote positive behavior changes for osteoporosis prevention.

Stratified by age and education level, the perceptions of cues to action and benefits were highly rated by participants. Based on age, an average of 86.39 % of the participants generally expressed their greatest cues to action that "they are updated with new health information; one should do his/her best to establish health related problems early; one should attend regular medical check-up with or without sickness; and one should adhere to health recommendations". Moreover, an average of 74.76% participants expressed their perceived benefits of undertaking preventive measures that "engaging in regular exercise prevents osteoporotic related problems; regular exercise helps to build strong bones; regular exercises improves my body outlook; engaging in regular exercises reduces development of bone fractures; adequate calcium intake prevents osteoporotic related problems; adequate calcium consumption reduces the risk of bone fractures; and I am used to taking a well-balance diet".

In terms of education level, the participants generally expressed their greatest belief in perceived benefits (74.76%) and cues to action (69.93 %) for the same items as for age, on average. This support previous report that perceptions of health beliefs such as relative benefit and cues to actions mediate between knowledge and behaviors for prevention of osteoporosis (Jang, & Ahn, 2015). Therefore, with proper knowledge and its use, these participants are likely to adopt changes in their behaviours to prevent osteoporosis, particularly with regard to engaging in exercise, calcium consumption, and taking balanced diet.

Stratified by age and education, the participants indicated less believe in perceived severity "having osteoporosis always makes one to be crippled; developing osteoporosis would cost me heavily; thinking about osteoporosis depresses and scares me; and developing osteoporosis is a very serious matter" at a mean of 58.40% and 55.47% respectively. This suggest that the participants considered osteoporosis a serious disease. Consistent to these findings, Muhammad *et al*. (2017) reported that more than half of the participants perceived seriousness of disease among the participants. On average, the perceived susceptibility (everybody is at risk of developing osteoporosis; and I am more likely to get osteoporosis if any of parents has osteoporosis) were rated low at 47.52 % and 49.88% based on age and education respectively. This is consistent with a previous study that found low perceptions of

both susceptibility and severity towards osteoporosis (Priyanka *et al.,* 2013). Similarly, Muhammad *et al.* (2017) reported that 14.0% participants perceived susceptibility regarding osteoporosis. The low mean susceptibility score implies that the participants hardly believed in develop osteoporosis since it was not considered a health threat and thereby low susceptibility to protection from osteoporosis.

Similarly, the participants expressed low perceived barriers (one should engage in regular exercise only if one is strong enough; one should exercise if she/he has access to a gym or a place for exercise; regular exercise is a difficult new habit for me to start; engaging in regular exercise is uncomfortable for me; and regular exercise upsets my daily routine) at an average of 33.53% and 33.84% for age and education respectively. The relatively low beliefs in perceived barriers to osteoporosis suggest their likelihood to practice osteoporosis preventive behavious (Gözüm, & Çapık, 2014). Therefore, the study population is more than likely to adopt protective behaviors to combat the disease without modifying their beliefs.

The study found an association between age and education level with perceived severity with regard to "osteoporosis always makes one crippled ($p = 0.011$ versus $p = 0.001$) and "developing osteoporosis would cost the individual heavily ($p = 0.008$ versus $p = 0.004$)". These findings suggest a relationship for intention to adopt preventive behavours with age. Consistent to my finding, Sinaki (2017) and Darba *et al.* (2015) stated that osteoporosis fractures may cause long-term problems that include chronic pain, disability, and death. By contrast, Priyanka *et al.* (2013) reported a lack of significant association between perceived severity and preventive behaviors. Additionally, there was an association between age and perceived benefit of "adequate calcium intake reduces risk of bone fractures ($p = 0.018$)" based on age and education respectively. This study suggests that the women perceived themselves susceptible to osteoporosis despite a lack of its symptoms. These findings are contrary to a previous study by Priyanka *et al.* (2013) reported a lack of significant association between perceived susceptibility and preventive behaviors.

There was also an association between perceived benefit of "adequate calcium intake in prevention of osteoporotic related problems (p = 0.047) and intake of balanced diet (p = 0.017)". This is in support of Wafaa HHAS and Wafaa GMA (2014) that an individual's perceptions of benefits are associated with osteoporosis beliefs. Based on age and education, this study found an association between perceived barriers with regard to regular exercise being done only by individuals who are strong enough (p = 0.004 versus 0.001), those with access to a gym (p = 0.014 versus p < 0.001); and regular exercise being a difficult new habit for one to start (0.045 versus p = 0.015) respectively. These perceptions negatively affect osteoporosis beliefs and thereby an individual's preventive efforts (Wafaa HHAS, & Wafaa GMA, 2014). Sitati *et al.* (2021) reported lack of association between osteoporosis and benefits of exercise. In this sense, it is critical to understand barriers to osteoporosis beliefs among the target group so as to develop effective solutions to these barriers.

Another health belief item that showed significant association with education level was perceived susceptibility that "I am more likely to get osteoporosis if any of parents has osteoporosis (p = 0.001)". This is consistent with the view that osteoporotic family history is among the non-controllable factors that influence osteoporosis (DVO, 2014).

There was also significant association between education level and the belief in perceived cues to actions for item 'one should adhere to health recommendations' p = 0.023). Consistent to this study, Najjar *et al.* (2015) observed that education level was one of the socio-demographic characteristics that significantly influenced medication knowledge and adherence. Similarly, Miller (2016) demonstrated that health literacy and adherence were positively correlated (*r*= .14) to each other. Therefore, improving the participants' education level may positively impact on medication knowledge, medication adherence, and overall treatment outcome.

This study showed an overall high rating for osteoporosis OSES with "work that involves movement and physical activities are good for health" as the most frequent agreed or strongly agreed with a mean of 91.86% versus "the more difficult the exercises is, the better for the body" as the least agreed or strongly at 54.8%. A previous study by Evelyn *et al.* (2014) reported moderately high self-efficacy scores.

The findings reflect participants' higher confidence level for adopting regular exercise and consuming foods rich in calcium than engaging in more difficult exercises.

Moreover, including calcium rich foods in individual's diet was significantly associated with age ($p = 0.039$). It is well established that intake of calcium promotes optimal bone health attainment (Byrd-Bredbenner *et al.,* 2013). There was also a significant association between education level and three OSES items: it is good to begin a new exercise program if not currently engaged in one ($p = 0.022$); it is good to commit some time to exercise regularly ($p < 0.001$), and the more difficult the exercises are, the better for the body ($p = 0.02$). These results suggest that the higher the participant's self-efficacy, the higher their likelihood to engage in exercises. Consistent with these findings, self-efficacy has been shown to be associated with low uptake of physical activity (Prince *et al.,* 2014). Collectively, these findings highlight the importance of understanding the knowledge of women about osteoporosis and their practices for osteoporosis prevention (Sayed-Hassan, & Bashour, 2013) as this is critical for developing evidence-based interventions to ensure its effective prevention.

