

**ASSESSMENT OF AFRICAN PATIENTS WITH FRAGILITY FRACTURES
IN THE ORTHOPAEDIC DEPARTMENT AT CHRIS HANI BARAGWANATH
ACADEMIC HOSPITAL**

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DECLARATION

I, Dr. Preetha Thomas, declare that this research report is my own work. It is being submitted for the degree of Master of Medicine (Internal Medicine) to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

Signed: _____ at Johannesburg on the date _____

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Firstly, to my parents for never-ending support and love

To my husband for forcing me to remain strong in all circumstances

To my siblings for humorous relief

To my grandparents for their prayers and blessings

To my supervisors Dr S Bhana and Dr I Butler

And lastly to friends, who encourage at the worst of times, and celebrate at the best of times

ABSTRACT

BACKGROUND: The aim of the study was to assess whether African subjects with fragility fractures were being identified for assessment for osteoporosis on presentation to the orthopaedic department at Chris Hani Baragwanath Academic Hospital (CHBAH) in Soweto. In addition, the recommendation for secondary prevention of disease for these subjects, was also assessed.

METHOD: One hundred African subjects over the age of 50 years with fragility fractures were identified in the orthopaedic wards and clinics at CHBAH. These subjects were interviewed with two separate questionnaires addressing risk factors and education regarding osteoporosis, and whether further management was suggested. The first interview was conducted in June and July 2015. After 18 months, a follow up telephonic interview was conducted, in December 2016, with 37 of the original 100 subjects.

RESULTS: Of the 100 subjects evaluated, 89 (89%) were asked at least one screening question. The most frequently asked question about risk factors for osteoporosis in the first interview, was regarding previous fractures and was asked of 61 (61%) of the 100 subjects. A further 37 (37%) of all subjects had been given advice regarding appropriate bone strengthening exercises to prevent osteoporosis. Only five subjects (5%) were asked to return for further assessment. The second interview showed that the most frequently asked question was regarding previous fractures in 24 (64.9%) of the 37 subjects and 18 (48.6%) of the 37 subjects had been advised to do bone strengthening exercises. Only two (5.4%) new subjects could confirm receiving a date to return for assessment.

CONCLUSION: In this study, orthopaedic surgeons were proven to be inadequately assessing risk factors for osteoporosis and were infrequently referring patients for therapy. Orthopedic surgeons are often the only practitioners to see patients with fragility fractures and thus they have a crucial role in identifying and appropriately referring these patients for further investigations and medical management for osteoporosis.

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ABBREVIATIONS

1,25(OH)₂D₃: 1,25 dihydroxycholecalciferol vitamin D₃

Ca₁₀(PO₄)₆(OH)₂: hydroxyapatite

BMD: bone mineral density

BMI: body mass index

BOA: British Orthopaedic Association

CAROC: Canadian Association of Radiologists and Osteoporosis Canada

CHBAH: Chris Hani Baragwanath Academic Hospital

CRF: clinical risk factors

DEXA: dual energy x-ray absorptiometry

ESR: erythrocyte sedimentation rate

FBC: full blood count

FLS: Fracture Liaison Service

FRAX: Fracture Risk Assessment Tool

HIV: human immunodeficiency virus

HREC: Human Research Ethics Committee

IGF: insulin-like growth factor

IL-1: interleukin one

IL-6: interleukin six

IOF: International Osteoporosis Foundation

M-CSF: macrophage colony stimulating factor

NICE: National Institute for Health and Clinical excellence

NIH: National Institute of Health

NOF: National Osteoporosis Foundation

NOFSA: National Osteoporosis Foundation of South Africa

PTH: parathyroid hormone

RANK: receptor activator of nuclear factor-Kappa B

RANK L: receptor activator of nuclear factor-Kappa B ligand

TNF: tumour necrosis factor

TSH: thyroid stimulating hormone

SA: South Africa

SD - standard deviation

SERMS: selective oestrogen receptor modulators

UK: United Kingdom

US: United states

WHO: World Health Organisation

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Osteoporosis is the most common bone disease in humans and is defined by the World Health Organisation (WHO) as a systemic skeletal disease characterized by 'low bone mass and microarchitectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture'. (1-2)

The criteria for diagnosis of osteoporosis are based on a history or evidence of a fragility fracture or by measuring a low bone mineral density (BMD). (1) The BMD criteria for the diagnosis of osteoporosis, according to the WHO, are by confirming a BMD measurement at the hip or lumbar spine that is less than or equal to 2.5 standard deviations below the mean BMD of a young adult reference population. (1) The risk of fractures is highest in those with the lowest BMD. (1) The latest WHO guideline recommends using the femoral neck as a single reference site for the diagnosis of osteoporosis. (2)

Fragility fractures are defined as fractures that are caused by injury that would be insufficient to fracture a healthy bone. (3) The WHO classifies fragility fractures as those that occur as a result of minimal trauma such as a fall from a standing height or less, or no identifiable trauma. (3) Typical fragility fractures include vertebral (spine), proximal femur (hip) and distal forearm (wrist) however they may also occur in other bones such as the proximal humerus, pelvis and ribs. (2-3)

1.2 DEMOGRAPHICS OF PATIENTS WITH OSTEOPOROSIS

Fracture risk increases two to fivefold in the elderly as compared to the young, regardless of BMD measurements. (4) Postmenopausal women are at increased risk of bone loss. (4) Females sustain fractures more frequently than males. (4) Bone loss in men starts later

and progresses at a slower rate however, by the age of 65 years both men and women have an equal and steady rate of bone loss. (5) Approximately 20% of men over the age of 50 years are at risk of having osteoporosis related fracture. (1)

The prevalence of osteoporosis varies amongst ethnic groups. (6-7) The reasons for this are differing BMD, genetic predisposition, inherent skeletal structural differences, bone turnover rate variability and electrolyte and mineral homeostasis changes. (6) Body composition, weight, gonadal hormone deficiencies and social status also contribute to the heterogeneity. (7)

1.3 BONE STRUCTURE AND PHYSIOLOGY

The long bones are composed of a hollow shaft (diaphysis), a flared metaphysis below the growth plates; and rounded epiphysis above the growth plates. (8) The diaphysis is composed primarily of dense cortical bone, whereas the metaphysis and epiphysis are composed of trabecular meshwork bone surrounded by a thin layer of dense cortical bone. (8)

Cortical bone is dense and surrounds the marrow space, whereas trabecular bone is composed of a honeycomb-like network of trabecular plates and rods interspersed in the bone marrow compartment. (8)

Different bones and skeletal sites have different ratios of cortical to trabecular bone. (8) The vertebrae are composed of cortical to trabecular bone in a ratio of 25:75. This ratio is 50:50 in the femoral head and 95:5 in the radial diaphysis. (8)

Bone remodeling is the process by which bone is renewed to maintain bone strength and mineral homeostasis. (8) Bone remodeling is regulated by osteoclasts that resorb bone, and osteoblasts that are involved in the formation of new bone. (8-9) Osteoblasts secrete the components of the bone matrix including collagen and proteoglycans that give the bones their tensile strength, and the tight binding with deposition of bone salts give the bones shear strength. (9) Osteoclasts express receptor activator of nuclear factor kappa-B (RANK) receptors which, when physiologically stimulated, cause an increase in bone resorption. (9)

Metabolic functions of the bone are controlled by two main calcium regulating hormones namely the parathyroid hormone (PTH) and 1,25 dihydroxycholecalciferol vitamin D3 [1.25(OH)₂D₃]. (8-9) Calcitonin is a third hormone that can inhibit bone resorption but only plays a small role in physiological calcium regulation. (4) PTH increases the serum calcium level by its action on the bone, kidney and intestine and stimulates the production of active vitamin D by the kidney. (8-9)

Calcium and phosphate salts have an intrinsic attraction to the bone matrix and are subsequently converted to hydroxyapatite [Ca₁₀(PO₄)₆(OH)₂], the main crystalline salt of the bone. (8-9) Hydroxyapatite gives bone its compressional strength. (8) Other hormones such as growth hormone, insulin-like growth factor (IGF), glucocorticoids, oestrogen and thyroid hormones can also regulate skeletal growth or loss. (8)

1.4 BONE STRUCTURE AND PHYSIOLOGY IN OSTEOPOROSIS

Bone loss by resorption is controlled by an interaction between osteoblasts and osteoclasts. Osteoblasts are the primary regulators of bone formation and osteoclasts are

mainly responsible for absorption. (6,8) Compared to normal bone, the microarchitecture of the bone in osteoporosis is severely compromised due to bone degradation. (10)

Osteoclast recruitment from hematopoietic cells is affected by the expression of an osteoclast differentiation factor known as receptor activator of nuclear factor kappa-B ligand (RANK-L). (6) RANK-L binds to a RANK receptor located on the surface of osteoclast precursors to initiate osteoclastogenesis. (6) Osteoblasts also produce macrophage colony stimulating factor (M-CSF) which enhances the replication of osteoclast precursors via action on the c-fms receptor. (6) Cytokines such as tumour necrosis factor (TNF), prostaglandin E2, interleukin (IL) 1 and 6 also promote bone resorption by elongating the lifespan of the osteoclast. (6)

Peak bone mass is reached in the third decade of life and is influenced by genetic factors, nutrition, endocrine status and physical activity. (1) Reasons for having low bone mass include failure to reach optimal peak bone mass or an increased loss of bone after achieving peak bone mass, or an inability to replace lost bone. (6) This can be influenced by genetic and environmental factors and by different hormones, for instance, a deficiency of oestrogen. (6) Oestrogen deficiency is a major factor associated with increased resorption of bone in women, resulting in aggressive osteoclastic activity and a decreased ability of osteoblasts to form new bone. (6) In older men, a decline in bone mineral density (BMD) is noted to be due to oestrogen deficiency rather than testosterone deficiency. (11) An excess of PTH, resulting from decreased absorption of calcium and decreased production of active vitamin D, also contributes to bone loss by interacting with osteoclastic promoting receptors on the osteoblastic cells and enhancing expression of the RANK-L. (6,11)

