"A HOSPITAL BASED ONE YEAR CROSS SECTIONAL STUDY TO KNOW THE PREVALENCE OF OSTEOPOROSIS IN WOMEN AGED MORE THAN 45 YEARS USING DUAL ENERGY X-RAY ABSORPTIOMETRY SCAN (DEXA)"

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This is to certify that the dissertation entitled **"A HOSPITAL BASED ONE YEAR CROSS SECTIONAL STUDY TO KNOW THE PREVALENCE OF OSTEOPOROSIS IN WOMEN AGED MORE THAN 45 YEARS USING DUAL ENERGY X-RAY ABSORPTIOMETRY SCAN (DEXA)"** is a bonafide research work done by **BL0109002.**

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ABSTRACT

Background and Objectives:

Osteopororsis is one of the most common non communicable disease in elderly women. It is also one of the most common under diagnosed condition in our Indian population. Aim of the study was to know the prevalence of osteoporosis in women aged more than 45 years in our region. To find out the various risk factors associated with osteoporosis.

Methodology :

Data was collected from all women with age more than 45 years attending outpatient and inpatient Orthopaedics department and also females attending osteoporotic check up camps who were willing to undergo DEXA Scan. DEXA was done at hip and spine to assess BMD. Various other risk factors were evaluated through a questionnaire. T Scores and Z Scores were evaluated for the presence of osteoporosis based on WHO Criteria.

Results:

100 women aged more than 45 years were studied. Prevalence of osteoporosis at the spine was 39% while at the hip was 20%. The overall prevalence was 42%. Mean height of osteoporotic women was not significantly different from other women, however osteoporotic women had lower body weight and significantly lower body mass index. Predominantly osteoporotic women were house wives (80%) and worked indoors with reduced duration of exposure of sunlight. Also most osteoporotic women were vegetarians (88%). Time since menopause was also associated with increased risk of osteoporosis and osteopenia. The prevalence of osteoporosis was higher among the group with inadequate exposure to sunlight (70%). 6% women positive family history for fracture of the hip and wrist after trivial fall and all the 6% women had osteoporosis in this study.

Conclusion and interpretation:

High prevalence in this semi urban group of women is a cause for concern. Measures such as adequate calcium and vitamin D intake, physical activity and exposure to sunlight will be useful in preventing occurrence of osteoporosis. As the diagnosis and long term treatment of osteoporosis and consequent fractures are expensive for the individual as well as the health system, there is a need for careful consideration in determining the risk factors as well as the future course of action on scientific evidence.

Key words: Prevalence, Osteoporosis, Women, DEXA

LIST OF ABBREVIATIONS USED

BMD	-	Bone Mineral Density
BMI	-	Body Mass Index
DEXA	-	Dual Energy X-ray Absorptiometry
H/O	-	History of
HRT	-	Hormone Replacement Therapy
Ht.	-	Height
IP No.	-	Inpatient Number
Lt	-	Left
OP.No.	-	Out Patient Number
pDEXA	-	Peripheral Dual Energy X-ray Absorptiometry
PTH	-	Parathyroid Hormone
QCT	-	Quantitative Computerized Tomography
RA	-	Radiographic Absorptiometry
ROM	-	Range of movement
Rt	-	Right
SERM	-	Selective Estrogen Receptor Modulator
Sl No.	-	Serial Number
USG	-	Ultra Sonography
Wt.	-	Weight

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INTRODUCTION

Osteoporosis, which literally means "porous bone", is a disease in which the density and quality of bone are reduced. The loss of bone occurs "silently" and progressively. Often there are no symptoms until the first fracture occurs.[1]

It is the commonest metabolic bone disease in clinical practice and is a major public health problem as commonly it is underdiagnosed.[1]

The term osteoporosis is used without a clear indication of its meaning. It may describe clinical end result that is fracture and the process that gives rise to it.[2]

Osteoporosis is defined as "a systemic skeletal disease characterized by low bone mass and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture" [1, 3]. This definition indicates that measurement of bone mineral density (BMD) is a central component to diagnosis of the disease.[4]

The diagnosis of osteoporosis is based on bone mineral density (BMD) measurements and is defined by the World Health Organisation (WHO) as :

1. Normal: a value of BMD or bone mineral content (BMC) $\leq$ 1 standard deviation (SD) below the young adult average value
2. Osteopenia: a value of BMD or BMC >1 SD below the young adult average value but >2.5 SD above
3. Osteoporosis: a value of BMD or BMC $\geq$ 2.5 SD below the young adult average value

4. Severe osteoporosis (established osteoporosis): a value of BMD or BMC ≥ 2.5 SD below the young adult average value and presence of one or more fragility fractures. [5]

Of notable concern are vertebral (spinal) and hip fractures. Vertebral fractures can result in serious consequences, including loss of height, intense back pain and deformity. A hip fracture often requires surgery and may result in loss of independent living.[1]

Osteoporosis is predominantly a disease of the women. It has been projected that a woman's life time risk of hip fracture equals the combined risk of breast, uterine, and ovarian cancer, and the risk of dying from hip fracture is probably higher than the mortality from breast cancer.[1,2]

Osteoporosis is one among the five non-communicable diseases of aging. The treatment costs are more expensive after diabetes, hyper lipidemia, hypertension and heart diseases. The incidence is increasing in developing countries as the longevity is increasing in these countries.[6]

The process of aging is associated with decreased calcium absorption from the gut, especially in postmenopausal women; thus,insufficient dietary calcium intake attributable to socioeconomic constraints and lack of awareness increases the risk of osteoporosis.[1]

In western countries the peak incidence of osteoporosis occurs at about 70-80 years of age, in India it may afflict those 10-20 years younger, at age 50-60. [7]

The world‘s Osteoporosis—Time Bomb“ is ticking, with projected global burden of Osteoporosis hip fractures expected to exceed six million by 2050.[8]

Thirty percent to fifty percent of women and 15-30% of men have lifetime risk for, osteoporosis and osteoporosis related fractures all over the world .[9]

Estimates indicate that the number of osteoporotic hip fractures occurring in the world will rise from 1.66 million to 6.26 million by the year 2050, thereby implying an urgent need for preventive strategies. Projections indicate that by the year 2050 45% of osteoporotic fractures will occur in Asia.[1, 2]

Osteoporosis not only causes fractures, it causes people to be bedridden with problems of back pain, loss of height, kyphosis, pneumonias and pulmonary thromboembolism. Prevention of the diseases and its associated fractures is essential for good health, quality of life, and independence among elderly. [1]

The single best technique to measure BMD is Dual energy x- ray absorptiometry (DEXA) Scan which measures bone mineral density. [1]

OBJECTIVES

1. To find out the prevalence of osteoporosis in woman aged more than 45 years.
2. To find out the risk factors affecting osteoporosis.
    a) Age
    b) Time since menopause
    c) Diet
    d) Socio economic status
    e) Sunlight exposure
    f) Smoking
    g) Alcoholism
    h) Occupation
    i) Body Mass Index
    j) Family history

REVIEW OF LITERATURE

History:

In eighteenth century English surgeon John Hunter discovered that as new bone is laid down in the body, old bone is destroyed, or resorbed. This process is now known as remodelling and was later shown to play a critical role in osteoporosis, though it wasn't even a recognized disease for more than 100 years after his death.[10]

Osteoporosis was first recognized by an English surgeon named Astley Cooper, during the early eighteen hundreds. He noticed that older individuals were at an increased risk of fracture due to lower bone density.[10]

A step toward such recognition was made in the 1830s by the French pathologist Jean Georges Chretien Frederic Martin Lobstein. He noticed that some patients' bones were riddled with larger than normal holes, and he coined the term osteoporosis (porous bone) to describe such deteriorated human bone. But Lobstein didn't pursue the question of what might be causing these holes to form in bone, or even whether they might be a symptom of disease.[11]