5.1.4 Attitudes of osteoporosis

The attitudes of women towards osteoporosis were highly and positively represented (mean score= 15.1± 3.9 out of 20). This finding suggests that the women in this study had good attitudes towards osteoporosis which are arguably reported to play an important role in osteoporosis prevention behaviors (Puttapitakpong *et al.,* 2014). Attitudes were significantly associated with age ($p = 0.002$) unlike education level ($p = 0.823$) which indicates that older women were more likely to adopt good attitudes that promote osteoporosis preventive measures.

Stratified by age, the item "Osteoporosis cannot be transmitted from one individual to another" was the highest positively ranked at 78.52%. This attitude item was also associated with age of the subjects ($p = 0.047$). Although osteoporosis is not a directly transmissible disease from person to person, it is one of the major musculoskeletal *n*on-communicable (NCD) disease that contributes to global burden worldwide (Aboderin, & Beard, 2015). The item "Osteoporosis can be prevented and managed by screening for osteoporosis" was second most rated at 72.9%. However, this item was

not significantly associated with age. Although no clear evidence exists to support the role of screening in prevention of osteoporosis, clinical guidelines recommend it for early identification of individuals at risk to initiate prevention and treatment and thereby reduces its burden.

Attitude item "women are at higher risk of osteoporosis than men" was ranked at 52.02% was also associated with age of participants (p =0.003). These finding confirm that being female heightens osteoporosis risk as previously reported (Cosman *et al.,* 2015). Although the incidences of osteoporosis increase with ageing (Svedbom *et al.,* 2014), and they are higher in postmenopausal than premenopausal women since estrogen levels reduce during transition to menopause heightens osteoporosis risk. The current finding suggests that both women gender and age are effective factors for osteoporosis which need to be monitored for effective prevention of osteoporosis and its complications. Although the attitudes item "Everybody in Kenya is at risk of developing osteoporosis" was rated high (65.48%), there was no association between this item and the participants' age. This high proportion of incorrect view about osteoporosis risk depicts the low osteoporosis knowledge among the participants.

When stratified by education level, we observed a general decrease in attitudes with increasing education level whereby most subjects positively rated none (69.48%) compared with post-tertiary (61%). These findings suggest more educated women had poor osteoporosis attitudes compared to less educated ones. This may be attributed to lack of adequate insight about consequences associated with the disease, which would be vital for promoting osteoporosis preventive behaviors (Puttapitakpong *et al.,* 2014). However, most women portrayed positive attitudes for the item "Osteoporosis cannot be transmitted from one individual to another" at 72.4%; and "Osteoporosis can be prevented and managed by screening for osteoporosis" at 70.8%; and "Everybody in Kenya is at risk of developing osteoporosis" at 70.12%. However, neither of these attitude items was associated with education. These findings suggest that education is not an effective factor for osteoporosis attitudes. It is arguable that higher education is likely to open learning horizons, promote knowledge accessibility and ultimately generate good attitude (Puttapitakpong *et al.,* 2014). Therefore, future studies are needed to ascertain the influence of education on attitudes.

5.1.5 Associations between osteoporosis knowledge, attitudes, and health beliefs

The mean values for all the knowledge, attitudes, and health beliefs generally increased with increase in age. Age was associated with knowledge (p=0.016), attitudes (p =0.009), and health beliefs (p=0.007). Consistent with these finding, some previous studies demonstrated a positive correlation between age and knowledge about a disease (Alghunaim *et al*., 2016). A more recent study in the same county reported an association between osteoporosis and advancing age ($p < 0.0001$). However, other studies showed a lack of significant relationship between knowledge of osteoporosis and age ($P = 0.188$) which was similar to other reports (Safizadeh *et al.*, 2015; Amani *et al.*, 2015). This study suggests that age may predict osteoporosis knowledge, attitudes plus health beliefs unlike education. However, there need for future studies to ascertain the influence of education in osteoporosis preventive behaviours.

There was no association between attitudes, knowledge, and health beliefs with education level, religion, and housing type. Inconsistent to my finding on education, osteoporosis awareness was shown to be affected by and positively correlated with education level (Alamri *et al.*, 2015; Fahd *et al.*, 2015) and more specifically, awareness about osteoporosis (Alghunaim *et al.*, 2016). Moreover, Grace (2014) reported a significant correlation between age, education, and dependent variables (knowledge, beliefs, attitudes plus barriers to practice bone health activities). It may be argued that education is a critical factor that influences cognitive skills, including seeking health knowledge or information, its access as well as its application. However, future studies are needed to ascertain the influence of education on knowledge and health beliefs, and how these domains affect osteoporosis preventive behaviours.

Marital status (p=0.038), occupation (p=0.005), and residence (p =0.013) were associated with knowledge but not attitudes, and health beliefs. These findings support previous report by Barzanji *et al.* (2013) which showed association between osteoporosis knowledge with occupation state and education. Other studies demonstrated that knowledge varied with residence (Fahd *et al.*, 2015; Osman, 2013). Priyanka *et al.* (2013) found that socio-demographic factors (education and marital

status) were not significantly associated with belief for intention to take osteoporosis screening from a pharmacy. Our findings suggest that marital status, occupation, and residence may influence knowledge and awareness factors but not attitudes and health beliefs about osteoporosis.

Economic status also has a bearing on osteoporosis awareness. A study by Fahd *et al.* (2015) found that the middle-income earners have higher awareness level about osteoporosis and then higher income earners whereas those with lower income lacked knowledge. Moreover, Fahd and colleagues (2015) found that most of the participants who were knowledgeable about osteoporosis were employed unlike most of those with poor knowledge. Similar findings were reported in another study by Barzanji *et al.* (2013). It can be argued that education is a requirement for securing employment which in turn predicted osteoporosis knowledge accessibility.

There was also moderately strong and significant correlation between osteoporosis health belief and self-efficacy (rho = 0.5789, $p < 0.001$). This is consistent with previous study by Cui *et al*. (2019) who found that beliefs were associated self-efficacy ($\beta = 0.31$, 95% CI = 0.25–0.38) and that beliefs significantly predicted self-efficacy ($\beta = 0.81$, $p<0.001$). This implies that both health beliefs and self-efficacy are effective in shaping individual's health behaviours towards osteoporosis prevention.

On the other hand, low economic status may predict a likelihood for developing osteoporosis since individuals with low income may lack financial ability to afford better healthcare services, healthy foods, and even better housing. In addition, majority of the people with low economic status have higher propensity of having lower literacy abilities due to lack of finances. This is consistent with Piao *et al.* (2015) that low-income earners are likely not to have adequate knowledge about osteoporotic fractures prevention. Similarly, Shehadeh-Sheeny *et al* (2013) established that individuals with lower income may be limited to comply with osteoporotic medication. Since socio-economic status is an effective factor for osteoporosis and knowledge, these highlight the need for policy makers to subsidize medical expenses to ensure access to appropriate treatments by all regardless of their SES.

The health beliefs were moderately strong and significantly correlated with osteoporosis attitude (rho = 0.5364, p < 0.001). Similarly, Priyanka *et al.* (2013) reported that the attitudes of women about screening from pharmacy for osteoporosis and intention to take screen from a pharmacy were significantly positively associated (rho =0.553, p=0.000). This finding implies that attitudes and health beliefs about osteoporosis may be important in predicting health behaviors of an individual.