Circulating insulin-like growth factor one (IGF-1) level decreases with age, and an association between osteoporosis and low IGF-1 has been documented. (6) Decreased BMD has been noted in patients with type I diabetes mellitus and a normal to increased BMD has been noted in insulin resistance states with increased circulating insulin. (6) Glucocorticoids inhibit bone formation via its effect on osteoblast proliferation and osteoblast survival. (6) Lastly, polymorphisms in the genes that encode collagen, the oestrogen receptor, interleukin-6 (IL-6) and the vitamin D receptor have also been shown to play a role in BMD regulation. (6)

1.5 CLASSIFICATION OF OSTEOPOROSIS

Causes of osteoporosis can be divided into primary and secondary. (12) Primary osteoporosis is divided into type 1 and type 2 and is age-related. Secondary osteoporosis is classified as type 3. (12) Type 1 disease occurs in 5 to 20% of postmenopausal women. (12) This type of osteoporosis is thought to be due to a deficiency in oestrogen resulting in resorption of calcium from the bone due to the heightened action of parathyroid hormone on the bone. (12) Type 2 primary osteoporosis is prevalent in patients over the age of 70 and is due to the decreased production of one alpha, 25 dihydroxycholecalciferol [1,25(OH)₂D₃] from the kidney resulting in a decrease in calcium absorption. (12) Due to decreased calcium levels, the level of PTH increases and bone resorption ensues. (12)

Secondary causes of osteoporosis may be found in up to 30% of patients with osteoporosis especially premenopausal women, men with osteoporosis and patients with hip fractures. (13) There are multiple causes of secondary osteoporosis and these include endocrine disorders such as diabetes and hyperthyroidism, eating disorders, marrow-related disease, gastrointestinal and bile tract abnormalities, chronic renal diseases and malignancies. (14) Common medical conditions such as chronic obstructive airway

disease and rheumatoid arthritis also contribute to the development of osteoporosis. (4) Anticonvulsants, corticosteroids, anticoagulants and aromatase inhibitors are just a few of the numerous drugs that have also been implicated in the development of osteoporosis. (4,14,15)

1.6 RISK FACTORS FOR OSTEOPOROSIS

There are multiple risk factors for osteoporosis, the major factors being advanced age, previous fragility fracture, body mass index (BMI) below 18 and a family history of osteoporotic fractures. (4) Other risk factors identified include smoking, excessive alcohol intake (three or more units per day), glucocorticoid intake, hypogonadism, inadequate calcium and vitamin D intake, sedentary lifestyle (i.e. less than 30 minutes a day, for two to three days of the week, of weight bearing and muscle strengthening exercises), high propensity to fall, genetic and ethnic factors and certain systemic inflammatory diseases known to affect bone adversely such as rheumatoid arthritis. (4,15) Factors that influence bone quality such as rate of bone remodeling, collagen and mineral distribution, porosity of the cortex and shape of the trabeculae within the bone, are not easy to determine. (16) For this reason, risk factors for fractures are used as surrogate markers of bone strength. (16)

Risk factors for fragility fractures and for osteoporosis are similar. However, risk factors specific to fragility fractures include gender, nutrient malabsorption and high caffeine intake. (17) Reduced bone density is a major risk for fragility fracture. (18) A prior fragility fracture after the age of 40 years is associated with a 1.5 to 9.5 fold increased risk of a future fracture. (18)

The majority of men have at least one secondary cause for osteoporosis. (5) The risk factors for secondary osteoporosis that are associated with osteoporosis in men include

hypogonadism, smoking, alcohol abuse, use of glucocorticoids, chronic diseases of the kidneys, gastrointestinal tract, immobilisation and low calcium intake. (5)

Due to the high prevalence of treatment-naïve human immunodeficiency virus (HIV) infected people in South Africa, it was initially thought that this would be a contributing factor to decreased bone mass, however this has not been conclusively proven. (19)

1.7 INCIDENCE AND ECONOMIC BURDEN

Approximately 10 million adults suffer from osteoporosis in the United States (US). (20) In the year 2000 it was estimated that nine million osteoporotic fractures occur annually worldwide, of which 1.6 million were at the hip, 1.7 million at the forearm and 1.4 million were vertebral fractures. (15,21) Every year osteoporotic fractures resulted in 432,000 hospital admissions, 2.5 million medical office visits, and 180,000 nursing home admissions in the US. (1) The percentage of patients with osteoporosis is known to increase progressively with age. (16,20,22) Women in Europe over the age of 45 spend more days in hospital due to osteoporosis than patients with diabetes mellitus or myocardial infarctions. (22) The number of patients with fragility fractures is also projected to increase and it is predicted that every third man and every second woman over the age of 60 will experience at least one fragility fracture in their lifetime. (23)

The present population in South Africa (SA) is estimated to be approximately 50 million. (24) It is estimated that around 1.4 million females aged over 50 years and 60000 males aged over 50 years, are suffering from osteoporosis in SA. (24) This data is extrapolated from international data and may not be considering ethnic differences in our population. Due to the rapidly ageing population in Africa, the burden of osteoporotic hip fractures is

expected to rise. (25) By the year 2050 out of 6 million predicted hip fractures, 70% of these fractures are predicted to occur in Africa, Asia and Latin America. (25)

In Africa, Egypt has statistics regarding bone disease: 53.9% of postmenopausal women have osteopenia while 28.4% have osteoporosis. (15) In both Cameroon and Morocco patients with hip fractures due to osteoporosis were identified however the fracture rate was low when compared to the US. (25)

An increase in the number of patients with fragility fractures comes with an increase in the economic burden to society. In the United Kingdom (UK) cost for osteoporotic care is estimated at two billion pounds per year. (26) In the countries forming part of the European union, osteoporotic fractures have accounted for 37 billion Euros being spent and the loss of 1,180,000 quality adjusted life years just in the year 2010. (21) Global cost of care for osteoporosis is set to increase by 25% from the year 2010 to 2025. (21)

Few studies have been done documenting the economic burden of osteopenia and fragility fractures. A study done in Mexico has shown a cost of \$154.9 million for both osteoporosis and osteopenia. (27) Costs due to fragility fractures were \$256.2 million for the year 2010 alone. (27) By the years 2015 and 2025 this amount has been estimated to be 19.2% and 41.7% higher respectively. (27) In SA currently, the acute cost of treating a hip fracture is R150000. (25)

1.8 PREDICTING FRACTURES

More than half of fragility fractures occur in patients that do not have osteoporosis with BMD criteria. (28) Limitations to diagnosis of osteoporosis using WHO criteria alone include a decreased sensitivity to predict fracture risk by using a single BMD

measurement, the use of the same criteria to assess patients of various races, ages and genders and that extra skeletal risk factors such as propensity to falls, decreased vision and presence of other systemic diseases, are not considered. (4) Consequently, a more accurate way to assess for future fracture risk in patients would be to combine BMD measurements with identification of clinical risk factors, assessment of bone turnover using biochemistry or bone histology and the results of various bone specific radiological investigations. (4)

Clinical risk factors (CRF) for osteoporosis have been used to identify patients who require BMD testing and to assess fracture risk so as to decide on future treatment options. (4,16) CRFs identified by WHO in the WHO Technical Report assessing 10-year risk of major osteoporosis-related fracture of the hip, spine, forearm and humerus include age, gender, prior fragility fractures, family history of hip fracture, low BMI, use of oral glucocorticoids, smoking, excess alcohol intake, secondary osteoporosis and rheumatoid arthritis. (4) CRFs differ in importance in different population groups and thus must be researched and validated in these populations. (4,7)

The Fracture Risk Assessment Tool (FRAX) has been developed by the WHO to calculate the 10-year probability of a major osteoporotic fracture taking into account clinical risk factors and femoral neck BMD. (1,22) It can also be calculated without the femoral neck BMD value if this is not available. This tool is available online and is validated for several countries. (13) FRAX is the most frequently recommended tool followed by QFracture in the UK, Canadian Association of Radiologists and Osteoporosis Canada (CAROC) in Canada and Garvan in Australia. (17,28) None of the fracture assessment tools were found to perform better than the others and simple tools were found to be just as good as complex ones. (17,28) Unfortunately comparisons of the tools in similar populations were

never carried out therefore firm conclusions, regarding the comparison between the tools, could not be made. (28)

FRAX is intended for use in postmenopausal women and male patients above the age of 50. (1) Treatment decisions should be based on fracture probability using FRAX. (28) FRAX has however not been validated for patients who are currently or were previously on treatment for osteoporosis nor in patients with secondary causes of osteoporosis. (1)

The value of the fracture risk assessment is not universally recognised as many criticisms have been made, including the necessity of internet access, variations in BMI and mortality across various ethnicities and the exclusion of variables such as falls. (28) FRAX underestimates fracture risk in patients with recent fractures, multiple osteoporosis related fractures and those who are at an increased risk of falling. (1) The use of FRAX in patients with low BMD at the lumbar spine and normal BMD at the femoral neck also underestimates the fracture risk in these patients. (1)

Identification of CRFs in patients is valuable in case finding and is probably more attainable than screening a population at risk with dual energy x-ray absorptiometry (DEXA). (4,28) Patients with fragility fractures often do not have BMD measurements in keeping with the criteria for the diagnosis of osteoporosis. (28) Approximately 50% have low bone mass or osteopenia on DEXA. (28) Assessing for CRFs in these patients would ensure appropriate referral for further investigations and would also assist with choice of pharmacotherapy. (3,28) A study done by Hegeman et al screened 100 patients with low trauma fractures in their fracture and osteoporosis clinic and found only 67% to have BMD criteria for osteoporosis. (29) The remaining 20% of the patients had osteopenia and 13% had normal DEXA scans. (29)