In 1940 Albright proposed his revolutionary hypothesis: Estrogen triggers the buildup of calcium reserves in bone, from which calcium can be released into the bloodstream during pregnancy and lactation to serve the needs of the fetus and newborn. The sharp reduction in estrogen that occurs with menopause causes a loss of bone, he suggested, by enabling more bone to be broken down than is subsequently built up. Albright named the resulting condition postmenopausal osteoporosis. He also showed that regular injections of estrogen reversed this calcium imbalance, boosting the amount of calcium retained in the body, presumably in the bones. Not only did

Albright identify a new disease, postmenopausal osteoporosis, but he also offered the first treatment for the condition.[12]

At about the same time, Albright's mentor, the Viennese pathologist Jacob Erdheim, noted that the parathyroid glands—pea-sized glands in the neck—were enlarged in three patients with a condition known as osteomalacia. Erdheim conducted a series of experiments and showed in 1906 that when he removed the parathyroid glands in rats, their teeth lost calcium. These findings suggested that the parathyroids might affect the amount of calcium lodged in the skeleton.[13]

In 1925 Canadian biochemist James B. Collip independently isolated the same active extract and showed that it boosted the level of calcium in the blood. These extracts were then purified and the active compound was named parathyroid hormone. This work led to the hypothesis that when blood levels of calcium are low, parathyroid hormone stimulates bones to release calcium into the bloodstream.[13]

In the 1960s, of Herbert Fleisch identified a new compound in human blood and urine that prevented the formation of calcium salts in laboratory experiments. The compound, a pyrophosphate. Fleisch was quick to see the potential usefulness of pyrophosphates in treating various bone disorders, including osteoporosis. Fleisch worked with pharmaceutical companies to develop longer-lasting synthetic versions of the compound he had discovered. Some of these pyrophosphate-mimicking drugs, known as bisphosphonates. Two of these drugs, alendronate (Fosamax) and risedronate (Actonel), have been on the market since 1996 and 2000, respectively, as treatments for postmenopausal osteoporosis.[13]

ANATOMY

The Skeletal Anatomy:

The proximal femur consists of spongy bone, invested by a thin layer of compact bone. The trochanteric region consists more of spongy bone.

Trabecular System: fig 1

In 1838, **Ward** described the internal trabecular system of the femoral head. The trabeculae are oriented along the lines of stress. There are five normal groups of trabeculae as described by Ward.

Primary Compressive Trabeculae: These are the strongest trabeculae, extending from the medial cortex at the base of the femoral neck to the subchondral bone of the superomedial part of the head.

Primary Tensile Trabeculae: These extend from the inferior region of the foveal area across the head and superior portion of the femoral neck into the greater trochanter, hence to the lateral cortex.

Secondary Compressive Trabeculae: These extend from the medial femoral cortex in the region of the lesser trochanter towards the greater trochanter.

Secondary Tensile Trabeculae: These extend from the lateral femoral cortex, inferior to the primary tensile trabeculae towards the middle of the femoral neck.

Greater Trochanteric Trabeculae: These extend from the superior border of the greater trochanter to its base . The space bounded by the primary compressive and tensile trabeculae and the secondary compressive trabeculae is known as the **Ward's Triangle**.[14]

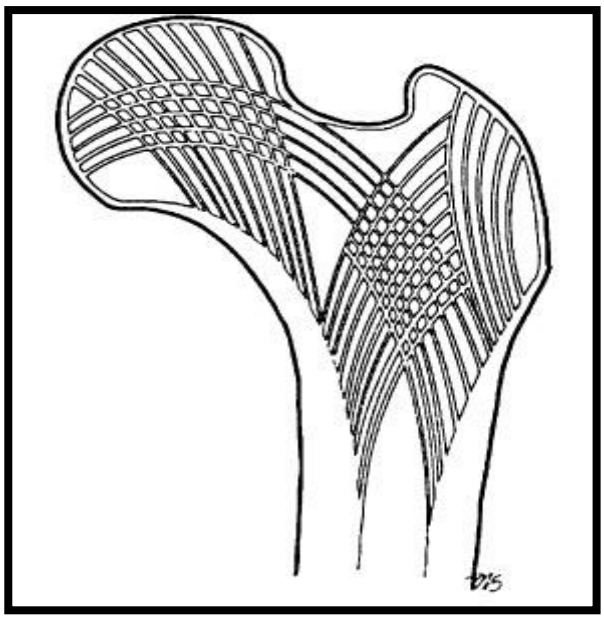


Fig 1: Trabecular pattern of the femur

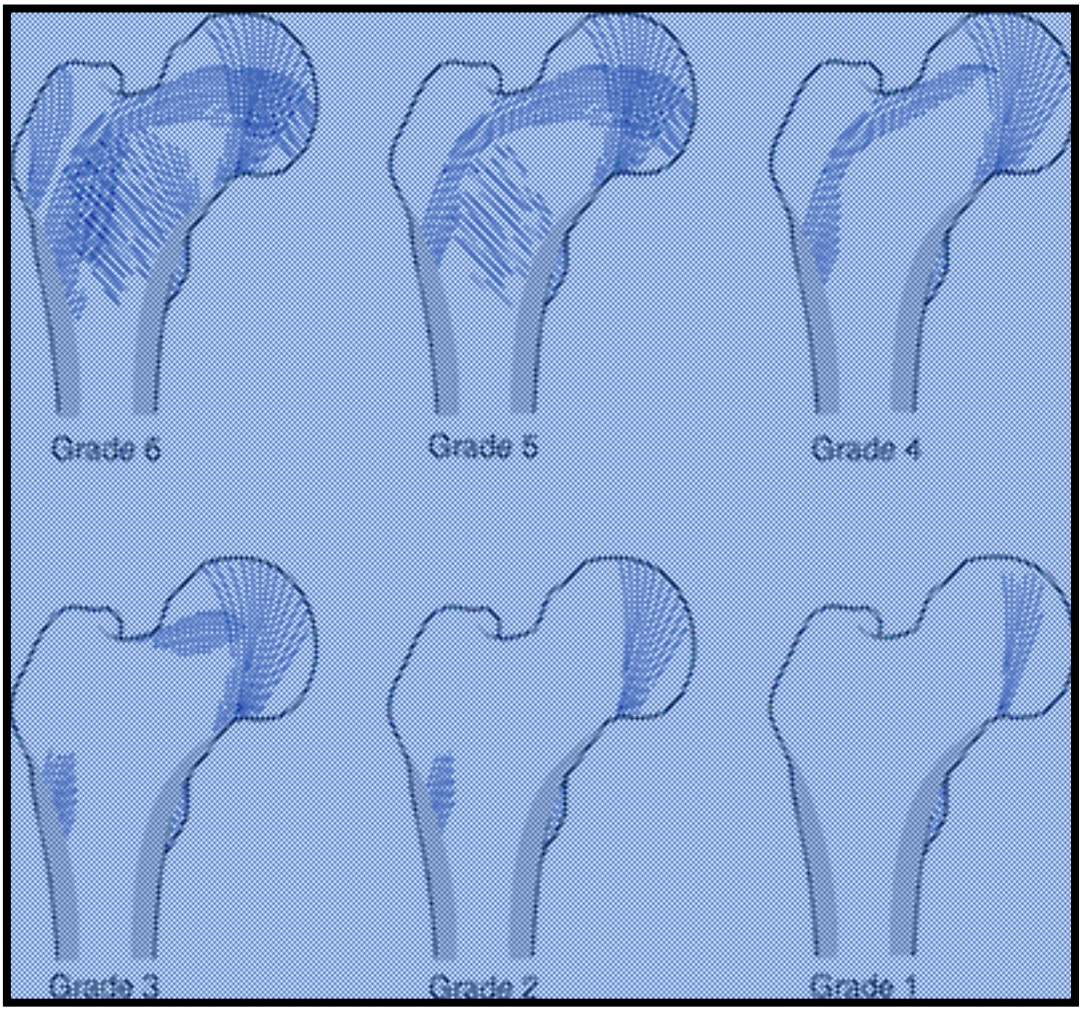


Fig 2 : Singh's Index

Singh M.