Puttapitakpong *et al.* (2014) reported that attitudes were significantly correlated with osteoporosis behaviors (adjusted odd ratio = 3.3 with 95% confidence interval of 1.9-5.7), educational level (adjusted odd ratio = 2.2 with 95% confidence interval of 1.4-3.4) as well as knowledge (adjusted odd ratio = 3.5 with 95% confidence interval of 1.8-6.8). Regardless of their knowledge about osteoporosis, the young women seemingly lacked appropriate behaviors for osteoporosis prevention. It is noteworthy that having the right osteoporosis attitude may predict osteoporosis preventive health practices.

On the other hand, the findings revealed a weak correlation between knowledge and attitudes of osteoporosis (rho = 0.2038, p = 0.0001). Additionally, linear regression model analysis showed that attitudes towards osteoporosis were associated with osteoporosis knowledge (p <0.001). Further analysis using multivariable linear regression of health belief, self-efficacy, and attitudes against osteoporosis knowledge showed that only attitude was significant effective on knowledge (p = 0.001). In the model adjusting for effect of health belief and self-efficacy, a unit change in score in attitude resulted change of 0.1 in the knowledge score of premenopausal women. Participants' scores in the osteoporosis knowledge test increased by 0.1 for each unit increase in scores measuring attitudes towards osteoporosis. Puttapitakpong *et al.* (2014) found that attitudes were significantly correlated with knowledge (adjusted odd ratio = 3.5 with 95% confidence interval of 1.8-6.8). The findings indicate that both factors influence each other and thereby having the right osteoporosis attitudes and good knowledge may predict better osteoporosis preventive health practices.

There was no correlation between osteoporosis knowledge and health beliefs (rho=0.0771, p =0.6687). Further linear regression model analysis showed that health

belief scale did not predict osteoporosis knowledge (p = 0.111). This suggests that the study participants are less likely to adopt osteo-protective behaviours. These findings are contrary to a previous report by Chin *et al.* (2019) that knowledge and health beliefs were positively associated with regard to benefits of exercise and consumption of calcium and health motivation domains. Since knowledge and health beliefs about osteoporosis are crucial factors for disease prevention, health education programs are needed to raise the knowledge level of osteoporosis, its risk factors, and consequences through awareness creation and subsequent health beliefs among the women in order to adopt preventive behaviours.

Osteoporosis knowledge was weakly correlated with self-efficacy (rho = 0.1376, p = 0.026). Further linear regression model analysis showed that osteoporosis self-efficacy was a significant predictor of scores on the osteoporosis knowledge test. The osteoporosis knowledge increased by 0.05 units for each unit increase in osteoporosis self-efficacy and this increase was statistically significant (p = 0.004). This implies that knowledge was an effective factor for intention to take osteo-protective measures by participants.

5.1.7 Study limitations

This study used simple random sampling to achieve a representative normal sample distribution. However, the findings are limited for generalization since the participants were recruited from only two hospitals which do not provide a representative sample for the whole country. This is a particularly true since other ethnic minorities were underrepresented in our sample. Moreover, this study used a descriptive cross-sectional design which does not provide adequate evidence for causal inference. Therefore, future studies with stronger designs on different population groups in different regions of the country are highly recommended. Finally, the selection of non-osteoporotic women was based on recall of the participants who believed they had never had osteoporosis which may have induced responder bias. Therefore, future studies may address this gap by performing a central DXA test to confirm that all participants are non-osteoporotic.

5.2 Conclusions

In conclusion, this study on knowledge, attitudes, and health beliefs about osteoporosis among women attending MCH clinic found that:

1. Women attending MCH in the two participating hospitals had moderate knowledge on osteoporosis and on average scored correctly half of the items on the OKT. The knowledge on OKT was significantly and positively associated with participants' age.
2. Based on the score in the modified osteoporosis health belief scale, women had relatively high scores for health beliefs about osteoporosis and this was not associated with most demographic variables except for age.
3. The women had a highly positive attitude towards osteoporosis and increasing participant age showed a significant association with positive attitude.
4. There was a significant association between osteoporosis knowledge and women's attitude towards osteoporosis, but knowledge did not show an association with health belief.

5.3 Recommendations

Considering the findings reported in this study, this study recommends the following for priority action:

i) There is a need to address the knowledge gap on osteoporosis evidenced by the moderate scores on the OKT. Potential strategies include health education that can be tailored and targeted particularly towards the younger age group which had significantly lower knowledge on osteoporosis.
ii) Although in general, women had positive attitudes towards osteoporosis, there is need to improve attitude items that ranked low for example towards risk of osteoporosis that had lower scores compared to attitudes towards primary prevention and transmissibility.
iii) Interventions that target osteoporosis health beliefs of younger women are required because of the significant association that was noted between negative health beliefs in women and younger age.

iv) Interventions designed to provide osteoporosis knowledge could form part of the strategy for improving attitudes towards osteoporosis because these two factors were associated in the current study.

v) Further research is needed to demonstrate the link between knowledge, attitudes and health beliefs and definitive osteoporosis outcomes which were not included in the current study.

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APPENDICES

Appendix I: Informed consent

Title of the study: Knowledge, health beliefs and attitudes about osteoporosis in women aged 18-52 years at Gatundu level IV and Thika level V hospitals.

Principal investigator: Jeremiah Magraubin Mchaka Wandabwa

Contacts: +254(0)724-718923/7876-419807

E-Mail:mchakaj@yahoo.com

Co- investigators

1. Dr. Everesto Opondo

Signature……..

Date:……..

2. Name: Prof. Anselimo Makokha

Signature……..

Date:……..

3. Name: Dr. Peter Wanzala

Signature……..

Date:…….

Purpose of the Study

Hello! My name is…… and I am a Post graduate student from Jomo Kenyatta University of Agriculture and Technology (JKUAT) at the Institute of Tropical Medicine and Infectious Diseases (ITROMID), taking my master's degree in Public

Health. I am conducting a study about Knowledge, health beliefs and attitudes about osteoporosis in women aged 18-52 years at Gatundu level four and Thika level five hospitals. This study has been approved by the National Commission for Science, Technology, and Innovation (NACOSTI).

Procedures to be followed

In this study, I intend to have consent from women between 18 and 52 years whom I shall also interviewee them regarding osteoporosis knowledge, health beliefs and attitudes. The interview will request information on socio-demographic data such as age, gender, highest educational level attained, religion, marital status, level of income, housing, living arrangement, food consumption patterns and dietary intake, health status or morbidity patterns, level of physical activity, occupation as well as family osteoporotic history, osteoporosis knowledge, and osteoporosis health beliefs. The intended interview may take about 30-40 minutes to complete.

The reason for this explanation is to give you the information you may need to decide whether you will participate or not. You may ask questions on anything about the study and on your participation. When all your questions have been answered, you can decide to participate or decline. Code numbers rather than names of the candidates will be used to identify candidates in order to maintain confidentiality, and the answers you provide will be kept confidential and will not be shared with anyone other than members involved in the study.

Risks

This study has no foreseeable risks other than protection of participants' data by ensuring confidentiality and privacy.