The British Orthopaedic Association (BOA) guidelines recommend that all patients above the age of 60 years with a fragility fracture be evaluated by a DEXA scan, and patients younger than 60 years old with fragility fractures should be assessed for the presence of risk factors for osteoporosis and scanned only if these risk factors are present. (26)

Patients in whom BMD testing should be considered, according to the United States (US) National Osteoporosis Foundation (NOF) include 1) women over the age of 65 years and men over the age of 70 years regardless of their clinical risk factors 2) adults who have a fracture at or after the age of 50 years 3) younger postmenopausal women, menopausal woman and men between the ages of 50 and 69 years old with clinical risk factors and 4) patients with a systemic disease or on medication associated with bone loss. (1)

The National Osteoporosis Foundation of South Africa (NOFSA) guidelines differ and suggest bone mass measurement in women aged 65 years and older and in men over the age of 70 years. (4) Bone mass measurement should also be done in patients with known secondary causes of osteoporosis, a history of fragility fractures after the age of 40 years, radiographic evidence of vertebral fractures or osteopenia, to facilitate a decision regarding initiation or cessation of a drug and if there is a presence of major clinical risk factors such as a family history of osteoporosis, excessive leanness, smoking, excessive alcohol intake and poor nutrition. (4)

1.9 INVESTIGATION OF PATIENTS WITH OSTEOPOROSIS

In patients with fragility fractures and/or osteoporosis, following a history taking and good physical examination, laboratory and radiological investigations are recommended. Serum calcium, albumin and phosphate, alkaline phosphatase and PTH levels are indicated in all patients with possible osteoporosis. (4,13) The measurement of 25-hydroxyvitamin D is

indicated in certain scenarios for example in elderly, malnourished or institutionalized patients. (4) Hyperparathyroidism and osteomalacia should be excluded as a cause for bone disease. (4) Other secondary causes of osteoporosis should be ruled out and blood tests necessary for the exclusion of these diseases must be done if clinically indicated. A full blood count (FBC), thyroid stimulating hormone (TSH), erythrocyte sedimentation rate (ESR), serum creatinine, protein electrophoresis, sex hormone levels and urine calcium levels may be useful to exclude secondary causes. (4) Radiological investigations appropriate for patients with osteoporosis include standard X-rays and DEXA with BMD measurement. Bone turnover markers, bone marrow aspirations and bone biopsies are rarely done and only if clinically indicated. (4)

In Africa, DEXA scans are not widely available and in Morocco for example, only 0.6 DEXA scans are available per million people. (30) In South Africa (SA) a DEXA scan costs \$130 which is relatively expensive when taking into account that this is approximately a third of the monthly income of an average person in the country. (30)

1.10 MANAGEMENT OF OSTEOPOROSIS

Management of both fragility fractures and osteoporosis is divided into non-pharmacological and pharmacological treatment. Non-pharmacological measures are undertaken to improve bone strength and prevent falls and involve encouraging physical exercise, limiting alcohol intake, cessation of smoking, adjusting of diet and avoidance of bone toxic drugs. (4,20)

Nutritional measures involve a healthy eating plan with sufficient protein and all the essential nutrients including calcium and vitamin D. (4,16,20) High calcium intake has been shown to augment peak bone mass however the effect of this is subject to dose,

baseline calcium intake, pubertal maturation and genetic factors. (4) Severe vitamin D deficiency induces osteomalacia and results in an increase in bone turnover and resultant osteoporosis. (4) Recommended daily intake of calcium based on SA osteoporosis societies is 600mg for adult men and women whose calcium intake with diet is insufficient. (31) The recommended dosage of vitamin D is 800-1200IU per day. (4,31)

A related meta-analysis showed only a small, non-progressive increase in BMD with calcium supplements. (32) Following these reviews, the United States food and drug administration suggested that an adequate calcium intake in the diet is the most beneficial for bone health. (1,32)

Supplementation of 20g of protein in the diet of elderly patients with hip fractures has been shown to prevent further femoral bone loss, lower mortality and shorten the hospital stay. (4) A high intake of fibre, oxalate and phytate has been shown to have a negative effect on intestinal calcium absorption. (4) High sodium intake also negatively impacts on the calcium levels in the blood by enhancing the urinary excretion of calcium. (4) Vitamins C, B6, K, and minerals like zinc, copper, boron and manganese have also been shown to reduce bone loss however this needs to be substantiated with further studies. (4)

Adequate physical exercise is necessary for normal bone formation and a sedentary lifestyle contributes to rapid bone loss. (1,4) Regular weight-bearing exercises such as jogging and dancing, and muscle-strengthening exercises such as yoga, have been recommended to reduce the risk of falls. (1,12) Walking for five kilometers at a brisk pace three to four times a week and back strengthening exercises have been recommended by the NOFSA to improve hip and vertebral bone strength respectively. (4)

The prevention of falls, especially in the elderly, is of great importance. One in three people over the age of 65 years old fall once annually, and of these falls five to six percent result in a fracture. (4,16) In the elderly, risk factor tools have been derived to predict the occurrence of a fall and the sensitivity and specificity of these are in excess of 70%. (4) Institutionalisation, cognitive impairment, gait and balance disorders, weakness and immobility, poor vision, extrinsic environmental hazards, cardiovascular disease (particularly orthostasis) and medication side effects are some of the main risk factors associated with falls. (2,4)

The cessation of smoking and a limitation of alcohol to less than three units per day are also recommended. (2,4,12) A great number of medications play a role in either reducing bone strength or predisposing to a fall. (4,12) Examples of drugs that increase the risk of osteoporosis and thus a future possible fragility fracture are glucocorticoids, anticonvulsants, aromatase inhibitors, chemotherapeutic drugs, immunosuppressants and lithium to name a few. (4) Many patients, especially the elderly, are on sedatives, antidepressants, antihypertensives and hypoglycaemic agents that play a pivotal role in increasing the risk of falling. (4)

Pharmacological agents that prevent bone loss, improve bone strength and reduce the risk of future fractures are used to treat osteoporosis once confirmed. (4) In addition to bone modifying drugs, analgesia is often prescribed for pain relief. (25) Bone resorption inhibitors include calcium and vitamin D, selective oestrogen receptor modulators (SERMS), bisphosphonates and oestrogen and its analogues. (4,12) Calcitonin is a bone resorption inhibitor but is seldom used. (4) Parathyroid hormone and fluoride are used as bone formation stimulators however fluoride is used infrequently and is currently not recommended by the NOFSA. (4) Strontium ranelate, anabolic steroids, vitamin D

metabolites and thiazide diuretics are drugs with a complex action on bone that can also be used for osteoporosis treatment. (4)

First line treatment in postmenopausal women, in men, and in certain secondary osteoporosis are bisphosphonates. (4,13,25) Initial choice of therapy will however be dictated by the patients age, general health, concomitant disease, patient preference and the clinical setting. (4) There has been a concern regarding the development of osteonecrosis of the jaw and atypical fractures in patients who have been on bisphosphonates. (4) However, the number of patients with these complications is small in comparison with the number of fractures that are prevented with treatment. (4)

Strontium ranelate has been registered in SA for use in the treatment of osteoporosis and works by both stimulating bone formation and inhibiting bone resorption however it is infrequently used due to cardiovascular safety concerns. (4) The only drug that has been registered to stimulate bone formation is the synthetic parathyroid hormone Teriparatide. (4,33) Teriparatide is only indicated in SA in patients with two or more fragility fractures, in patients who have failed treatment with bone active medication and in patients on chronic glucocorticoid therapy with i) BMD T-score <-3.5 with no fractures ii) BMD T-score <-2.5 with one or more fragility fracture or iii) multiple fragility fractures with bone that cannot be assessed by a DEXA. (4) Denosumab is an osteoclast stimulator that has recently been proposed as an additional treatment for osteoporosis. (32-33) In SA Denosumab is currently not yet registered for use. (32)

All patients with fragility fractures require therapy regardless of BMD measurement. (4) There are many pharmacological options for the treatment of osteoporosis however each patient must be assessed individually to select the most appropriate therapy.

1.11 MONITORING OF THERAPY

Clinical evaluation for all patients with fragility fractures and osteoporosis on medication should be done regularly to assess progression of disease, drug side effects and adherence to therapy. (4) Vertebral imaging is recommended every four to five years as vertebral fractures are often asymptomatic. (4) Routine bone mass measurements are also recommended to monitor treatment and should preferably be done using the same modality, ideally a DEXA scan. (1,4) Currently there is no consensus regarding BMD intervals for patients already on therapy. (20) DEXA scans and serum calcium and 25-hydroxy vitamin D levels can be done as frequently as deemed clinically necessary. (13)

If bisphosphonate therapy is used, bone turnover suppression can be assessed using bone turnover markers such as a urine N-telopeptide level or beta-crosslaps. (13) This may serve as a proxy for bone metabolic activity however its limitation is that it is expensive and not often clinically indicated. (13) The continued need for bisphosphonate therapy should be assessed after four to five years of therapy. (31) Current NOFSA guidelines suggest consideration of a drug holiday after five years of bisphosphonate therapy. (4)

1.12 MORTALITY AND MORBIDITY ASSOCIATED WITH OSTEOPOROSIS

Deaths due to fragility fractures associated with osteoporosis are usually dependent on the type of fracture, age, gender and race of the patient. (34) Other systemic illnesses, frailty and underlying comorbidities may also be contributing factors to mortality in these patients. (34)

Mortality rates are highest in patients with fractures of the vertebrae and hip. (34) In hip fractures mortality rates are highest in the first six months immediately after the fracture.