Introduced a method of determining the degree of osteoporosis by evaluation of the trabecular pattern of proximal femur seen on x-rays. The degree of osteoporosis is graded from 1 to 6.

Singh Index:

Grade VI: All the normal trabecular groups are visible, and the upper end of femur seems to be completely occupied by cancellous bone.

Grade V: The structure of the principal tensile and compressive trabeculae is accentuated. Ward's triangle appears prominent.

Grade IV: Principal tensile trabeculae are markedly reduced but can still be traced from the lateral cortex to the upper part of the femoral neck.

Grade III: There is a break in the continuity of the principal tensile trabeculae opposite the greater trochanter. This grade indicates definite osteoporosis.

Grade II: Only the principal compressive trabeculae stand out prominently; the others have been more or less completely resorbed.

Grade I: Even the principal compressive trabeculae are markedly reduced in number and are no longer prominent.[15]

RISK FACTORS

Peak Bone Mass:

For the prevention of Osteoporosis development and maintaining the peak bone mass is most vital for the bone health. Peak bone mass is the bone tissue and the outcome of the skeletal maturation.[16] The consequences of Osteoporosis appear at the later life but it develops from child hood and adolescence period. The peak bone mass is the major determinant for osteoporosis, and 40% of bone mass develops between from the late childhood and the early adolescence.[17] A recent study from India shows that peak bone mineral density is attained in healthy males at the age of 25 years and in females at 28 years.[18] This is significantly less than in the Western counterparts.

Genetic Factors:

Genetic factors have a role on Bone mineral Density at the age of 20-30 and bone mineral loss at post menopause period.[19] Fifty percent of the Peak bone mass, bone geometry, bone strength, bone architecture depends on genetic predisposition.[20]

Other studies indicate that seventy- five percent peak bone mass depends on the genetic factors like Vitamin D-receptor gene, Estrogen receptor gene, Collagen receptor gene.[21] The Scientific reports show that black women had High Bone mineral Density, and fewer incidences of hip fractures than the other populations . Women who had a history of a maternal hip fracture are two times more at risk than women without similar family history.[22] Indian Studies showing vitamin D Receptor (VDR) gene polymorphism, Estrogen receptor Alpha

polymorphism gene associated with decreased bone density in Indian postmenopausal women.[23]

Gender and Sex:

All over the World life time risk of 30 to 50% of women and 15 to 30% men are suffering with Osteoporosis.[24] Globally incidence of Osteoporotic fractures in women is more than the total incidence rates of heart attack, Stroke and Breast cancer in women.[25] In the lifetime, Women are three times more at risk for osteoporosis than men.[26]

Age:

As age increases, there is a risk for osteoporosis and increase incidence of fractures in both women and men equally.[27] There is a decrease of bone density when the age increases. India old age populations are increasing rapidly because increase of longevity and improving living standards. The population pyramid show there is increase above fifty years population among both men and women.

Menopause

In woman, postmenopausal osteoporosis is the commonest and causing more morbidity and mortality.[27] A same report considers it is considered as a major public health problem in women and easily preventable. In the world, average age for women reaching menopause is around 52 years, but in India is comparatively less and more hysterectomy were reported in urban India .[28] According World Bank estimates India by 2030 the postmenopausal women population will be the second highest in the world after China.[29] Duration of menopause greater than 5 years was associated with increased risk of osteoporosis.

Parity & lactation:

Studies from developing countries from Morocco, Vietnam, and Korea show parity and lactation have a detrimental effect on Bone mineral Density factor.[30] Studies from South America shows nulliparous women had a more Osteopenia and Osteoporosis than the non-nulliparous women.[31] Prolonged lactation, period of amenorrhea and pre pregnancy weight have role on bone mineral density and studies show prolonged lactation leads to the loss of calcium and leads to the decrease of Bone mineral Density .[32]

Medical Factors:

Gastrointestinal disorders (Malabsorption, Inflammatory bowel Syndrome) hematological disorders (eg: Thalassemia and Pernicious anemia) and hypogonadal states, thyrotoxicosis & anorexia nervosa are the lead causes for secondary Osteoporosis in men and women.[33] Steroids usage is rising in routine treatment schedules in India .Studies showing increased usage of steroids may lead to reduced bone loss and lead to increased fracture risk.[34] The recent meta analysis from Cochrane show use of steroidal contraceptive like Depot medroxyprogesterone acetate (DMPA) will reduce the bone mineral density and prone for fractures.[35]

Nutrition factors:

Vitamin D: Vitamin D deficiency may precipitate Osteopenia, Osteoporosis and more risk for fractures and it plays very important role in bone homeostasis and bone health.[36] Vitamin deficiency is common in the Middle East, India, China and Japan and less common in Northern Europe and South East Asia.[37] Studies

showing low levels Of Vitamin D in the elderly and causing for more Osteoporosis fractures especially Hip fractures and Vitamin deficiency will increase the PTH production and leads to the high bone turn over and bone loss .[38] In India Low vitamin D level are responsible for lower bone densities and poor bone health.[39] The study show there is high prevalence of Vitamin D deficiency in the schoolchildren of North India.[40] Recent study show there is a widespread Vitamin D deficiency all over the world including India and responsible for osteoporosis fractures and going to be major public health problem.[41]

Calcium : Cross sectional studies showing higher intake of calcium in the childhood and adolescent age it may increase the bone mineral density in children adolescent and the young women.[42] Dietary Calcium deficiency and Low body mass index (BMI) play important role in on lean men and women lead to the reduction in Bone Mineral density.[43] Study from India show in the low socioeconomic groups the Calcium intake is only 300 mg/dl, which is 700mg less than the required amount.[44] India about 40% people from Low socio economic groups suffers with Chronic Energy Deficiency and have inadequate energy, protein Calcium and other micro Nutrients.[45] So many medications like Diuretics, anti Convulsions, Non Steroidal anti Inflammatory medications Corticosteroids, Immunosuppressive medications and some antibiotics will impair the Calcium absorption.[46]

Vegetarianism: Indian study showing vegetarians have 50% risk of osteoporosis and 98.82% are osteopenic.[47] Vegetarian diet consists of less calcium, less absorption of calcium and poor bioavailability may be the reason for Low bone

mineral density and risk for Osteoporosis fractures among the vegetarians.[48] Pure vegetarianism was shown as a risk factor in Indian and Iranian subjects respectively .