Benefits

The information you provide will help to provide insight regarding knowledge, health beliefs and factors associated with osteoporosis in women at Gatundu and Thika level five hospitals, in order to inform relevant policy formulation and strategic

programming on the measures to be taken to prevent and control osteoporosis and the associated factors within Kiambu County and Kenya at large.

Study costs

Given the importance of this study, you are requested to volunteer your time and take part in the intended interview. You are free to participate or withdraw your consent to participate in this study at any time. Your rights shall be protected throughout the study period. Taking part in this study will not involve any payment for those procedures we perform.

Confidentiality

The research data will be entered using a password and all the participants will not be referred by their names in case the study findings will be published. The findings will also be communicated to the community, the hospital management at Gatundu and Thika level five hospitals, the university, and in local and international scientific conferences. The information gathered will only be handled by the principal investigator and will be treated as confidential and only used for intended purpose as mentioned before. The questionnaire will be protected from unauthorized access by keeping them in lockable cabinet. I will not divulge any information to anybody. Any publications or presentations arising from this study will not include any information that will make it possible to identify you as a subject. However, your record for the study may be reviewed by the officials from the institute of Tropical Medicine and Infectious Disease (ITROMID, KEMRI) or JKUAT. If the records are reviewed, the officials will protect your privacy.

Development of Problems

There are no anticipated risks of participating in this study that may cause medical problems. I also wish to inform you that you have the right to withdraw from the study at any time.

Inquiries

You are free to volunteer or decline this request or even withdraw from the study at any time without penalty. The information obtained will be kept confidential. I hope that you will participate since your views are important. At this juncture, do you have any question on the study? Do you accept to participate? If yes, sign the form below.

You may ask any question pertaining the study whenever need be from the principal investigator at +254(0)724-718923/786-419807 or through the e-mail:mchakaj@yahoo.com.

Any additional information about the study will be provided to all the participants, including the final study results. In case you need more information or clarification pertaining to the rights as a research participant, the contact persons are:

a. The secretary,

National Commission for Science, Technology and Innovation (NACOSTI),

P.O Box 30623, Nairobi

Telephone numbers: 203310571 / 0202241349/ 0713 788 787 / 0735 404 245

E-mail: registry@nascoti.go.ke

b. The Graduate Program Coordinator,

Institute of Tropical Medicine and Infectious Diseases (ITROMID)

Kenya Medical Research Institute (KEMRI)

PO Box 20752 Nairobi, Kenya.

Telephone numbers: 020-725016/7/8

E-mail: itromid@nairobi.mimcom.net

c. The Director ,

Institute of Tropical Medicine and Infectious Diseases (ITROMID)

PO Box 62000-00200 Nairobi, Kenya.

Telephone numbers: +254-067-52711/52181-4

E-mail: itromid@nairobi.mimcom.net

Appendix II: Consent form for participants

Participant's statement:

This study has been explained to me and I have had a chance to ask questions. I consent to participate in the study.

Signature/Thumbprint---------- Date----------

Participant Signature---------- Date----------

Principal Investigator: **Jeremiah Magraubin Mchaka Wandabwa**

Signature ---------- Date ----------

Fomu ya ridhaa ya Mshiriki

Taarifa ya Mshiriki:

Nimesoma maelezo juu ya utafiti huu, na ninaelewa jinsi mimi nitakavyohusika katika utafiti huu, na nimepewa nafasi ya kuuliza maswali kuhusu utafiti huu na nimejibiwa, nikaridhika. Mimi naruhu kushiriki.

Sahihi/ Kidolegumba ya Mshiriki..... Tarehe .....

Sahihi ya Mtafiti Mkuu..... Tarehe .....

Appendix III: Interview schedule questionnaire-English version

Title of the study: Knowledge, health beliefs, and attitudes about osteoporosis in women aged 18-52 years at Gatundu level four and Thika level five hospitals.

Questionnaire No:

Code of the enumerator:

Location Id:

Questionnaire checked:

Date checked:

Date of interview:

Instructions: Please answer all the questions.

Section A: Socio-demographic Questionnaire

1. Age of respondent

I. 18-22 II.23-27 III.28-32 IV.33-37 V.38-42 VI.43-47

VII.48-52

2. Gender

I. Female II. Male

3. Highest level of education attained

I. None II. Primary III. Secondary IV. Tertiary V. Post tertiary

4. Religion

I. Christian II. Muslim

III. Other *(Specify)*

……
……

5. Marital Status

I. Single II. Married III. Separated IV. Divorced V. Widowed

6. Residence

I. Urban II. Peri-Urban III. Rural

7. What is your housing type?

I. Temporal II. Semi-permanent III. Permanent

8. What is your occupation?

I. Unemployed II. Self-employed III. Farmer IV. Student V. Formal wage employment VI. Retired

VII. Other (specify)
……
……

Section B: Osteoporosis Knowledge Test (OKT) Questionnaire

The questions assess your knowledge on osteoporosis. Please circle the correct answer by choosing True, False or Don't know.

9. Osteoporosis increases the risk of developing bone fractures

I. True II. False III. Don't know

10. Osteoporosis commonly manifests with symptoms such as pain before fractures develop

I. True II. False III. Don't know

11. Osteoporosis affects men more than women

I. True II. False III. Don't know

12. Osteoporosis equally affects most children and the elderly

I. True II. False III. Don't know

13. Engaging in any physical activity is important in preventing osteoporosis

I. True II. False III. Don't know

14. Individuals with a family member with osteoporosis have a higher risk of developing osteoporosis

I. True II. False III. Don't know

15. Milk is a good source of calcium to the body

I. True II. False III. Don't know

16. Use of calcium supplements alone may prevent bone loss

I. True II. False III. Don't know

17. The onset of menopause is associated with the risk of osteoporosis

I. True II. False III. Don't know

18. Osteoporosis treatment is not effective in Kenya

I. True II. False III. Don't know

Section C: Osteoporosis Health Belief Scale (OHBS) Questionnaire

The following statements assess your actual belief about osteoporosis. Please circle the correct answer by choosing strongly disagree, disagree, neutral, agree, or strongly agree. Note that the phrase "taking in enough calcium" implies adequate consumption of calcium from calcium rich foods or calcium supplements.

19. Everybody is at risk of developing osteoporosis

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

20. I am more likely to get osteoporosis if any of parents has osteoporosis

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

21. Having osteoporosis always makes one to be crippled

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

22. Developing osteoporosis would cost me heavily

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

23. Thinking about osteoporosis depresses and scares me

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

24. Developing osteoporosis is a very serious matter

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

25. Engaging in regular exercise prevents osteoporotic related problems

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

26. Regular exercise helps to build strong bones

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

27. Regular exercises improves my body outlook

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

29. Engaging in regular exercises reduces development of bone fractures

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

30. Adequate calcium intake prevents osteoporotic related problems

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

31. Adequate calcium consumption reduces the risk of bone fractures

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

32. One should engage in regular exercise only if one is strong enough

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

33. One should exercise if she/he has access to a gym or a place for exercise

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

34. Regular exercise is a difficult new habit for me to start

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

35. Engaging in regular exercise is uncomfortable for me

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

36. Regular exercise upsets my daily routine

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

37. I am used to taking a well-balance diet

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

38. I am updated with new health information

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

39. One should do his/her best to establish health related problems early

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

40. One should attend regular medical check-up with or without sickness

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

41. One should adhere to health recommendations

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

Section D: Osteoporosis Self-Efficacy Scale (OSES) Questionnaire

This questionnaire assesses your actual feeling related confidence about undertaking exercises including walking, golfing and biking as well as aerobic and dancing. Please circle the correct answer that explains your confidence by choosing strongly disagree, disagree, neutral, agree, or strongly agree.