(34) After a hip fracture, approximately 20% of patients do not survive more than a year and 30% do not regain their previous level of independence. (16) In the Middle East and Africa, the mortality rates post hip fractures are predicted to be two to three-fold higher than in Western populations. (30) Following surgery for hip fracture, postoperative complications include sepsis and the development of cardiovascular events such as myocardial infarctions, and these complications increase the risk of mortality to 90%. (34) Black women have a higher mortality rate than white women following a hip fracture. (34) Male patients post hip fracture had a higher mortality rate than female patients regardless of race. (34)

Vertebral fractures are the most frequent complication of osteoporosis and are associated with back pain, loss of height, kyphosis, respiratory compromise and functional disability. (34) After the age of 50 years, the lifetime risk of a vertebral fracture is 9% in men and 15% in women. (34) The prevalence of vertebral deformities increases from 5-10% percent in women in their 50s, to 45 - 55% of those in their 80s. (34) Annual mortality rates for vertebral fractures range from 1.9-42%. (34) The most common cause of death in patients with vertebral fractures are pulmonary causes such as pneumonia and restrictive lung disease and their complications. (34)

Data is lacking regarding mortality in fractures not occurring in the hip or vertebrae, and long-term mortality risk following an osteoporotic fracture. Mortality rates for SA patients are also lacking.

1.13 THE ROLE OF THE ORTHOPAEDIC SURGEON

The clinical relevance of osteoporosis is that it results in fractures. (18) Even fragility fractures that occur after low impact trauma hint at an underlying compromise of bone

strength. Due to these resultant fractures, the orthopaedic surgeon is frequently the first and often the only doctor to manage the patient. (18)

Most patients with osteoporosis sustain fractures of the hip, vertebrae, wrist and proximal humerus and of these, it is frequently those with hip and vertebral fractures that are likely to be admitted. (26) Patients with wrist and proximal humerus fractures are usually discharged after a very short hospital stay or are not admitted at all and are treated on an outpatient basis. (26) Orthopaedic surgeons thus have an opportunity to address the compromise in bone strength either by clinical assessment and further radiological investigations or by appropriate referral to a physician or endocrinologist. Despite this, orthopaedic surgeons often rely on primary care providers to assess and initiate treatment for underlying osteoporosis in fragility fractures. (18)

A study done by Jadhav et al in India involved 16 orthopaedic doctors and 45 general practitioners and compared their knowledge of fragility fractures, risk factors, complications, prevention and management, between the two sets of practitioners. (18) A questionnaire with a total of ten questions was used for this study. (18) The orthopaedic surgeons had more knowledge regarding fragility fractures when compared to the general practitioners. (18) This would imply that while the orthopaedic surgeons are largely relying on general practitioners to further evaluate and treat these patients, these general practitioners are neglecting to adequately investigate and treat such patients due to a very poor knowledge of fragility fractures. In particular, the risk factors associated with these fractures and the prevention thereof was especially lacking. (18)

One can postulate that future fracture risk in these susceptible patients is not being assessed and thus the morbidity and mortality of the patients may increase with time. To

add to this, economic investment in these patients for the future will be significantly higher especially considering the emergency department resources that will be necessary, cost of future inpatient admission, radiological investigations, treatment and probably surgical interventions may be required. (18) For the patients themselves, suffering a future fracture would adversely affect their physical and psychological well-being, quality of life and mortality rate. (18)

In a survey of 3422 orthopaedic surgeons across six countries, 90% of them did not routinely do a BMD measurement for a patient with a first-time fragility fracture and 50% admitted to poor knowledge and having had no formal training regarding osteoporosis. (34) Only 20% of the surgeons referred patients with a first-time fragility fracture for a BMD measurement. (35)

Two similar studies were carried out in Iran and the UK respectively. The study done in Iran by Sorbi et al tested the knowledge of 2021 orthopaedic surgeons via a questionnaire covering topics of diagnosis, treatment and approach to a patient with a fragility fracture. (23) Less than 10% of those surveyed included BMD while evaluating a fragility fracture, 32% prescribed the correct dose of calcium and vitamin D and only 30% would appropriately refer if a low impact trauma was suspected. (23) This study concluded that majority of the orthopaedic surgeons had only limited knowledge with regards to fragility fractures and the assessment of osteoporosis in patients with such fractures. (23) Orthopaedic surgeons seem to have a perception that they are not involved in care for osteoporosis and patients are under investigated and often go untreated. (23)

A British study done in 2007 retrospectively reviewed 38 patients who had probable fragility fractures six months post injury via a telephonic questionnaire to assess whether

they had been assessed, investigated or treated for osteoporosis. (26) The majority of the patients had never been referred for investigations or to a general practitioner for independent screening after the first audit. (26) After initiating an awareness programme regarding recent guidelines and changing infrastructure in the fracture clinic, still only 50% of patients were appropriately referred. (26)

Gardner et al retrospectively analysed 300 randomly selected British patients with fractures of the femoral neck. (36) Only 58 (19.3%) had received a prescription for calcium and vitamin D at the time of their discharge. (36) Of these patients, 40 (13.3% of the overall group) had been prescribed calcium alone, but only 18 (6.0% of the overall group) had received medication to actively prevent bone resorption and to treat osteoporosis. (36) The remaining 81% of patients were discharged without osteoporosis medication and none had a bone density scan while in hospital. (36)

Efforts to highlight the crucial role that orthopaedic doctors play in the role of identifying patients at risk, referring them appropriately and initiating treatment must be continued. (26) Orthopaedic surgeons should be aware that they play a vital role in the reduction of future fracture risk and the associated complications in these patients. (26)

The increasing life expectancy in countries in Africa and the Middle East will result in an increase in the burden of osteoporosis in years to come. (30) It therefore becomes necessary to encourage identification and promote management of osteoporosis in these populations to curb future financial strains on health care.

This study was based on several studies assessing various aspects of fragility fractures and resultant osteoporosis. These studies surveyed risk assessment for future fragility

fractures, (26,37) referral for further osteoporosis management (38) and awareness amongst orthopaedic surgeons with regards to appropriate diagnosis and referral of patients with suspected osteoporosis. (18,23)

This study was based primarily on a study in Germany done by Kolios et al who used a medical questionnaire containing 19 questions for men and 21 questions for females to quickly and effectively screen large numbers of patients for reduced BMD. (39) In the study by Kolios et al, bone specific laboratory investigations and DEXA scans were also examined as diagnostic instruments for osteoporosis however no laboratory investigations or DEXA scans were done in this study due to time and resource constraints. (39)

Other studies reviewed include a study by Gidwani et al who audited the assessment, investigation and treatment of patients with fragility fractures in their hospital using a telephonic questionnaire. (26) Similarly, Sugi et al used a telephonic interview to survey whether patients 50 years or older with fragility fractures had been identified and appropriately referred. (38)

It is often thought by practitioners that patients with fragility fractures and osteoporosis are very elderly however this is not always the case. One in two women and one in five men older than the age 50 years will sustain an osteoporotic fracture in their lifetime. (21,25) A recent fracture at any major skeletal site in an adult older than 50 years of age should be considered a significant event for the diagnosis of osteoporosis. (1) Subjects aged 50 years and above were recruited for the study based on this and on previously done similar studies that recruited subjects in this age group. (18,23,26,38,39) Low trauma fractures were used as a surrogate for fragility.

In South African hospitals, trauma units are overburdened with a large number of patients. If a screening tool, that is not time consuming, is available to the orthopaedic department this may aid practitioners immensely in detecting bone loss and implementing anti-osteoporotic therapy. (39)

1.14 AIMS AND OBJECTIVES

AIM

To assess whether African subjects with fragility fractures are being identified for assessment for osteoporosis on presentation to the orthopaedic department.

OBJECTIVES

To determine if orthopaedic surgeons question subjects with fragility fractures about risk factors for osteoporosis.

To assess whether orthopaedic surgeons educate subjects with fragility fractures about secondary prevention.

To ascertain whether subjects were referred for further assessment of underlying bone disease for osteoporosis.

CHAPTER 2: SUBJECTS AND METHODS

The study was conducted in the Orthopaedic wards, outpatient clinic and casualty area at Chris Hani Baragwanath Academic Hospital (CHBAH) in Soweto, South Africa. The CHBAH is a large hospital with 2888 beds of which 232 beds are allocated to orthopaedic patients. (40) The hospital serves 3.5 million people in the community and surroundings of Soweto. (40)

2.1 SUBJECTS

Inclusion criteria:

Subjects > 50 years of age

Both male and female African subjects

Subjects with fragility fractures

Exclusion criteria:

Subjects with high impact fractures

Subjects who did not consent to be in the study

Approval was obtained from the Human Research Ethics Committee (HREC) (Medical) of the University of the Witwatersrand (M150261) (Appendix 1). An appendant to the original ethics form was approved by the HREC in December 2016 (Appendix 2).

2.2 METHODS

This study was conducted using two qualitative questionnaires, both designed and administered by the researcher to assess whether subjects had been asked about their risk for fragility fractures, and whether they had been educated about prevention of future fractures by the orthopaedic surgeons. Both questionnaires were adapted from similar published studies (26,37,39).

The first questionnaire (Appendix 3) was administered in a bedside interview with the subjects, after written, informed consent (Appendix 4) was obtained and comprised of 13 questions that addressed specific risk factors for osteoporosis, patient education and referral for further management. Risk factors addressed included a history of prior fracture, family history of osteoporosis and the use of corticosteroids. Advice regarding lifestyle choices detrimental to bone health were addressed in the first questionnaire including smoking, alcohol use, diet, bone strengthening exercises, cortisone use and the use of hormone replacement therapy. Lastly subjects were asked if they were advised to return for assessment for bone disease.

A second questionnaire (Appendix 5) was administered telephonically by the researcher 18 months after the first interview. Telephonic consent was obtained from all subjects prior to the interview (Appendix 6). The second questionnaire specifically addressed whether orthopaedic surgeons had asked about ten risk factors for osteoporosis. Questions regarding advice on lifestyle changes for bone health from the first questionnaire were also incorporated into the second questionnaire. Lastly, subjects were asked if they were told to return for assessment of bone disease.