Physical activity:

The cohort studies showing Physical inactivity in the old age populations are responsible for decline of bone mass and the major risk factor for Osteoporosis fractures.[49] Cross sectional studies shows weight bearing exercises have beneficial impact on the bone mass, development of peak bone mass and reduces the bone loss and the mechanical stress.[50] Studies from China shows more physical exercise by postmenopausal women have a substantially reduction in BMD loss and have positive health effect was observed.[51]

European vertebral osteoporosis study (EVOS) studies shows high physical activity leads to the fractures in men.[52] Another study show high physical activity is more associated with hip fracture than the other fractures.[53] An Indian study shows Low Socio economic people have poor bone health instead of high physical activity because of inadequate nutrition.[54]

Lower body weight and Body mass index:

Literature shows low Body mass index (BMI), a measure of body composition, may be associated more no of Osteoporosis fractures, and osteoporosis.[55] Low body mass index associated with lower peak bone mass and have leads to more bone loss and leads to the osteoporosis and osteoporosis fractures.[56] Epidemiological studies shows low body weight is the one of the main determinant and risk factor for hip fractures.[57] In European studies shows if BMI less than 19kg/m× are at risk of Osteoporosis Hip fracture.[58]

Low exposure to sun light:

The multi centric and cross sectional studies showing there is a strong association between less exposure to sun light leads to the hip fractures in the age groups of above 50 years.[58] Vitamin D is essential for bone health and had an influence on growth and development of children and its deficiency leads to the increased bone turn over, enhanced bone loss and fracture risk.[59] In developing countries especially in India, vitamin D levels are comparatively lesser than Western counterparts are and studies shows there is a correlation with Vitamin D levels and bone mineral density.[60]

Smoking:

India is producing third worlds tobacco and NFHS2 data show smoking prevalence among above 30 years of men is 41.2% and 18.2% of wome.[61] A case control study from USA show current smokers had a risk of hip fracture OD 2.27 (95%CI 1.22-4.21) and the former smoker had a risk of OR 3.72 (95% CI 1.59-8.70). Large cohort study on smokers and non smokers followed for 12 years show women who smokes more than 25 cigarettes or more had 1.6 times risk for hip fracture than the (95% CI,1.1-2.3) non smokers .[62]

Studies identified strong association between cigarette smoking and risk of Osteoporosis considered as Public health problem and showing deficit in spinal bone density of 1.5% and Hipbone density 1.1% in men and women 1.5 and 0.4%.[63] Prospective and cohort studies shows smoking will decrease the Bone mineral Density and leads to the risk of Osteoporosis fractures in both men and women and also studies demonstrating that quitting smoking may help to reduce the fractures.[64] Studies showing smokers have lower retention capacity of calcium

and lead to bone loss.[65] Cigarette smoking in women reduces the Bone mineral Density and leads to early menopause, reduced body weight and lead to metabolic break down of exogenous estrogen in women and causes fractures in women.[66] Epidemiological studies showing cigarette smoking is the independent risk factor for hip fractures in men and women.[67]

Geographical Variation:

The incidences of Osteoporosis fractures widely differ from one geographical area to the other demonstrating substantial geographical variation.[68] People living far from equator had a higher incidence of fractures than those who are staying near the equator.[69] The incidence of hip fractures are more in Caucasians, Scandinavian than the North America and even Europe hip fractures incidence rates are different from each country.[70] Lower life expectancy may be a reason for lower incidence rates in developing countries.[71]

Osteoporosis hip fractures incidence rates are more in urban than rural areas and urban population ha d lower bone mass.[72] Fracture rates and prevalence of Osteoporosis are different in different ethnic groups living in the same region like in Singapore; hip fractures are more in the Indian population than the other ethnic groups.[73] A study shows Lower Spinal Bone mineral density is comparatively less in Indo Asian women than the Caucasian women.[74] Study from Vietnam results showing in the pre menopausal women prevalence of osteoporosis was higher in urban areas than the rural areas.[75]

Scientific reports describe osteoporosis is the outcome of the modernization and incidence of osteoporosis fractures are more in urban than the rural areas.[76] In China and other developing countries, bone mineral densities are different

between urban and rural population because of rapid transition towards urbanization.[77] Because of rapid urbanization in Hong Kong and other parts of Asia lower incidence of hip fractures rates were reported in rural than the urban areas.[78]

Secular trends :

Increase of life expectancy all over the world and increase of old age population, increase of financial and health costs of the osteoporosis may be doubled in the future.[79] There is negative impact on bone mass or risk of falling is influencing the rise of fractures in successive generations of the elderly.[80] In developing countries in the process of developmental transition the countries like Hong Kong Osteoporosis fractures cases are rising but in western countries it reached plateau.[81] Studies show there is positive correlation with Birth weight, short birth length at the time of delivery correlated with Osteoporosis fractures at the adult age, and infant weight can predict the future fractures.[82] Increasing trend of fracture cases in India and other countries because of Good screening procedures, Availability of good Diagnostic techniques and underestimates the future projections.[83]

Ethnicity:

The bone mineral density was varies between different ethnic groups and blacks had a more BMD than Caucasians and Asians had a less bone mineral density.[84] Fractures rates are lower in the blacks and Asians than the whites are and Hispanics had higher fracture rates.[85] Osteoporosis hip fractures are more in Caucasians than the Black and Asians.[86]

Review of Literature:

Sridhar et al used visual X-ray assessment to report that 6 out of 100 apparently healthy Indians below 50 years of age had osteopenia.[87]

Khanna and Bhargava in another study reported that 13% of 60 asymptomatic Indians between 10 and 70 years of age had osteopenia on radiological study of bones.[88]

The first normative reference database of bone mineral density in the Indian women and men was established by Pande et al in a study from Nagpur which included 261 women and 177 men reported low bone mass in nearly 50% of women and 36%of men over 50 years of age using digital x-ray radiogrammetry.[89]

Acharya et al in their study to evaluate Prevalence of Osteoporosis using Quantitative Ultrasound for Menopausal women in Rural and Urban Area in 1136 women aged 40 to 60 years using calcaneal quantitative ultrasound reported prevalence of osteoporosis to be 15% & Among premenopausal women, the crude prevalence of osteoporosis was higher in the urban areas compared with the rural areas. By contrast, in postmenopausal women osteoprosis was more in rural women than urban.[90]

Sharma et al screened 158 urban women from jammu using calcaneal QUS. The incidence of osteoporosis was (20.25%) and osteopenia (36.79%) with maximum number of both osteoporosis and osteopenic women recorded in the age group of (55-64 years). After the age of 65 years, there was an almost 100% incidence of either osteopenia or osteoporosis. Religion, caste and diet also had an influence on the outcome of osteopenic and osteoporosis score. [91]

All the above data were based on conventional radiographs when DEXA was not available. Serious attention to osteoporosis in India started only a little over a decade ago- the first DXA machine was installed in 1997.

A population based study on osteoporosis by Melton indicates that 30.3% of white American women above the age of 50 years have osteoporosis.[92]

Normative data for proximal femur BMD in South Indian women have been evaluated by Anburanjan et al. The rates of BMD loss at the age of 65 years were 0.91%, 0.84%, 0.72%, 0.78%, 1.66%. per annum respectively for the neck of femur, trochanter, intertrochanteric region, total hip and Ward's triangle.[93]

Normative BMD and fracture threshold were estimated in South Indian elderly women by Usha G et al to correlate BMD with risk factors. The study suggests BMD value of 0.72 at the femoral neck as a fracture threshold. Increasing age and post menopausal state negatively correlate with BMD as in western studies.[94]

Paul TV et al in a study done in semi urban region of south India to know the prevalence of osteoporosis by calculating BMD in ambulatory post menopausal of 150 sample size using a DEXA Scan and its relationship to calcium nutrition and vitamin d status showed that the prevalence of osteoporosis at lumbar spine level was 48% and at femoral neck it was 16.7% and it was 50% at any site.[95]

Another study done among elderly women living in Delhi & rural Haryana study the prevalence of osteoporosis underwent BMD assessment showed that the prevalence of osteoporosis among them was 53% from Delhi & 76 % from Haryana. They also concluded there was no significant difference in height or menopausal age

in relation to the prevalence but there was a significant difference in BMI (26.95 vs. 21.6). [96]

A study done to assess the prevalence & relative importance of risk factors for low bone mass in urban Indian women above 40 years of age by Kadam et al showed BMD at all three sites of measurement (Spine, Hip & wrist) was significantly lower in post menopausal then pre menopausal women ($p< 0.001$) . Prevalence of osteoporosis was highest at the lumbar spine (25.8%) in post menopausal women, while prevalence of osteopenia was high in pre menopausal women (44.3%). Vitamin D deficiency was seen in 54.5% pre and 41.8 % post menopausal women. Correlation between sun index and lumbar spine BMD was marginally significant.[97]