42. It is good to begin a new exercise program if not currently engaged in one

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

43. It is good to commit some time to exercise regularly

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

44. The more difficult the exercises is, the better for the body

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

45. My diet should include calcium rich foods

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

46. It is good to obtain calcium rich foods

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

47. Work that involves movement and physical activities are good for health

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

Section E: Attitudes and perceptions

This questionnaire assesses your actual attitude or perception about osteoporosis. Please circle the correct answer that applies to you by choosing strongly disagree, disagree, neutral, agree, or strongly agree

48. Everybody in Kenya is at risk of developing osteoporosis.

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

49. Women are at higher risk of osteoporosis than men

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

50. Osteoporosis cannot be transmitted from one individual to another

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

51. Osteoporosis can be prevented and managed by screening for osteoporosis

I. Strongly disagree II. Disagree, III. Neutral IV. Agree V. Strongly agree.

Thank you for taking your time to participate in this research study.

Appendix IV: Interview schedule questionnaire-Swahili version

Kiambatisho cha : Ratiba ya mahojiano dodoso

Kichwa cha Utafiti: Elimu, imani na mitazamo kuhusu tatizo la mifupa katika wanawake wenye umri wa miaka 18-52 katika hospitali ya kiwango cha nne ya Gatundu na kiwango cha tano ya Thika.

Jina langu ni **Mchaka** , mwanafunzi wa Chuo Kikuu cha Jomo Kenyatta cha Kilimo na Teknolojia, na ninafanya shahada yangu ya pili ya Afya kwa Uma. Mimi nafanya utafiti kuhusu **Elimu, imani na mitazamo kuhusu tatizo la mifupa katika wanawake wenye umri wa miaka 18-52 katika hospitali ya kiwango cha nne ya Gatundu na kiwango cha tano ya Thika.**. Nafurahi kukujulisha kuwa umechaguliwa kushiriki katika utafiti huu na ninakusihi kuchukua nafasi hii ili uchangie maoni yako kuhusu **tatizo la mifupa**. Nitakuuliza maswali kuhusu **tatizo la mifupa kwa dakika isiyozidi 20**. Taarifa yako ya kibinafsi kama jina na nambari ya simu haitachuliwa, na maoni yoyote utakayotoa itawekwa salama na kutumika kwa madhumuni ya utafiti peke yake.Utafiti huu hauna madahra yoyote na kushiriki kwako ni kwa hiari na ninakusihi kchukuwa wajibu wa kujibu maswali yote utakayoweza. Pia unaweza kuondoka kutoka mahojiano wakati wowote unataka. Hata hivyo, maoni yako ni yamuhimu kwa sababu yataboresha mipango ya kudhibiti tatizo la mifupa katika hospitali hii , idara ya afya na taifa kwa ujumla.

Kwa wakati huu, je, unataka kuuliza swali lolote kuhusu utafiti huu? Kama una maswali lolote wakati wowote hata baada ya mahojiano, jisikie huru kuuliza. simu ya mawasiliano ya mkuu wa utafiti huu ni : 0728654396.

Fomu ya ridhaa ya Mshiriki

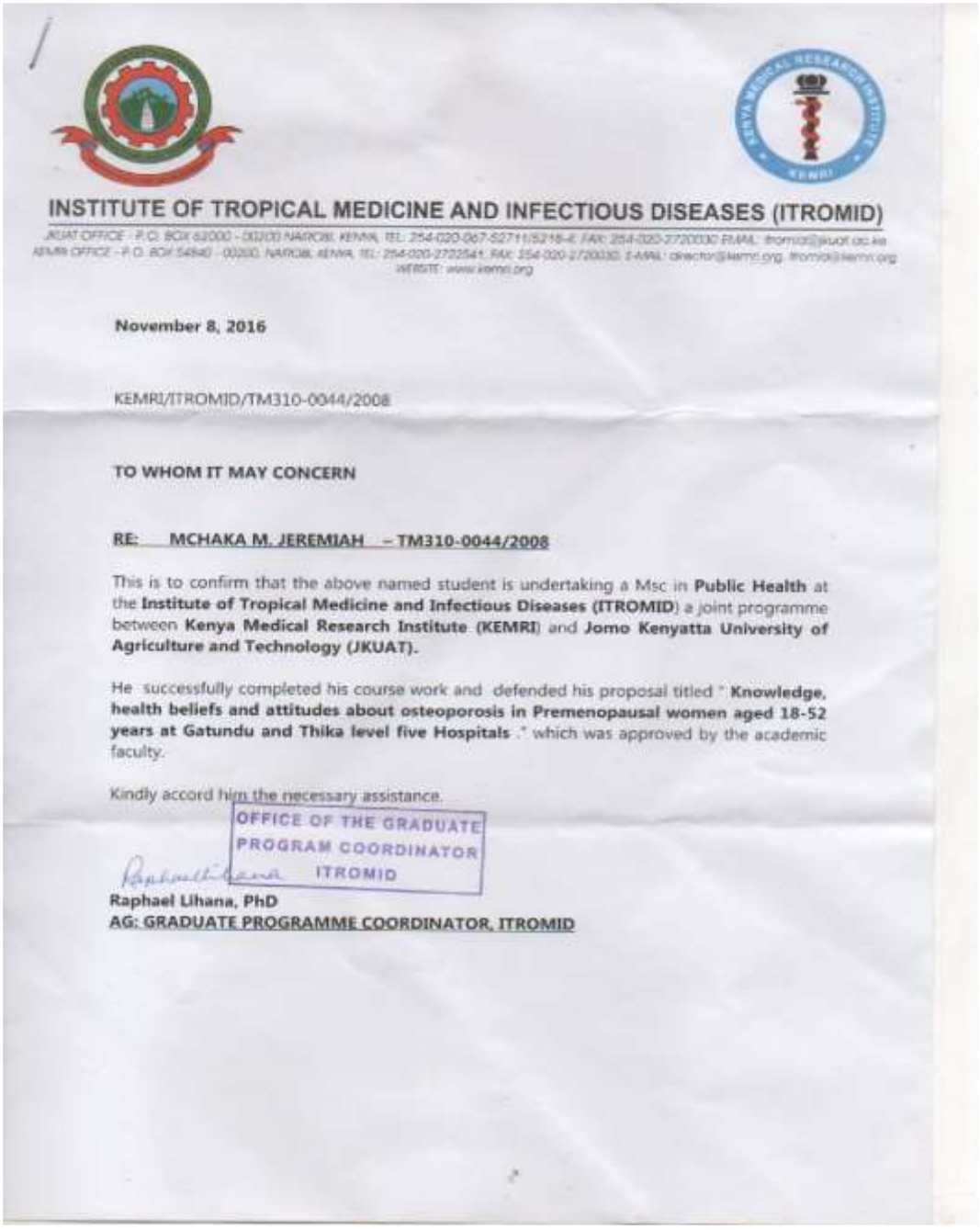
Taarifa ya Mshiriki:

Nimesoma maelezo juu ya utafiti huu, na ninaelewa jinsi mimi nitakavyohusika katika utafiti huu, na nimepewa nafasi ya kuuliza maswali kuhusu utafiti huu na nimejibiwa, nikaridhika. Mimi naruhu kushiriki.