All completed questionnaires were analysed for frequency of responses and reported as the number of responses received.

2.3 STATISTICAL ANALYSIS

Descriptive analysis of the data was carried out as follows: categorical variables were summarised by frequency and percentage tabulation, and illustrated by means of bar charts. Continuous variables were summarised by the mean and standard deviation and their distribution was illustrated by means of histograms.

CHAPTER 3: RESULTS

3.1 SUBJECT CHARACTERISTICS

A total of 103 subjects were identified as meeting inclusion criteria during June to September 2015. Three female subjects declined to participate and 100 subjects were studied. All subjects recruited for the study signed a consent form prior to the first interview. The majority of the subjects recruited were female (77/100;77%).

The majority of the subjects recruited were from the orthopaedic wards (89/100;89%), far fewer from the orthopaedic clinics as screening proved to be difficult (11/100;11%), and none were recruited from the casualty area of CHBAH.

The mean age of male and female subjects combined was 63.6 (SD+/-10) years. Majority of the subjects were between 50-60 years of age. (Figure 3.1.1)

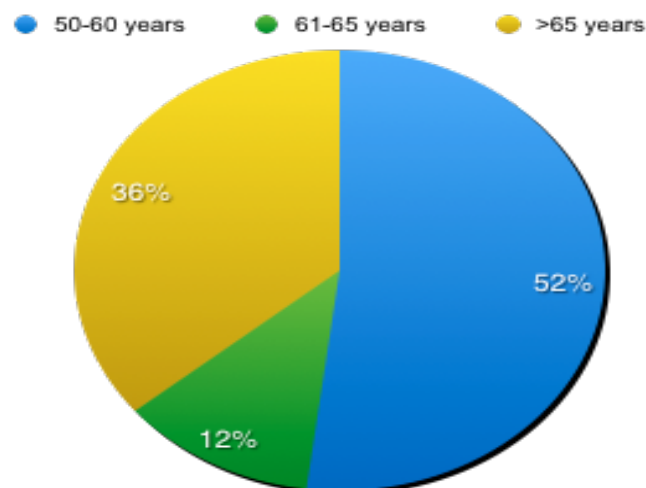


Figure 3.1.1 Percentage of subjects in each age group

The main mechanism of injury was falling while walking which occurred in 85/100;85% of the subjects, 13/100;13% of the subjects slipped on a smooth surface, one subject fell while climbing out of a vehicle (1/100;1%) and one had no identifiable trauma (1/100;1%).

Table 3.1.1 Baseline characteristics of the study population including age, gender, recruitment site and mechanism of injury

	Males (n=23)	Females (n=77)
Mean Age (SD)	61.0 (+/-7.8)	64.4 (+/-10.7)
STUDY RECRUITMENT SITE:		
Orthopaedic ward n (%)	18 (78.3)	71 (92.2)
Orthopaedic clinic n (%)	5 (21.7)	6 (7.8)
Casualty n (%)	0 (0)	0 (0)
MECHANISM OF INJURY:		
Fell while walking n (%)	23 (100)	56 (72.7)
Slipped on a smooth surface n (%)	0 (0)	19 (24.7)
Fell while climbing out of a car n (%)	0 (0)	1 (1.3)
No identifiable trauma n (%)	0 (0)	1 (1.3)

3.1.1 FEMALE SUBJECTS

The majority of female subjects presented with fractures of the femur including neck of femur, intertrochanteric, proximal and distal femur. The number of typical fragility fractures that occurred in female subjects of different age groups is represented according to highest prevalence. (Figure 3.1.2)

Other less prevalent fractures noted in the female subjects studied included fractures of the patella (4/77;5.2%), olecranon (2/77;2.6%), and tarsal bones (1/77;1.3%). These fractures are depicted in figure 3.1.2 as 'Other fractures'.

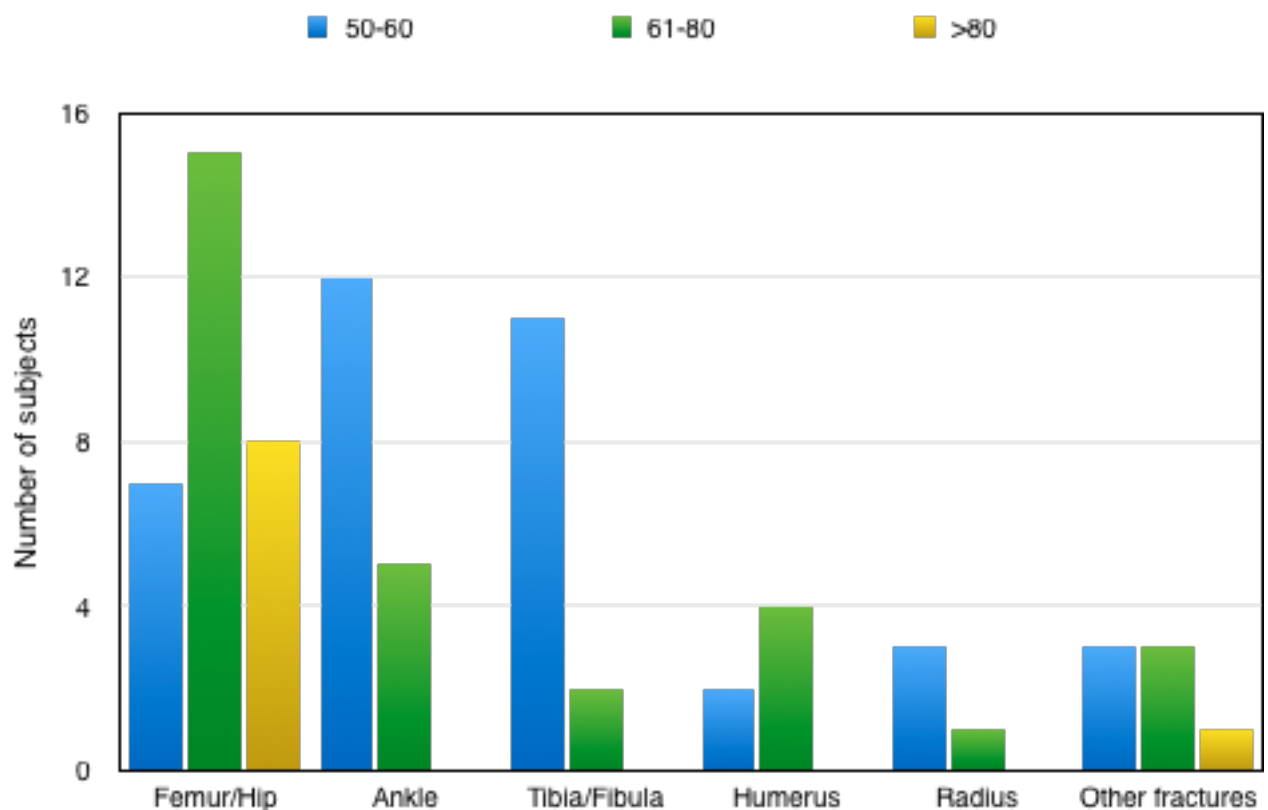


Figure 3:1:2 Number of female subjects and type of fracture in different age groups

3.1.2 MALE SUBJECTS

The majority of male subjects also presented mainly with fractures of the femur including neck of femur and distal femur fractures. The number of typical fragility fractures that occurred in male subjects of different age groups was represented according to prevalence. (Figure 3.1.3)

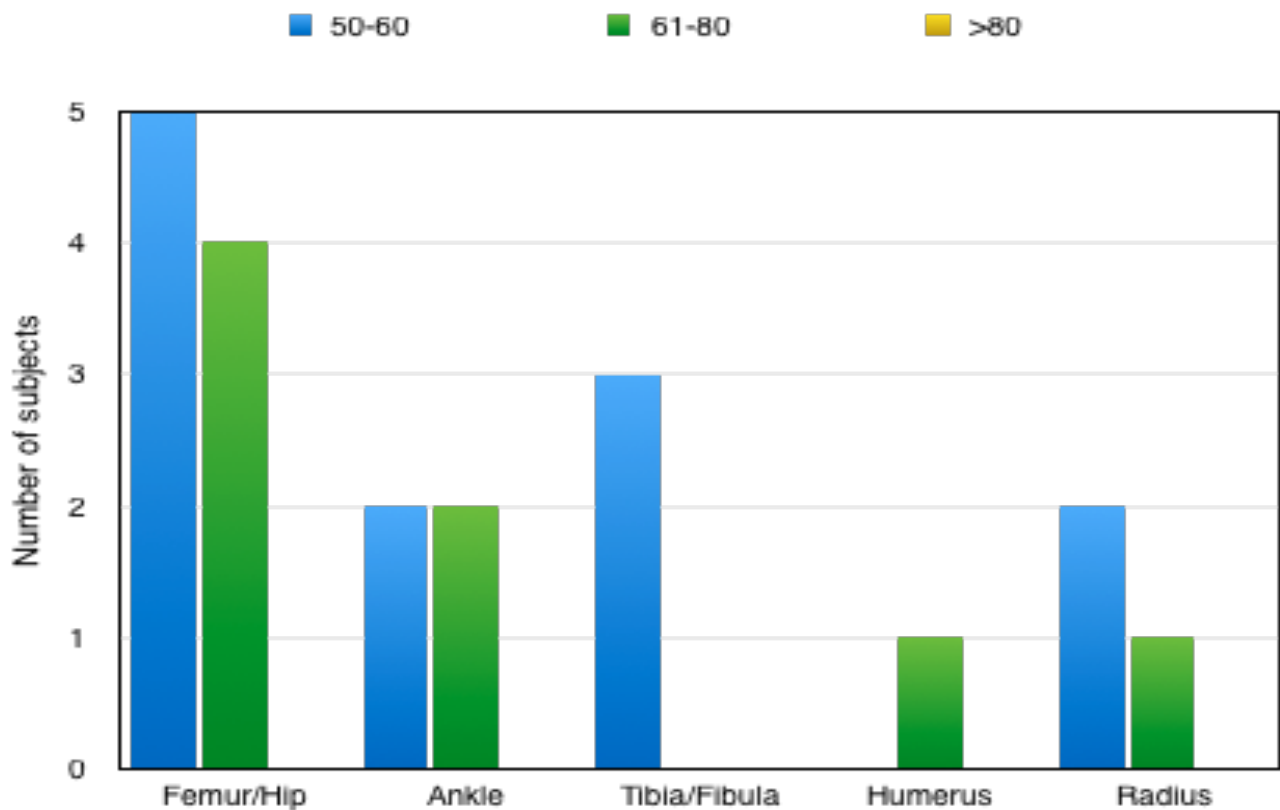


Figure 3.1.3 Number of male subjects and type of fracture in different age groups

Less prevalent fractures in the male subjects studied included fractures of the vertebrae (1/23;4.3%) and tarsal bones (2/23;8.7%). Figure 3.1.4 compares femur fractures, in male and female subjects, with fractures of the vertebrae and other less prevalent fractures.