A study done to assess bone status of Indian women from a low income group and its relationship to nutritional status by Veena et al in 289 women in the 30-60 year age group using DEXA Scan showed the prevalence of osteoporosis at the femoral neck was around 29%. BMD and T scores at all the skeletal sites were much lower than the values reported for developed countries. BMD showed a decline after the age of 35 years in cases of lumbar spine & femoral neck. BMD at all skeletal sites and whole body increased significantly with increasing body weight and BMI of women. In the multiple regression analysis, apart from body weight , age, menopause and calcium intake were other important determinants of BMD.[98]

Marwaha R K et al in their study to assess bone health in healthy Indian population aged 50 years and above evaluated One thousand six hundred healthy subjects aged more than 50 years, residing in Delhi, for bone mineral metabolic parameters and compare compare peripheral DXA (pDXA) with central DXA in evaluation of osteoporosis. Osteoporosis was present in 35.1% subjects (M-24.6%, F-

42.5%) and osteopenia in 49.5% (M-54.3%, F 44.9%). Bone mineral density (BMD) correlated positively with body mass index (BMI) and negatively with PTH levels. No correlation was observed with serum 25(OH) D levels. BMD at forearm and calcaneum, measured using pDXA, showed strong positive correlation with BMD measured by central DXA, pDXA had sensitivity of 88%, specificity of 55%, and negative and positive predictive values of 89% and 52%, respectively, at T-score -2.5 at peripheral sites compared to central DXA.[99]

Unni et al in their study to assess bone mineral density in women more than 40 years of age found that osteopenia was found in 31.4% subjects and osteoporosis in 14.3% subjects. Increasing age and time since menopause was associated with increased risk of osteoporosis. Age at Menarche, Lactation, and Exercise were not found to be statistically significant as risk factors. Women from the lower socioeconomic strata had a significantly higher percentage of osteopenia and osteoporosis. Adequate calcium intake was found to have a significant positive impact on BMD. BMD was higher in obese women, but the difference between this group and those with normal BMI did not achieve statistical significance.[100]

Mehta et al in their study to determine Bone mineral status in immigrant Indo-Asian women and to compare the bone mineral at the lumbar spine and femoral neck of Indo-Asian immigrant women with that of age-matched Caucasian women concluded that Indo-Asian women appear to have lower spinal BMD than Caucasians, these differences disappear when BMAD values are calculated. While BMD is an areal density, not taking into account the 'depth' of the bone, BMAD is an estimation of volumetric density. Hence lower BMD values in Asians may be a size-related artefact. [101]

BMD Assessment

Densitometric measurement of bone mass has become central to the diagnosis of osteoporosis and decisions about treatment to prevent fracture. BMD measurements are used to establish a diagnosis of postmenopausal osteoporosis; determine fracture risk, identify candidates for intervention and assess changes in bone mass over time in both treated and untreated patients.

Various other techniques for BMD assessment are present & include quantitative computed tomography (QCT), ultrasonography, single-energy x-ray absorptiometry (SXA), and radiographic absorptiometry. Common central skeletal sites for measurement include the spine and hip; peripheral sites include the forearm, wrist and heel. Dual energy x-ray absorptiometry (DEXA) of the hip is the gold standard for the diagnosis of osteoporosis using the WHO criteria. DEXA of the hip and spine is the gold standard for baseline BMD determination and follow-up measurements.[1-3]

The T-score is a widely used parameter to assist in the interpretation of BMD results. It measures the departure of the patient's BMD value from the mean BMD for a young adult healthy population in units of the population standard deviation (SD).[1-3]

The Z-score is similar in concept to the T-score, with the exception that the mean BMD and SD for a healthy age- and sex-matched population are used as reference values instead of the mean BMD and SD for a young normal group. Z-scores are not used to define osteoporosis, since they would not reflect the increasing prevalence of osteoporosis with age. For example, elderly patients may have a Z-score of zero, based on comparison to their own age group, but a T-score that would put them in the osteoporotic category.[1-3]

The diagnosis of osteoporosis and fracture risk assessment are based primarily on BMD. The World Health Organization (WHO) has defined low bone mass and osteoporosis on the basis of axial skeleton measurements of bone density to help facilitate screening and identify individuals at risk. The diagnosis of osteoporosis is based on T-score thresholds. It may be reasonable to diagnose any patient with low bone density and a fragility fracture as having osteoporosis.[1]

World Health Organization Diagnostic Criteria For Osteoporosis[1]

Normal BMD value within 1 S.D. of young-adult mean (T-score at or above -1)

Osteopenia BMD value between -1 S.D. and -2.5 S.D. below young-adult mean (T-score between -1 and -2.5)

Osteoporosis BMD value at least -2.5 S.D. below young adult mean (T-score at or below -2.5)

Recommendations for BMD Testing

Screening recommendations in postmenopausal women have been developed by government and private organizations, many of which recommend BMD screening in women at risk for osteoporosis. The NOF, U.S. Preventive Services Task Force (USPSTF), and the International Society for Clinical Densitometry (ISCD) recommend that all Caucasian women aged ≥ 65 years be offered BMD screening .In postmenopausal women with a history of fragility fracture, BMD measurements are not required for a clinical diagnosis of osteoporosis. In these instances, BMD measurements are useful in establishing a baseline for assessing the response to treatment and quantifying fracture risk.[4-5]

Recommendations for Measuring BMD in Women for Assessing Risk of Fracture

National Osteoporosis Foundation[5]

- All women aged 65 and older regardless of risk factors
- Younger postmenopausal women with 1 or more risk factors, other than being white, postmenopausal, and female
- Postmenopausal women who present with fractures (to confirm diagnosis and determine disease severity)

US Preventive Services Task Force[1,4]

- All women 65 years of age and older should be screened routinely for osteoporosis
- Routine screening beginning at 60 years of age for women at increased risk for osteoporotic fractures.

The USPSTF makes no recommendation for or against routine osteoporosis screening in postmenopausal women who are younger than 60 years of age or in women 60 to 64 years of age who are not at increased risk for osteoporotic fractures.

International Society for Clinical Densitometry[1,4]

- Women 65 years of age and older
- Postmenopausal women under 65 years of age with risk factors
- Men aged 70 years and older
- Adults with a fragility fracture
- Adults with a disease or condition associated with low bone mass or bone loss

- Adults taking medications associated with low bone mass or bone loss
- Anyone being considered for pharmacologic therapy
- Anyone being treated, to monitor treatment effect
- Anyone not receiving therapy in whom evidence of bone loss would lead to treatment

Dual energy x-ray absorptiometry (DEXA/DXA)[1]

Bone densitometry is the most important tool in the diagnosis of osteoporosis. It allows for accurate, precise and reproducible assessment of bone mineral content and bone mineral density and enables the detection of osteoporosis before the occurrence of clinical fractures. Of all the technologies available for the measurement of BMD, central DEXA is the technology of choice.

It can be used to measure BMD at the lumbar spine, the hip, and other sites. The relation between BMD and fracture risk in untreated patients has been assessed in a meta analysis of several prospectively well-designed studies, which confirm that a decrease in BMD is associated with an increased risk of fracture. The predictive power of BMD for hip fracture is similar to the predictive power of blood pressure for stroke and better than the predictive power of serum cholesterol level for cardiovascular disease.

DXA uses two x-ray beams of different energy levels to scan the region of interest and measure the attenuation as the beam passes through the bone. Low-energy beams experience greater attenuation than high-energy beams, and bone attenuates x-rays more than soft tissue. Based on this discrepancy, corrections for soft tissue can be made, which are particularly important due to the individual variability in soft tissue content around the hip and spine.