Sahihi/ Kidolegumba ya Mshiriki..... Tarehe .....

Sahihi ya Mtafiti Mkuu..... Tarehe

Appendix V: University approval letter for proposal



INSTITUTE OF TROPICAL MEDICINE AND INFECTIOUS DISEASES (ITROMID)

JKUAT OFFICE - P.O. BOX 62000 - 00200 NAIROBI, KENYA, TEL: 254-020-067-52711/5218-E, FAX: 254-020-2720030 EMAIL: itromid@jkuat.ac.ke
KEMRI OFFICE - P.O. BOX 54840 - 00200, NAIROBI, KENYA, TEL: 254-020-2722541, FAX: 254-020-2720030, EMAIL: director@kemri.org, itromid@kemri.org
WEBSITE: www.kemri.org

November 8, 2016

KEMRI/ITROMID/TM310-0044/2008

TO WHOM IT MAY CONCERN

RE: MCHAKA M. JEREMIAH – TM310-0044/2008

This is to confirm that the above named student is undertaking a Msc in **Public Health** at the **Institute of Tropical Medicine and Infectious Diseases (ITROMID)** a joint programme between **Kenya Medical Research Institute (KEMRI)** and **Jomo Kenyatta University of Agriculture and Technology (JKUAT).**

He successfully completed his course work and defended his proposal titled " **Knowledge, health beliefs and attitudes about osteoporosis in Premenopausal women aged 18-52 years at Gatundu and Thika level five Hospitals** ." which was approved by the academic faculty.

Kindly accord him the necessary assistance.

OFFICE OF THE GRADUATE PROGRAM COORDINATOR ITROMID

Raphael Lihana, PhD
AG: GRADUATE PROGRAMME COORDINATOR, ITROMID

Appendix VI: Ethical Approval letter for proposal

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/79

8th March 2017

Jeremiah M.M.Wandabwa
TM310-004/2008
College of Health Sciences
JKUAT

Dear Jeremiah

REVISED RESEARCH PROPOSAL: KNOWLEDGE, HEALTH BELIEFS AND ATTITUDES ABOUT OSTEOPOROSIS IN PREMENOPAUSAL WOMEN AGED 18-52 YEARS AT GATUNDU AND THIKA LEVEL FIVE HOSPITALS (P828/11/2016)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and approved your above revised proposal. The approval period is from 8th March 2017 – 7th March 2018.

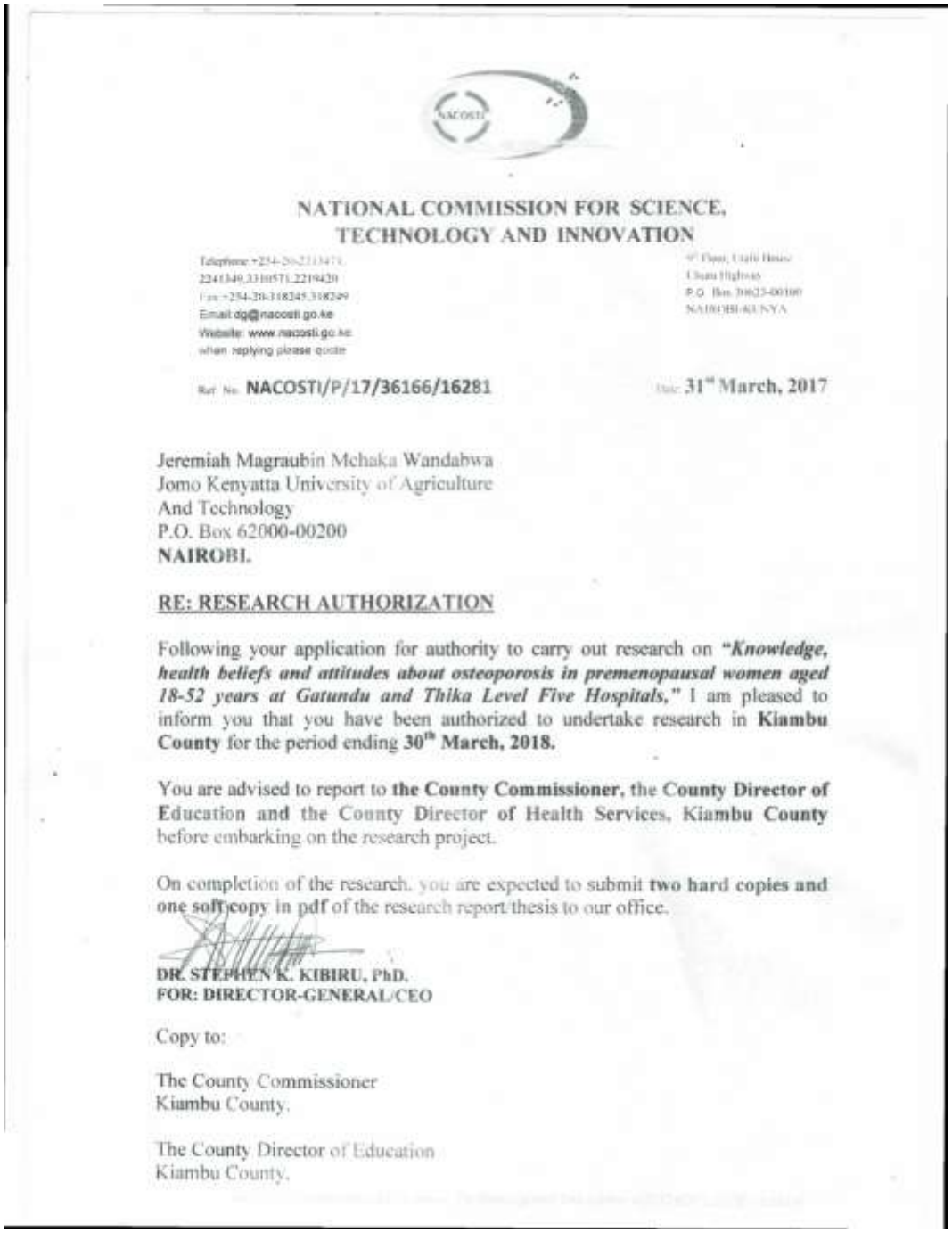
This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*)
f) Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website **http://www.erc.uonbi.ac.ke**

"Protect to Discover"

Appendix VII: Permit to conduct research



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone +254-20-2213471,
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Fax +254-20-318245,318249
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Website: www.nacosti.go.ke
when replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 59623-00100
NAIROBI-KENYA

Ref. No. NACOSTI/P/17/36166/16281

Date: 31st March, 2017

Jeremiah Magraubin Mchaka Wandabwa
Jomo Kenyatta University of Agriculture
And Technology
P.O. Box 62000-00200
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Knowledge, health beliefs and attitudes about osteoporosis in premenopausal women aged 18-52 years at Gatundu and Thika Level Five Hospitals,"*** I am pleased to inform you that you have been authorized to undertake research in **Kiambu County** for the period ending **30th March, 2018.**

You are advised to report to **the County Commissioner**, the **County Director of Education** and the County Director of Health Services, **Kiambu County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy** in pdf of the research report/thesis to our office.