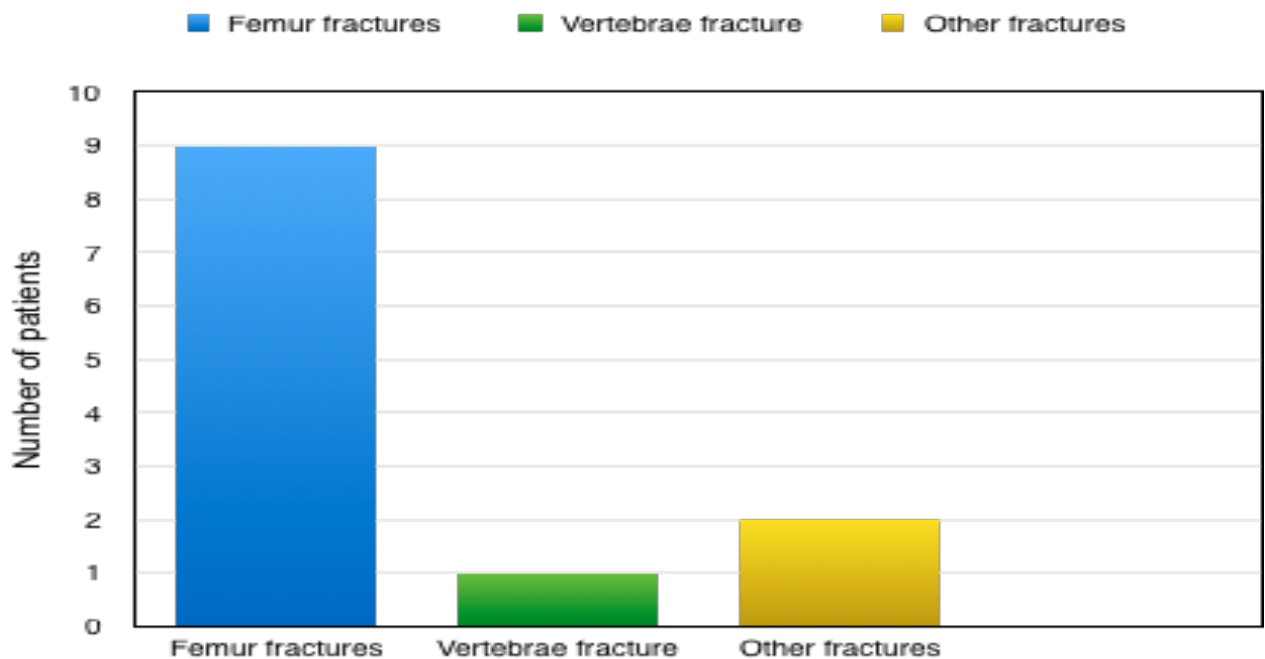


Figure 3.1.4 Femur fractures versus vertebral and other less prevalent fractures

3.2 QUESTIONNAIRE RESULTS

3.2.1 QUESTIONNAIRE ONE RESULTS

A total of (89/100;89%) subjects were asked at least one screening question about the risk of osteoporosis. The most frequently asked question about risk factors for osteoporosis in the first interview, was regarding previous fractures. Thirty seven percent (37/100;37%) of all subjects had been given advice regarding appropriate bone strengthening exercises to prevent osteoporosis in the future. Only five subjects (5/100;5%) with fragility fractures were asked to return for further assessment.

Table 3.2.1: Number of subjects asked questions regarding risk factors, education and referral for osteoporosis

Questions	Number of subjects (n=100)
Have you been asked about being diagnosed with osteoporosis?	6/100 (6%)
Have you been asked about prior fractures?	61/100 (61%)
Have you been given any dietary advice to prevent osteoporosis?	2/100 (2%)
Have you been advised to do bone strengthening and weight bearing exercises for 30 minutes 2/3 times a week?	37/100 (37%)
Have you been advised against cigarette smoking?	13/100 (13%)
Have you been advised against excessive alcohol intake?	12/100 (12%)
Have you been put on any calcium supplements?	2/100 (2%)
Have you been put on any vitamin D supplements?	1/100 (1%)
Have you used cortisone before?	2/100 (2%)
Have you been advised against the use of cortisone?	0/100 (0%)
Do you have a family history of bone disease?	2/100 (2%)
Have you been educated about hormone replacement therapy to prevent osteoporosis?	0/100 (0%)
Have you been advised to come back to be assessed for bone disease?	5/100 (5%)

3.2.2 QUESTIONNAIRE TWO RESULTS

To determine if subjects had been referred for investigation since discharge, a second interview was conducted telephonically in December 2016. Only 37 of the 100 subjects (37/100;37%) initially interviewed could be contacted telephonically. The remaining 63 subjects (63/100;63%) were not contacted because they had either demised (3/63;4.8%), they did not have a phone number (34/63;54.0%), the phone was switched off (12/63;19.0%) or the number was incorrect (14/63;22.2%). Of the 37 subjects, 30 were female (30/37;81.1%). The mean age of the female and male subjects interviewed was 60.9 years (SD+/-8.4) and 59.3 years (SD+/-9.4) respectively.

Table 3.2.2: Number of subjects asked questions regarding risk factors, education and referral for osteoporosis during telephonic interview

Questions	Number of subjects (n=37)
Have you been asked about being diagnosed with osteoporosis?	0/37 (0%)
Have you been asked about prior fractures?	24/37 (64.9%)
Did your doctor ask you if your diet included dairy products or calcium rich food?	0/37 (0%)
Have you been given any dietary advice to prevent osteoporosis?	1/37 (2.7%)
Did your doctor ask you if you spend less than 10 minutes outdoors?	0/37 (0%)
Have you been advised to do bone strengthening and weight bearing exercises for 30 minutes 2/3 times a day?	18/37 (48.6%)
Did your doctor ask you if you are currently smoking?	6/37 (16.2%)
Have you been advised against cigarette smoking?	4/37(10.8%)
Did your doctor ask you if you are drinking >3 alcoholic drinks per day?	5/37 (13.5%)
Have you been advised against excessive alcohol intake?	4/37 (10.8%)
Were you asked if you were on any calcium or vitamin D supplements?	2/37 (5.4%)
Have you been put on any calcium supplements?	2/37 (5.4%)
Have you been put on any vitamin D supplements?	2/37 (5.4%)
Were you asked if you had used cortisone before?	0/37 (0%)
Have you been advised against the use of cortisone?	0/37 (0%)
Were you asked if you have a family history of bone disease?	0/37 (0%)
If female, were you asked if you were postmenopausal?	0/37 (0%)
Have you been educated about hormone replacement therapy to prevent the development of osteoporosis?	0/37 (0%)
Have you since been diagnosed with osteoporosis or been advised to come back to be assessed for bone disease?	3/37 (8.1%)

Most subjects were asked the question regarding prior fractures and the most frequent advice given was still regarding bone-strengthening exercises. Only three subjects (3/37;8.1%) stated that they had been either diagnosed with osteoporosis (following a DEXA scan) or advised to come back for assessment. Of these three subjects, two subjects were newly diagnosed or referred for assessment (2/37;5.4%). Thus, in total after both interviews had been conducted, only seven out of the 100 subjects (7/100;7%) were appropriately diagnosed or referred however none could recall having had a DEXA scan. Four of the seven subjects (4/7;57.1%) referred for further management were male.

CHAPTER 4: DISCUSSION

Osteoporosis is a silent disease usually presenting with pain related to a fracture or loss of height related to vertebral compression fractures. (41) The prevalence of the disease, lack of early symptoms, and availability of effective treatments make screening for osteoporosis critical to the management of this disease. (41)

In this study, approximately half of the subjects were between the ages of 50 and 60 years proving that osteoporosis is not a disease solely affecting the elderly. Considering that the majority of subjects were below 60 years old, it is not surprising that the majority of patients were female since male subjects tend to develop fragility fractures and osteoporosis later in life. (5)

Both genders presented mainly with hip or femur fractures and this is in keeping with data worldwide showing these to be one of the most prevalent fragility fractures noted. (1,4,25) Surprisingly only one male subject presented with a vertebral fracture as this is usually the most prevalent fragility fracture seen and these subjects often require hospital admission. (26,42) This may be due to this subset of patients being found to be clinically stable and not having to undergo surgery and therefore not needing to be admitted. It is also possible that patients were discharged due to staff or resource limitations.