DEXA Scans of the Hip

BMD of the hip can be measured at several regions, including the femoral neck, trochanteric, intertrochanteric, Ward's Triangle and/or total hip. With the large region of interest in the total hip, measurement errors may be minimized. However, caution must be used in measuring Ward's triangle; its small area introduces a higher possibility of measurement error and the anatomic site itself may be variably defined by different manufacturers (Figure 3). Unlike the spine, where cancellous bone is uniformly distributed and, thus, shows a uniform pattern of bone loss, the hip shows variable BMD because different areas of the femur are composed of different percentages of cancellous bone, and have different risks of fracture.

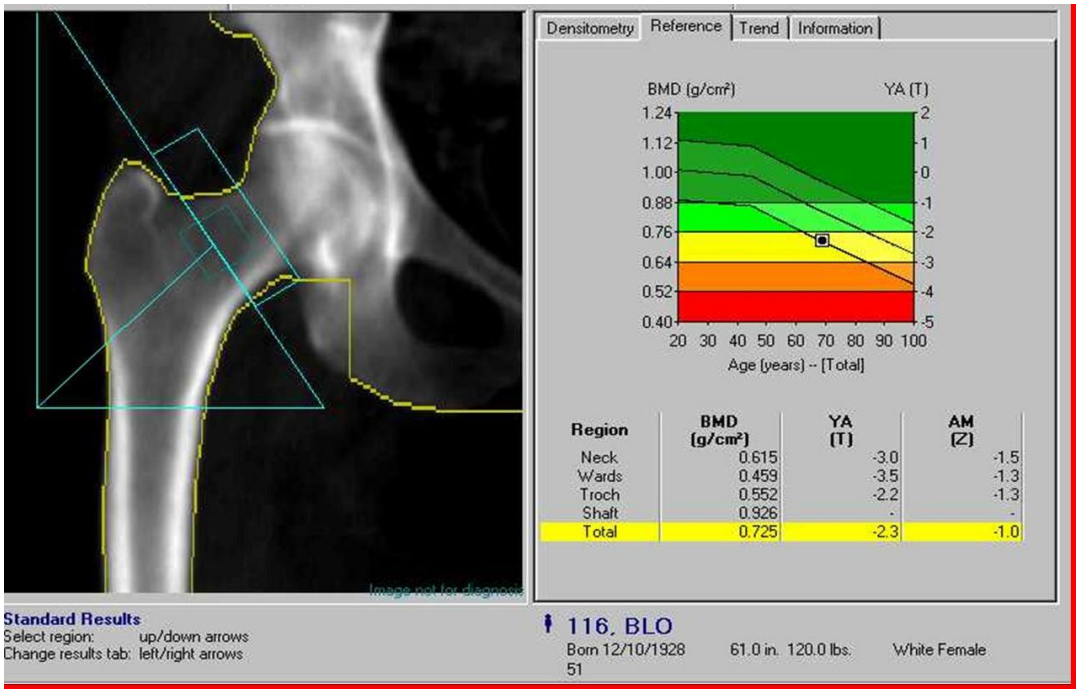


Fig 3: DEXA Scan of Hip

DEXA Scans of the Spine

DEXA scans of the spine can focus on either the posteroanterior (PA) projection or a lateral view of the lumbar vertebrae. Typically, a region including L1-L4 or L2-L4 is sampled. General limitations of measuring bone density of the vertebra in the PA projection include the confounding presence of osteophytes, calcification of paraspinal ligaments, aortic calcification and vertebral scoliosis. Additionally, existing vertebral compression fractures may be interpreted as increased bone density. Lateral views eliminate the potential artifacts of osteophytes or aortic calcifications. However, limitations of lateral views include the increased amount of soft tissue in this projection, and the overlap of the ribs and pelvis. This, in turn, decreases the number of vertebrae that can be analyzed, affecting the precision of the measurements and, thus, reducing the usefulness of lateral measurements for following the response to therapy.

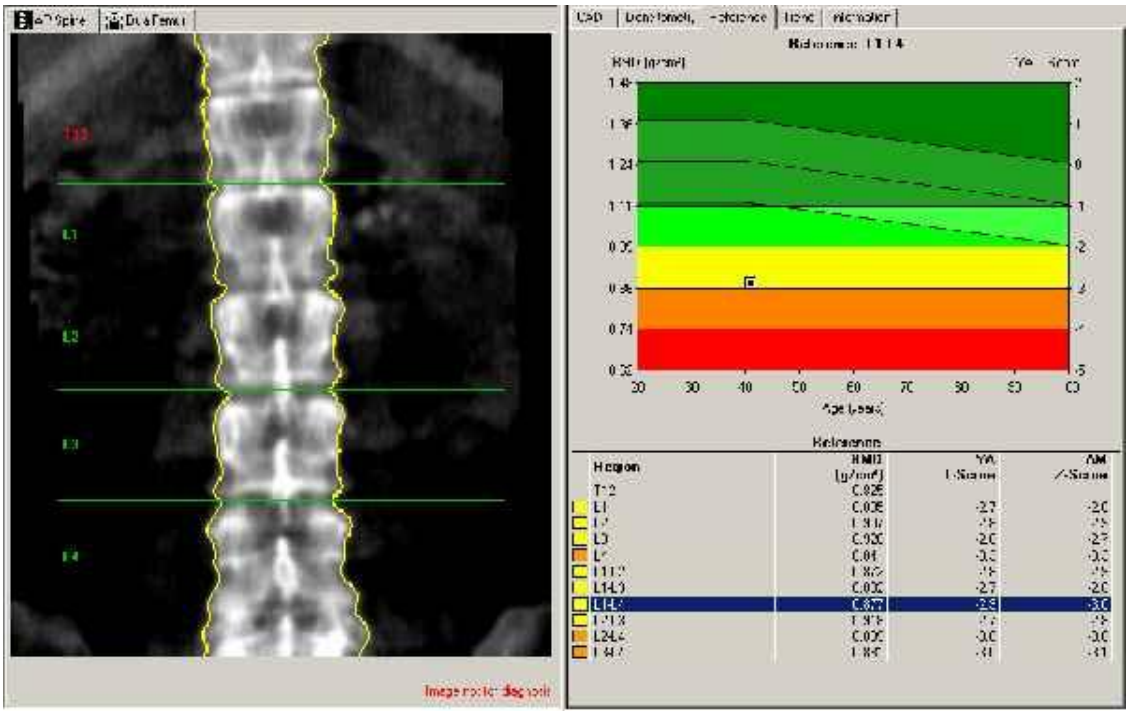


Fig 4: DEXA Scan of lumbar spine

Peripheral DEXA

Peripheral DEXA can be performed by using any of the standard DEXA machines that measure hip, spine, and total body BMD. In addition to these DEXA machines, there are a number of peripheral DEXA machines. For example, a peripheral DEXA system has received FDA approval for measuring BMD at the middle phalange of the middle finger. DEXA of the finger is highly correlated to radiographic absorptiometry.

DEXA for Measuring BMD and Detecting Vertebral Fractures

Another more recent consideration in the selection of the anatomic site is the ability of DEXA to detect vertebral fractures as an adjunct to a BMD measurement. Only 20%-30% of vertebral fractures are recognized clinically and the rest are discovered incidentally on lateral spine radiographs. Lateral spine x-rays have not been recommended as a component of risk assessment for osteoporosis, because of the cost, radiation exposure and the fact that the x-ray would require a separate procedure in addition to the BMD study. However, lateral spine images can be obtained using DEXA and, thus, it is possible to screen for vertebral fractures at the same time a subject is undergoing assessment of BMD. This imaging may be referred to as morphometric x-ray absorptiometry (MXA), but manufacturers of DEXA technology have also referred to this procedure as "instant vertebral assessment " (IVA) or "lateral vertebral assessment" (LVA).