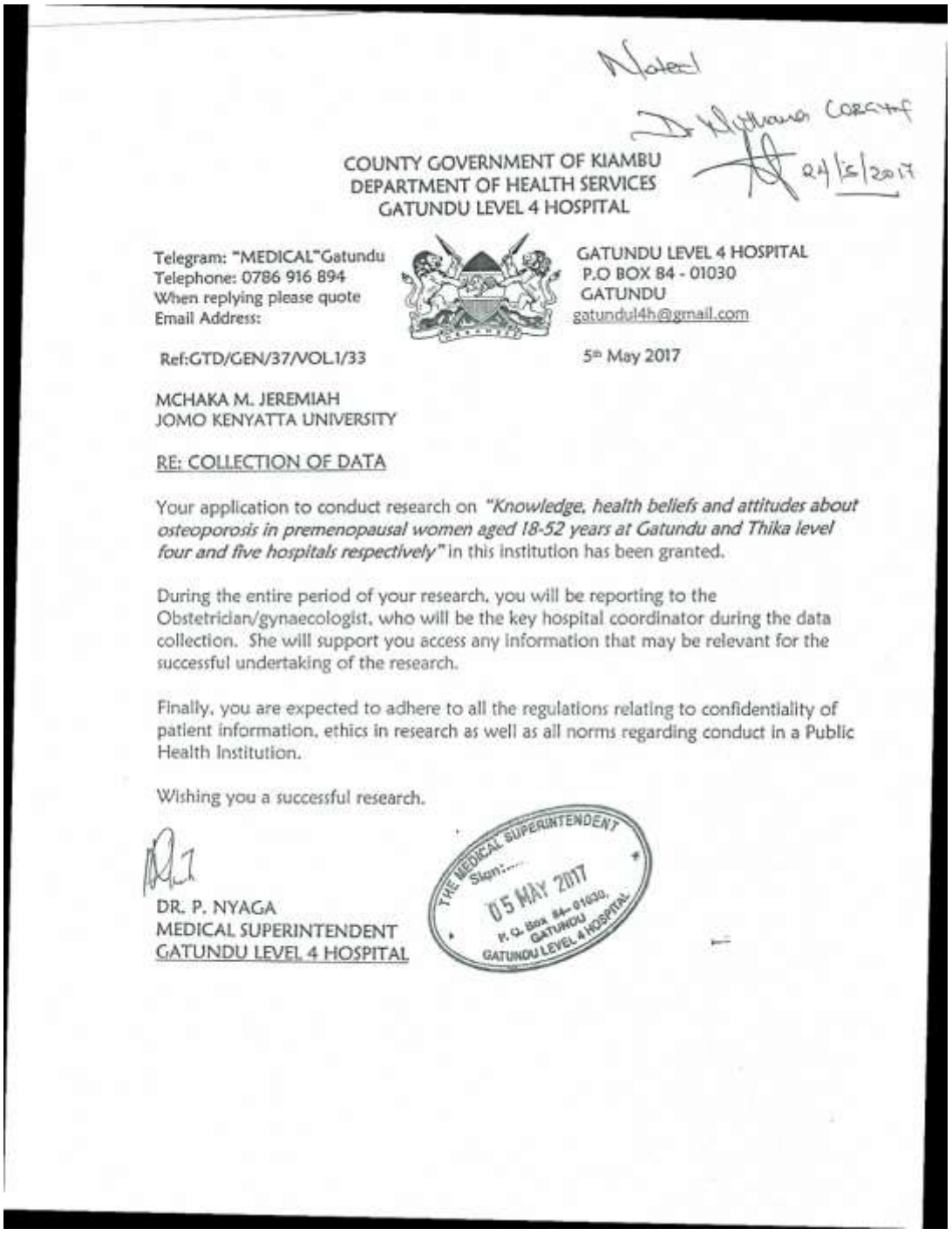
DR. STEPHEN K. KIBIRU, PhD.
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Kiambu County.

The County Director of Education
Kiambu County.

Appendix VIII: Clearance to conduct research-at Gatundu Level 4 Hospital



Noted

24/5/2017

COUNTY GOVERNMENT OF KIAMBU
DEPARTMENT OF HEALTH SERVICES
GATUNDU LEVEL 4 HOSPITAL

Telegram: "MEDICAL"Gatundu
Telephone: 0786 916 894
When replying please quote
Email Address:

GATUNDU LEVEL 4 HOSPITAL
P.O BOX 84 - 01030
GATUNDU
gatundul4h@gmail.com

Ref:GTD/GEN/37/VOL1/33

5th May 2017

MCHAKA M. JEREMIAH
JOMO KENYATTA UNIVERSITY

RE: COLLECTION OF DATA

Your application to conduct research on *"Knowledge, health beliefs and attitudes about osteoporosis in premenopausal women aged 18-52 years at Gatundu and Thika level four and five hospitals respectively"* in this institution has been granted.

During the entire period of your research, you will be reporting to the Obstetrician/gynaecologist, who will be the key hospital coordinator during the data collection. She will support you access any information that may be relevant for the successful undertaking of the research.