Fractures of the radius and humerus were infrequently noted with only 14 subjects identified. This is in keeping with studies showing forearm fractures to be rare in African subjects with osteoporosis. (2) However, other studies have shown forearm fractures to be more prevalent in subjects over the age of 65 years. It can be postulated that patients with forearm fractures were found to be clinically stable and were discharged without hospital admission. It is also possible that such patients presented to primary or secondary care

facilities for management rather than to CHBAH. According to studies fragility fractures of the ankle and tibia/fibula were much less prevalent than those of the hip, spine and forearm. However, in our study, up to 39% of females and 30% of men presented with these fractures. The reason for this is unknown and would require a full history from the patient to confirm the mechanism of injury.

In Denmark, a study done by Eiken, surveyed 56 orthopaedic departments throughout the country to assess the management of osteoporotic patients with regards to referral for DEXA scan, modification of lifestyle risk factors, and treatment initiation. (43) Of the departments surveyed, 88% of them did not refer patients with low trauma fractures for a DEXA scan. (43) Only 50% of the departments were educating their patients regarding lifestyle risk factors. (43) In addition, only 11% of the departments initiated treatment for their patients with calcium and vitamin D. (43) These study results are similar to our study results confirming suboptimal management of these patients by our orthopaedic surgeons.

The results of both interviews conducted via the questionnaire confirmed that the only risk factor that was regularly identified by the orthopaedic surgeons in the majority of the patients was a history of prior fractures. Prior fragility fractures have been identified as one of the most important risk factors with which to predict future fractures and thus this information is vital to plan treatment and prevent future fractures. (44) However, this particular risk factor may have been relevant to the orthopaedic surgeon in order to focus their attention on the surgical therapy for the subject rather than as a screening question for underlying osteoporosis. The majority of orthopaedic surgeons, world over, focus their attention on the intervention required for the fracture rather than medical therapy necessary for the prevention of future fractures. (23,45)

In the second interview it was found that other important risk factors such as smoking, alcohol use, poor diet, lack of exercise and the use of cortisone and hormone replacement therapy were assessed only in 32% of the subjects.

The multinational survey reported on by Dreinhofer et al highlighted the lack of knowledge and confidence amongst orthopaedic surgeons in diagnosing and treating osteoporosis. (35) This is unfortunate, as the orthopaedic surgeon is often the first and only practitioner to attend to patients with fragility fractures. (23) A number of studies have been done showing the poor rates of screening and subsequent treatment in these patients. Freedman et al reviewed a database of three million patients with fragility fractures in 30 different states within the US and found that only 24% of these patients had had either a diagnostic evaluation or treatment for osteoporosis. (43)

A number of theories regarding the decline in the diagnosis and treatment of osteoporosis have been put forward. (46) A disregard for the seriousness of osteoporotic fractures and a decrease in the number of DEXA scans done, even in private institutions, were factors that may have resulted in a decrease in disease identification. (46) There have also been numerous concerns regarding the rare complications of bisphosphonates such as osteonecrosis of the jaw and atypical fragility fractures. (46,47)

In CHBAH, due to the large number of patients seen in the orthopaedic ward and clinics, there may have been insufficient time and resources for orthopaedic surgeons to fully screen patients with low impact trauma for osteoporosis. In addition, the need for a high patient turnover in the wards may reduce the impetus to keep the patients longer for further investigations. As such, after discharge, patients may be lost to follow up or referred to local clinics without appropriate investigations. In the orthopaedic wards it is

often the junior doctors who are tending to these patients and due to a lack of knowledge or insight, investigations and treatment for osteoporosis may be neglected.

Since patients are unlikely to perceive osteoporosis as a disease that results in significant morbidity and mortality, it is therefore up to clinicians to educate the patient on risk factors and complications of the disease even prior to discussing treatment options. (41) Non-pharmacological interventions regarding bone-strengthening exercises, cessation of smoking, reducing excessive alcohol consumption, diet and avoidance of corticosteroids were addressed in only 44% of patients. Prior to discharge, only one new subject had been advised regarding the detrimental effects of alcohol on bone health.

In this survey, only 7% of the subjects were either diagnosed with osteoporosis or referred for further management leaving 93% of the subjects with no appropriate diagnosis nor investigation. These numbers are on par with international studies showing up to 95% of patients discharged without determining a cause for the fracture. (23) Vestergaard et al published a study in Denmark involving 18566 patients with fractures possibly due to osteoporosis. Of these subjects, only 0.3% of men and 2.2% of females were diagnosed and managed appropriately. (48) At present, there are no other similar SA studies to compare our data with.

Less than 5% of the subjects surveyed were asked about medication use, and advised against medication detrimental to bone health. Only one new subject was initiated on vitamin D supplementation following discharge. Calcium and vitamin D supplementation is only deemed necessary if dietary intake is proven to be insufficient. (1,31,32) However in the second interview conducted, no subjects were assessed to determine if their diet had sufficient calcium.

Calcium and vitamin D have been shown to be effective in preventing the development of osteoporosis however, a clinical review by Murad et al in patients with fragility fractures showed them to be ineffective if given separately. (49) A combination of both calcium and vitamin D at recommended doses of 1200mg and 800mg respectively was found to reduce the risk of future fractures by improving bone strength. (49) Only four subjects in our study were adequately treated following their fracture.

Studies have shown that orthopaedic surgeons were unable to extract a detailed history from patients regarding risk factors, comorbidities or medications due to time constraints. (38) The “own the bone” initiative by the American orthopaedic association thus proposed the establishment of a multidisciplinary team to adequately care for those with osteoporosis. (38) A combined medical effort with various practitioners was deemed more beneficial.

Orthopaedic surgeons agree that they should expand their role in the medical management of osteoporosis, however many believe that general practitioners would be more suited to manage these patients. (23,43) If treatment were to be initiated by the orthopaedic surgeons it is relatively simple, a yearly infusion of zoledronate 5mg given within 90 days significantly reduces the risk of vertebral and non-vertebral fractures in patients with an average age of 74.5 years and a recent hip fracture. (25) A study done by Edwards et al showed that the effect of immediate treatment for osteoporosis in patients presenting with fragility fractures, usually carried out by orthopaedic surgeons, was much superior than delayed treatment by general practitioners. (38) General practitioners have cited cost, a lack of available guidelines and an inability to keep up to date with new data, as reasons for often missing the diagnosis of osteoporosis. (43) An uncertainty regarding medication has also resulted in inappropriate treatment for the disease. (43)

Fragility fractures increase societal burdens in terms of mortality, quality of life, as well as economic costs. (49) The combined annual cost of all osteoporotic fractures has been estimated to be \$20 billion in the US and €30 billion in the European Union. (49,50) In SA, currently minimal data exists regarding incidence of disease or cost involved for all osteoporotic fractures. As such, identification of osteoporosis in relevant patients becomes of paramount importance to prevent increased mortality and morbidity and to decrease the resultant economic burden. (51)

Guided by the NOF and the International Osteoporosis Foundation (IOF), a Fracture Liaison Service (FLS) was proposed to encourage a multidisciplinary approach to patients admitted to hospitals, clinics and emergency rooms with osteoporotic fractures to prevent future fractures. (47,51) These patients, once identified, would be incorporated into well-developed osteoporosis treatment and management plans. (47) Use of the FLS was found to improve quality of care and reduce the rate of subsequent fracture. (41)

In SA, funding for a designated professional to screen for osteoporosis in each hospital and clinic may be difficult due to the financial constraints for medical care in this developing country, where HIV and Tuberculosis dominate the budget. However, if the estimated annual cost and mortality rate is considered, the long-term benefits of a fracture intervention programme are unquestionable.

A study done by Sewell et al in the UK monitored patients with fragility fractures admitted to a fracture clinic. (52) Initially, a mere 33% of the patients surveyed were appropriately managed for secondary prevention of fractures. (52) Thereafter a fragility fracture prevention strategy was implemented consisting of fracture clinic infrastructure changes, a staff awareness teaching programme and the assignment of an osteoporosis nurse

specialist. (52) After six months, new patients with fragility fractures were evaluated and 88% of them had been appropriately managed for secondary prevention. (52) This study demonstrates viable changes that can possibly be considered for the SA setting.

A cost-effective method of screening patients in SA may also be for the orthopaedic doctors to use a simple questionnaire such as the one used in this study, on all patients with low trauma fractures who present to them. Junior doctors or qualified nurses in the orthopaedic department would find this screening process simple and would require no more than ten minutes to interview their patient. If risk factors are identified, lifestyle modifications can be encouraged, a DEXA scan can be booked if required and treatment for osteoporosis can be initiated. Gosch et al published an algorithm in 2013 for orthopaedic surgeons to use to make assessment easier and less time consuming. (47)

In SA risk factors and BMD measurements specific to our unique population need to be investigated further. BMD criteria on DEXA scan to diagnose osteoporosis needs to be confirmed in our ethnically diverse population.

The crucial role of orthopaedic surgeons in referring patients with fragility fractures is highlighted by this survey. The detection and appropriate referral of such patients should primarily be the responsibility of the orthopaedic surgeon. The interpretation of scans and prescription of medication can however be done by other practitioners such as a general physician, endocrinologist, rheumatologist or geriatrician if necessary. (26) In SA, due to financial constraints, many patients find it difficult to frequent health care facilities for regular assessments. In light of this, optimal care for the patient should ideally be initiated on presentation to the hospital with a fragility fracture.

Educational opportunities need to be established for orthopaedic surgeons to tackle the limitations in knowledge of osteoporosis assessment and treatment. (18) Postgraduate training should also encompass effective screening and secondary prevention of osteoporosis. (18)

Unfortunately, there were a number of limitations to the study done. Subjects were recruited for the study if they had a low trauma fractures however not all the subjects recruited had traditional fragility fractures. Fractures of the olecranon, patella and tarsal bones were included in the study on the basis of the mechanism of injury noted in the file. The criteria for recruitment into the study should ideally have been improved with additional information.