Quantitative Computed Tomography (QCT)[1,4]

QCT is based on the differential absorption of ionizing radiation by calcified tissue. Standard CT scanners are used, and attenuation measurements are compared

with a standard reference to calculate bone mineral equivalents. Unlike other techniques, 3-dimensional BMD is directly calculated. QCT is the only technique that can distinguish between cortical and cancellous bone. A focused examination of cancellous bone may be useful in assessing response to therapy. However, QCT's limited availability, relatively high radiation exposure and high cost may impose some restrictions on its clinical use.

Ultrasonography[1,4]

Ultrasound densitometry of bone, most commonly measured at the heel or tibia, is less expensive than other methods and can be performed in a physician's office. Therefore, bone ultrasonography could be ideally suited for screening large numbers of patients. Two parameters of ultrasonography have been investigated: velocity, which depends on elasticity and density, and at tenuation, which results from scattering and absorption. Because bone (particularly cancellous bone) is inhomogeneous, ultrasound scattering is complex. Attenuation in bone is determined by plotting the linear relationship of the amplitude loss of the sound wave at various frequencies. The slope of this line is referred to as the broadband ultrasound attenuation (BUA). Attenuation is influenced by both bone density and microarchitecture. Currently, ultrasound assessment of bone density is acceptable for screening at-risk individuals with confirmation of the diagnosis by DXA. Ultrasound densitometry is not recommended to monitor response to therapy.

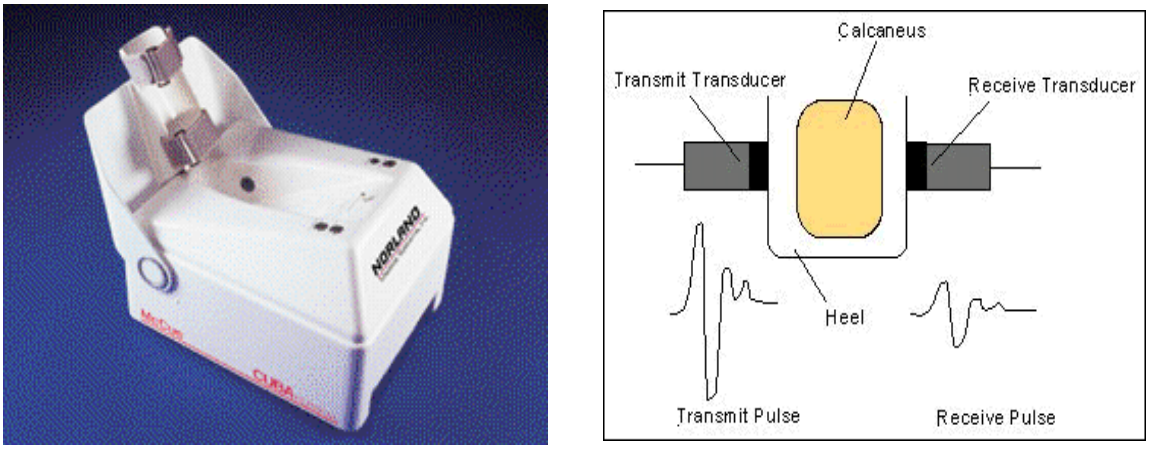


Fig 5: Calcaneal Ultrasound

Radiographic Absorptiometry (RA)[1,4]

Radiographic absorptiometry (RA), a technique that is more than 50 years old, is a quantitative assessment of the metacarpals and phalanges based on a plain radiograph. In traditional RA measurements, an aluminum wedge is included in the radiograph in order to correct for variables, such as voltage setting, exposure time, and film variables.39 More recently, commercially available digital imaging software has been developed. This software allows BMD reports to be calculated from hand x-rays scanned into a computer or works with digital (film-less) x-ray equipment. Some studies have found phalangeal bone density determined in this manner to be predictive of fracture risk.

<u>BMD Measurement Reports</u>

Reports of BMD measurements typically include the following:

a. An image of the bone within the area scanned. The image may be reviewed to determine whether confounding artifacts are present. If the study is compared

to a previous one, it is important to make sure the same anatomic site is assessed (i.e., the same region of the hip).

b. The BMD expressed in g/cm2. The bone mineral content of the scanned region of interest (ROI).
c. Normal values based on the reference database.
d. The T- and Z- score, based on comparison of the patient's BMD with the reference database. The results may also be presented as a percentage of the mean value of the reference population.

Possible Pitfalls in BMD Measurements at Various Site[1]

Lumbar spine	• Osteoarthritis (posterior elements, vertebral body, osteophytes
(anteroposterior view)	• Fracture
	• Hyperlordosis/scoliosis
	• Calcified aorta
	• Radio-opaque material (e.g., Thorotrast)
	• Size of region of interest
	• Presence of barium
	• Fat tissue (differences between individuals and redistribution over time)
Lumbar spine	• Ribs, pelvis overlying the region of interest

(lateral view)	• Scoliosis
	• Fat tissue (differences between individuals and redistribution over time)
Proximal femur	• Size of region of interest
	• Location of region of interest
	• Leg position (rotation, abduction

TREATMENTS FOR OSTEOPOROSIS

Treatments for osteoporosis are either pharmacological or non-pharmacological. The pharmacological interventions currently available on the market can be divided into six categories:

Calcium & Vitamin D

They are most often given as a combination treatment of both substances. It is not entirely clear to what extent Vitamin D and Calcium reduce the risk of osteoporotic fractures on their own. Therefore, they are often given as an add-on to other osteoporotic drugs.[102]

Hormone replacement therapy (HRT)

It stops the bone loss by restraining the bone resorption. Several studies have shown that HRT reduces the risk of fractures. [103,104] However, HRT has recently been shown to have several extra-skeletal effects. Combined oestrogen and progesterone for the treatment of women with an intact uterus has been shown to increase the risk of cardiovascular disease and breast cancer and decrease the risk of colorectal cancer. [103,105] According to a large government-sponsored trial known as the Women's Health Initiative (WHI), hormone therapy can reduce risk of hip fractures and symptomatic fractures of the spine by 34% and all other fractures by 24% .[106]

Bisphosphonates

They act preventing bone loss and thereby reducing the risk of fractures. There are several different bisphosphonates. Those currently available on the market for the treatment of osteoporosis are etidronate, alendronate and risedronate.

Bisphosphonates have been shown to reduce the fracture risk primarily in postmenopausal women with low BMD. Etidronate, the oldest bisphosphonate, has been shown to reduce the risk of vertebral fracture while, alendronate and risedronate have demonstrated a risk reduction for hip and wrist fractures as well.[106-108] The safety profile is more favourable for bisphosphonate than for HRT. The most frequent adverse event is mild to moderate gastrointestinal discomfort.[109]

Selective Estrogen Receptor Modulators (SERMs)

They are hormone-like drugs that affect multiple tissues. These drugs are able to selectively block estrogen from certain tissues, namely the breast, while increasing its availability in other areas such as the bones. In its simplest terms, the goal of these drugs is to maximize the beneficial effect of estrogen on bone and to minimize the deleterious effects of the hormone on the breast and endometrium (lining of the uterus).

Two SERMS, tamoxifen and raloxifene (Evista), are currently used in postmenopausal women. Raloxifene is FDA-approved for the treatment and prevention of osteoporosis, while tamoxifen is used to treat and prevent breast cancer.

Raloxifene, which currently is the only available SERM on the market, has been shown to reduce the risk of vertebral fractures and breast cancer in early postmenopausal women with low BMD.[110] Moreover, raloxifene has in one study shown to reduce the risk of coronary heart disease (CHD) among patients at high risk of cardiovascular disease.[110] On the negative side raloxifene shows an increased risk of thromboembolic events.