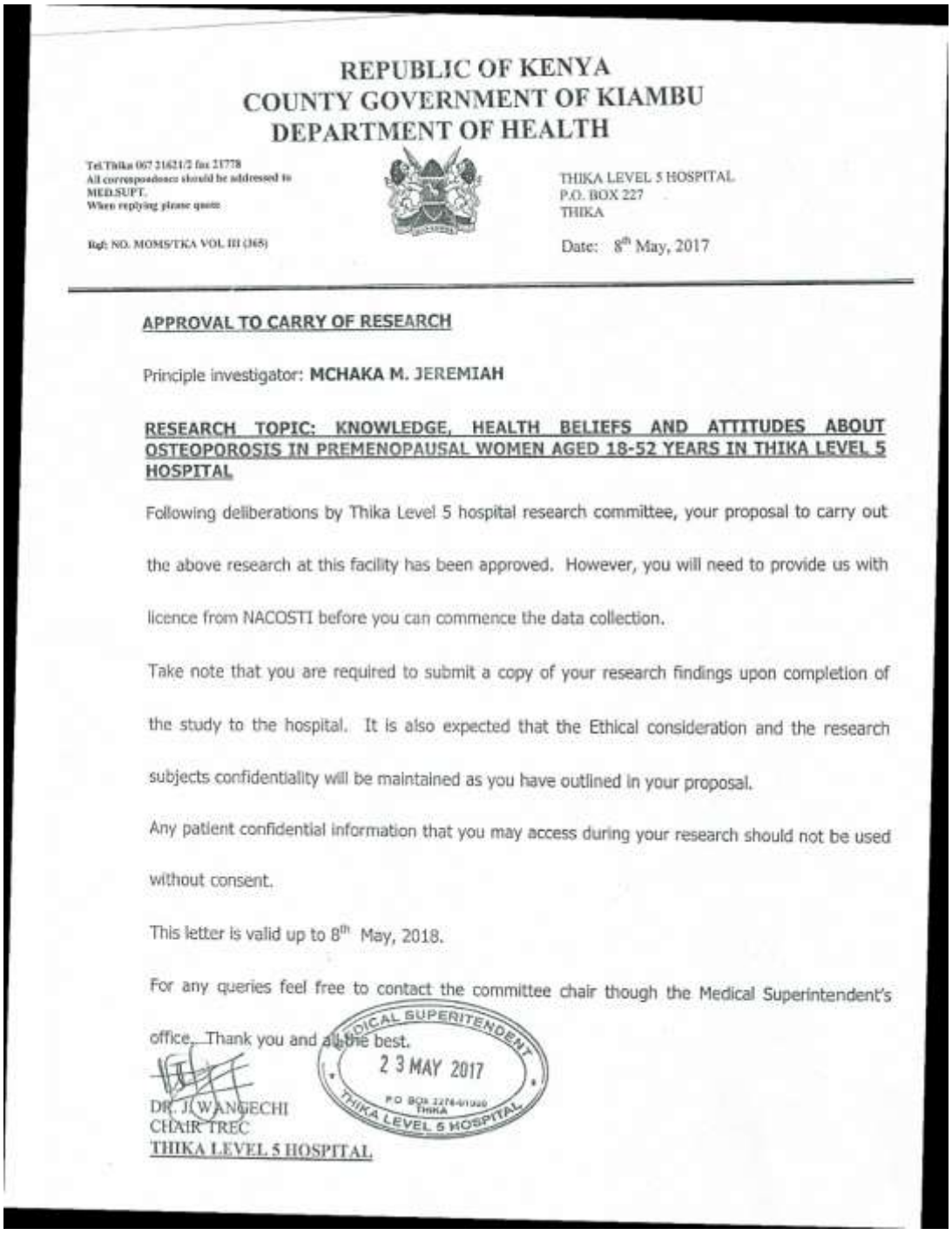
Finally, you are expected to adhere to all the regulations relating to confidentiality of patient information, ethics in research as well as all norms regarding conduct in a Public Health Institution.

Wishing you a successful research.

DR. P. NYAGA
MEDICAL SUPERINTENDENT
GATUNDU LEVEL 4 HOSPITAL

THE MEDICAL SUPERINTENDENT
Sign:....
05 MAY 2017
P. O. Box 84- 01030,
GATUNDU
GATUNDU LEVEL 4 HOSPITAL

Appendix IX: Clearance to conduct research at Thika Level 5 Hospital



REPUBLIC OF KENYA
COUNTY GOVERNMENT OF KIAMBU
DEPARTMENT OF HEALTH

Tel Thika 067 21621/2 fax 21778
All correspondence should be addressed to
MED.SUPT.
When replying please quote

Ref: NO. MOMS/TKA VOL III (365)

THIKA LEVEL 5 HOSPITAL
P.O. BOX 227
THIKA

Date: 8th May, 2017

APPROVAL TO CARRY OF RESEARCH

Principle investigator: **MCHAKA M. JEREMIAH**

RESEARCH TOPIC: KNOWLEDGE, HEALTH BELIEFS AND ATTITUDES ABOUT OSTEOPOROSIS IN PREMENOPAUSAL WOMEN AGED 18-52 YEARS IN THIKA LEVEL 5 HOSPITAL

Following deliberations by Thika Level 5 hospital research committee, your proposal to carry out the above research at this facility has been approved. However, you will need to provide us with licence from NACOSTI before you can commence the data collection.

Take note that you are required to submit a copy of your research findings upon completion of the study to the hospital. It is also expected that the Ethical consideration and the research subjects confidentiality will be maintained as you have outlined in your proposal.

Any patient confidential information that you may access during your research should not be used without consent.

This letter is valid up to 8th May, 2018.

For any queries feel free to contact the committee chair though the Medical Superintendent's office. Thank you and all the best.

MEDICAL SUPERINTENDENT
23 MAY 2017
P.O BOX 227-01000 THIKA
THIKA LEVEL 5 HOSPITAL

DR. J. WANGECHI
CHAIR TREC
THIKA LEVEL 5 HOSPITAL

Appendix X: Prove of Journal publication

Researchjournali's Journal of Public Health *Vol. 4 | No. 12 December | 2018* ***1***

http://www.researchjournali.com/view.php?id=4823

Knowledge of Osteoporosis and the Associated Factors among Premenopausal Women Aged 18-52 Years Attending Maternal Child Health (MCH) Clinics at Gatundu and Thika Level Five Hospitals, Kenya

Jeremiah M.M. Wandabwa

Student, Jomo Kenyatta University of Agriculture & Technology (JKUAT)-Institute of Tropical medicine (ITROMID)

Dr. Everisto O. Anindo

Jomo Kenyatta University of Agriculture & Technology - Department of Surgery

Prof. Anselimo O. Makokha

Jomo Kenyatta University of Agriculture & Technology - Department of Food Science & Technology

Dr. Peter Wanzala

Kenya Medical Research Institute (KEMRI) - Oral Health Unit

Jeremiah pursued his undergraduate studies at Egerton University from August 2000 and received his Bachelor degree in September 2005. He also earned a Mid-term Monitoring & Evaluation Fellowship certificate from University of Nairobi in March 2014. This research work was published at the time Jeremiah was completing his Masters of Science in Public Health at the Institute of Tropical Medicine and Infectious Diseases (ITROMID), Jomo Kenyatta University College of Agriculture and Technology (JKUAT) as a requirement for his degree award.

ABSTRACT

Background: Osteoporosis (OP) is a skeletal disease characterized by low bone quality and mineral density. Although knowledge regarding health plus health services is critical for defining patients' health beliefs besides attitudes and values, little is known about its role in OP prevention. **Objective:** This study assessed the general OP knowledge and the associated factors among 428 premenopausal women aged 18-52 years at MCH clinics in Gatundu level 4 and Thika level 5 hospitals. **Methodology:** A cross-sectional quantitative study was conducted to collected data from the participants using modified Osteoporosis Knowledge Test (OKT). Data was analyzed using SPSS Version 20. Statistical significance was set at $P \leq 0.05$. **Results:** The overall mean age was 28.5 years and the mean knowledge score on the OKT was 5 out of 10. OP knowledge was significantly associated with family history of OP ($p = 0.004$), milk as source of calcium ($p < 0.001$), risk of OP in men than women ($p = 0.004$), menopause onset ($p = 0.011$), and effectiveness of OP treatment in Kenya ($p = 0.009$) unlike age, education level and other risk factors. **Conclusions:** Education initiatives towards increasing OP knowledge may be an important primary OP prevention measure for the premenopausal women.

Keywords: Osteoporosis, fractures, knowledge, premenopausal women.