The limitation regarding the questionnaires was that they were both adapted from similar studies that have been published, but they were not piloted, nor were any validated scoring tools used which would have obviated the need to pilot the questionnaires. The first questionnaire contained questions that were not accurate and as such were unable to achieve the main objective of the study. Following this, a second questionnaire was devised in order to more accurately answer the initial research question posed. Only 37 of the original 100 patients could be contacted and interviewed and this was done approximately 18 months after the first interview. This resulted in a much smaller number of patients that could be assessed appropriately.

During both interviews, great care was taken to enable the patient to understand the questions posed. However, despite this, subjects may have misinterpreted the questions. This could be due to language barriers or due to a lack of insight and understanding. Questions may have been ambiguous inciting inaccurate responses. Furthermore,

subjects often could not understand the difference between standard X-rays and DEXA scans when asked if they had been diagnosed with osteoporosis or given follow up dates for assessment thereof. Therefore, the accuracy of the data regarding the assessment following their fragility fracture is questionable and the number of patients assessed appropriately is likely to be even lower.

The strength of this study is that it identified a lack of adequate assessment and follow up of patients with fragility fractures in CHBAH. This highlights the need for further education of orthopaedic service practitioners in order to initiate risk factor modification and treatment as well as to improve access to follow up care for these subjects.

CHBAH is one of the largest hospitals in the world with a very busy orthopaedic unit. Turnover rates of patients in the orthopaedic ward at CHBAH are high and orthopaedic clinics are held almost daily thus making it relatively easy to acquire the large number of subjects needed for the study. This study looked at the assessment of fragility fractures in African patients alone, which has not been done in prior research studies. Very little data is available on bone disease in African patients and reference ranges for this population are still to be determined for DEXA scans. More studies assessing African patients will be necessary to better understand and subsequently manage these patients. This study will hopefully improve the care of patients with fragility fractures presenting at CHBAH.

5. CONCLUSION

It is vitally important that patients with fragility fractures be identified as potentially having underlying bone disease and be referred appropriately for further investigation and management. Osteoporotic fractures are largely preventable as environmental risk factors can be altered and pharmacological therapy is readily available for treatment thereof. (53,54) The prevention of future fractures should be made a priority and orthopaedic surgeons are often the only practitioners with an opportunity to do so. While a multidisciplinary approach would be ideal for patients with fragility fractures, if they are not appropriately identified as having risk factors for osteoporosis by orthopaedic surgeons on presentation, further investigations and management may never commence.

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7. APPENDICES

APPENDIX 1: ETHICS CLEARANCE CERTIFICATE



R14/49 Dr Preetha Thomas et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M150261

NAME: Dr Preetha Thomas et al
(Principal Investigator)

DEPARTMENT: Internal medicine
Chris Hani Baragwanath Academic Hospital

PROJECT TITLE: Assessment of African Patients with Fragility
in an Orthopaedic Setting at Chris Hani
Baragwanath Academic Hospital in Soweto

DATE CONSIDERED: 27/02/2015

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr S Bhana

APPROVED BY: 
Professor P Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 29/05/2015

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned

contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature

Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX 2: ETHICS CLEARANCE CERTIFICATE (APPENDENT)



27 January 2017

Dr Preetha Thomas
Internal medicine

Sent by email to: preetha7@gmail.com

Dear Dr Thomas

Re: Protocol Ref No: M150261

Protocol Title: Assessment of African Patients with Fragility in an Orthopaedic Setting at Chris Hani Baragwanath Academic Hospital in Soweto

Principal Investigator: Dr Preetha Thomas et al

Protocol Amendment: Questionnaire

This letter serves to confirm that the Chairman of the Human Research Ethics Committee (Medical) has approved the amendment of questionnaire for the abovementioned protocol, as detailed in your letter dated 14 December 2016.

The following documents were received:

- Summary Letter.
- Questionnaire.
- Telephonic Consent Form.
- HREC (Medical) Clearance Certificate.

Thank you for keeping us informed and updated.

Yours Sincerely,

Mr Rhulani Mkansi
Administrative Officer
Human Research Ethics Committee (Medical)



APPENDIX 3: QUESTIONNAIRE ONE

QUESTIONS:	YES	NO	UNSURE
Have you been asked about being diagnosed with osteoporosis?			
Have you been asked about prior fractures?			
Have you been given any dietary advice to prevent osteoporosis?			
Have you been advised to do bone strengthening and weight bearing exercises for 30 minutes 2/3 times a week?			
Have you been advised against cigarette smoking?			
Have you been advised against excessive alcohol intake?			
Have you been put on any calcium supplements?			
Have you been put on any Vit D supplements?			
Have you used cortisone before?			
Have you been advised against the use of cortisone?			
Do you have a family history of bone disease?			
Have you been educated about hormone replacement therapy to prevent the development of osteoporosis?			
Have you been advised to come back to be assessed for bone disease?			

APPENDIX 4: INFORMED CONSENT FORM

INFORMED CONSENT

I hereby confirm that I have been informed by the study doctor, Dr. P.M.Thomas about the nature, conduct, benefits and risks of the clinical study: Assessment of patients with fragility fractures in the Orthopaedic setting at Chris Hani Baragwanath Academic Hospital.

I have also received, read and understood the above written information (Participant information leaflet and Informed consent) regarding the clinical study.

I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into the study report.

In view of the requirements of research, I agree that data collected during this study can be processed in a computerized system by Dr. P.M.Thomas or on their behalf.

I may, at any stage, without prejudice, withdraw my consent and participation in the study.

I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

PARTICIPANT:

Printed NameSignature/ThumbprintDate and time

I, Dr.P.M.Thomas, herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

STUDY DOCTOR:

Printed NameSignatureDate and time

TRANSLATOR/OTHER PERSON EXPLAINING INFORMED CONSENT _____
(DESIGNATION):

Printed NameSignatureDate and time

WITNESS:(IF APPLICABLE):

Printed NameSignatureDate and time

VERBAL PARTICIPANT INFORMED CONSENT:

- ☐ I, the undersigned, Dr.P.M.Thomas have read and have explained fully to the participant, named and/or his/her relative/friend/legal representative, the participant information leaflet.
- ☐ The account I have given has explained both the possible risks and benefits of the study as well as the alternative treatments available for his/her illness. The participant and/or his/her relative/friend/legal representative understands these.
- ☐ The participant and/or his/her relative/friend/legal representative indicated that he/she understands that the participant will be free to withdraw from the study at any time for any reason and without jeopardising his/her subsequent treatment.

I hereby certify that, the participant and/or his/her relative/friend/legal representative, acting on his/her behalf, has agreed to participate in this study.

PARTICIPANT:

Printed NameSignature/ThumbprintDate and time

I, Dr.P.M.Thomas, herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

STUDY DOCTOR:

Printed NameSignatureDate and time

TRANSLATOR/OTHER PERSON EXPLAINING INFORMED

CONSENT _____ (DESIGNATION):

Printed NameSignatureDate and time

WITNESS:(IF APPLICABLE):

Printed NameSignatureDate and time

APPENDIX 5: QUESTIONNAIRE TWO

QUESTIONS:	YES	NO	UNSURE
Have you been asked about being diagnosed with osteoporosis?			
Have you been asked about prior fractures?			
Did your doctor ask you if your diet included dairy products or calcium rich food?			
Have you been given any dietary advice to prevent osteoporosis?			
Did your doctor ask you if you spend less than 10 minutes outdoors?			
Have you been advised to do bone strengthening and weight bearing exercises for 30 minutes 2/3 times a week?			
Did your doctor ask you if you are currently smoking?			
Have you been advised against cigarette smoking?			
Did your doctor ask you if you are drinking >3 alcoholic drinks per day?			
Have you been advised against excessive alcohol intake?			
Were you asked if you were on any calcium or Vitamin D supplements?			
Have you been put on any calcium supplements?			
Have you been put on any Vit D supplements?			
Have you used cortisone before?			
Have you been advised against the use of cortisone?			
Were you asked if you have a family history of bone disease?			
If female, were you asked if you were postmenopausal?			
Have you been educated about hormone replacement therapy to prevent the development of osteoporosis?			
Have you since been diagnosed with osteoporosis or been advised to come back to be assessed for bone disease?			

APPENDIX 6: TELEPHONIC CONSENT FORM

TELEPHONIC CONSENT FORM

Good day Mr/Miss/Mrs....., my name is Dr. Preetha Thomas. I am a medical doctor. We first spoke when you were treated for a fracture in the Orthopaedic ward or clinic at the Chris Hani Baragwanath Academic Hospital in June or July of 2015. Do I have the correct person? At that time, I was doing research to find out if you had been questioned by the orthopaedic doctor about risk factors for fracturing your bone after very minimal injury, otherwise called a fragility fracture. I also wanted to know if you had been referred for further bone strength testing. The title of my study is 'Assessment of fragility fractures in African patients in the Orthopaedic setting at Chris Hani Baragwanath Academic Hospital'.

Unfortunately, the questions that I asked you at that time did not give me enough information to complete my research. This is the reason for my call today.

If you have about 10 minutes, I'd like to ask a few more questions that will help me know if you have since then been assessed as having a risk factor for fragility fractures and osteoporosis, and referred to a doctor to have the strength of your bones tested, specifically a DEXA scan.

Only 'Yes' or 'No' answers will be required. Being part of this study is completely your choice and you may refuse to participate at any time. There is no compensation for responding nor is there any known risk. All your personal information will be kept confidential. Just as with the first interview. I have permission from the University of the Witwatersrand Human Research Ethics Committee (HREC).

Do I have your permission to begin asking you questions?

YES _____

NO _____

Thank you for your time, I appreciate your help in this regard.

If you would like any further information regarding your rights as a research participant, or you have any complaints regarding this research study please feel free to contact me on 0721725387, or alternatively you may contact the Human Research Ethics committee (HREC) at the University of Witwatersrand at (011) 717 2301.

2017 corrections done.pdf

by Preetha Thomas

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