Calcitonin

Calcitonin is a naturally occurring hormone produced by the thyroid gland and is involved in calcium regulation and bone metabolism. It is approved for women who are more than five years past menopause and for people with Paget's disease or hypercalcemia. Calcitonin is available as an injection or nasal spray. Studies show that injectable calcitonin can produce some modest gains in spine BMD.[111] Small studies have shown that the nasal spray provides modest effects on bone turnover and bone density in the spine but no significant effect on the hip.[111] Since calcitonin is a protein, it cannot be taken orally as it would be digested before it could work.

Parathyroid Hormone (PTH)

It is given by intermittent injection restores bone strength by stimulation of new bone formation. A clinical study has shown PTH to reduce the risk of vertebral and non-vertebral fractures in postmenopausal women with previous vertebral fractures and low bone mass.[112] Teraparatide is currently the only available PTH on the market.

Strontium ranelate

It acts by reducing bone resorption while allowing continued bone formation.[113] Clinical studies have shown strontium ranelate to reduce the risk of vertebral and non-vertebral fractures in postmenopausal women with low BMD. Strontium ranelate has not been found to have any serious adverse events. The most common adverse events were diarrhoea and nausea, which mostly occurred during the first three months of treatment. A less common adverse event was venous

thromboembolism, which was slightly more frequent among strontium ranelate users.[114, 115]

Examples of non-pharmacological interventions are nutrition, exercise and hip protectors . Interventions such as hip protectors may reduce the risk of hip fracture, though recent studies suggest little or no effect.[116, 117]

METHODOLOGY

The present study was conducted in the department of Orthopaedics, KLES Dr.Prabhakar Kore Hospital and Medical Research Centre, Belgaum.

Study design:

One year Cross Sectional Study.

Source of Data:

Data was collected from all women aged more than 45 years undergoing DEXA scan attending outpatient & inpatient of department of Orthopaedics KLES Dr. Prabhakar Kore Hospital and Medical Research Center, Belgaum, Karnataka. & also attending osteoporotic check up camps from January 2010 to December 2010.

Sample Size

100 women aged more than 45 years were selected who were willing to undergo a DEXA Scan.

Sampling procedure :

Sample size was calculated by using the formula $4pq/d^2$ where p is preavalence of Otseoporosis in % (In a similar study done) & was 50% , q = (100-p)%, d is absolute error taken as 10%.

SELECTION CRITERIA

Inclusion criteria:

1. Women aged more than 45 years.

Exclusion criteria:

1. Participants on following medication which are known to affect calcium metabolism
    a. Long term steroids
    b. Phenytoin
    c. Eltroxin
    d. Heparin
    e. Thiazide diuretics
    f. Oestrogen
2. Patients with following long term diseases
    a. Chronic liver/ kidney diseases
    b. Chronic skin disease
    c. Malignancy
    d. Rheumatoid Arthritis

Procedure :

The study was approved by the Ethical and Research Committee of Jawaharlal Nehru Medical College, Belgaum. After finding the suitability as per inclusion and exclusion criteria ,patients were selected for the study and briefed about the nature of the study, the interventions used and written ,informed consent was obtained (Annexure–I). The consented patients were enrolled in the present study. Further, descriptive data of the participants & risk factors were evaluated through a Questtionaire .(Annexure II).

Proforma:

The patients were evaluated through a proforma & after ruling out the patients in the exclusion criteria, the rest were enrolled in the study.

IPD/OPD No. :

Name:

Age: Age is an important factor to be noted, as the study was focused on patients aged more than 45 years.

Sex : Female

Address: Address was noted to communicate with the patient for treatment purposes if found osteoporotic & osteopenic.

Socioeconomic Status: Was determined according to BG Prasad classification.

Questionnaire:

1. Occupation:

Occupation of the individual was asked and it was further classified into manual labour, sedentary work and other group. This was to assess the amount of physical activity a patient involves in as increased bone mass is seen among women with higher physical activity.

2. Complaints of the individual

To know the reason for attending the department of orthopaedics for evaluation & treatment.

3. Medication History.

To rule out all the exclusion criteria. To advice the patient to stop calcium supplementations 48 hours prior to the scan.

4. History suggestive of following chronic diseases.

a. Chronic liver disease
b. Chronic kidney disease
c. Chronic skin disease
d. Rheumatoid arthritis
e. Diabetes mellitus
f. Hypertension
g. Malignant conditions

5. History of alcohol Consumption.

Alcohol consumption was asked as it leads to fall in bone mineral density. If the women consumed alcohol quantity of intake was assesed.

6. History of smoking cigarettes.

Cigarette smoking was asked as it leads to fall in bone mineral density. If the women smoked cigarette, the no of cigarettes smoked per day was asked.

7. History of consumption of milk & milk products.

To assess whether the patient is on calcium rich diet as it leads to increase in BMD.

8. Diet

Patients diet was assessed whether the patient is a vegeterian or a non vegetarian.

9. Sunlight exposure

A history of exposure to sunlight (number of hours per day) was solicited.

10. Menstrual History.

The attainment of menopause was & the time of menopause and time since menopause was determined.

11. Family history of fractures after trivial fall or deformity of the back (Hunch Back) was asked.
12. Body mass index was calculated after determining the Height & weight

BMI:- wt(kg)/Ht(m2)_____.

Investigation:

BMD (Bone mineral density) measurement was done using DEXA Scan of make GE Wipro and 2008 Lunar model.

DEXA Scan Evaluation technique:

A dual energy X-ray absorptiometry (DEXA) scan uses X-ray equipment and a computer to measure bone density. Bone mineral density is the most important tool in the diagnosis of osteoporosis . It allows for accurate , precise and reproducible assessment of bone mineral density and enables the detection of osteoporosis before the occurrence of fractures. DEXA Scan is the gold standard in the assessment of BMD.

Pre Scan Requisites

1. Completion of the questionnaire

2. Selection of the study group after ruling out the exclusion criteria
3. Filling of the informed consent.

Instructions prior to the scan

1. Stoppage of calcium supplements 48 hours before the scan.
2. Removal of clothes that have metal buttons or other metal accessories & change to a gown if necessary.
3. To remain still during the procedure.

Procedure:

The procedure was quick , painless and time taken was about 10 minutes. It involved exposing the body to a small dose of X-ray radiation. Patient was taken to the X-ray room and asked to lie down on an X-ray table. A radiographer operated the scanning equipment.

Scan was carried out at two sites the lumbar spine followed by the hip joint. Patient legs were flexed & placed over a large block for scanning of the lumbar spine. This was done to achieve straightening of the spine. For scanning of the hip joints patientwas made to lie supine only. The scanning apparatuswasl then passed over the patients lumbar spine & the hip joints respectively and it will project X rays beam. Some of this radiation travels straight through the bones and a certain amount is absorbed by them - how much depends on how dense the bones are.

A detector measured how much radiation passes through the bones and sends the information to a computer . A printed report was then obtained stating the BMD, 'T' & 'Z' scores.

Assessment of data:

The Bone Mineral Density (BMD in g/cm2) and 'T' and 'Z' scores was determined. 'T' score compares the BMD result with that of a young adult of the same gender with a peak bone mass while 'Z' score compares the BMD result with people of the same age group size and gender.

Data was analyzed as follows.

- Normal BMD: T scores not more than 1 SD below the adult mean.
- Osteopenia: T score between -1.0 and- 2.5.
- Osteoporosis: T score <- 2.5 with or without fragility fracture.

Data was collected and recorded and diagnosis based on the BMD score was done. BMD data was correlated with the data of various risk factors obtained through the questionnaire and correlations were derived.

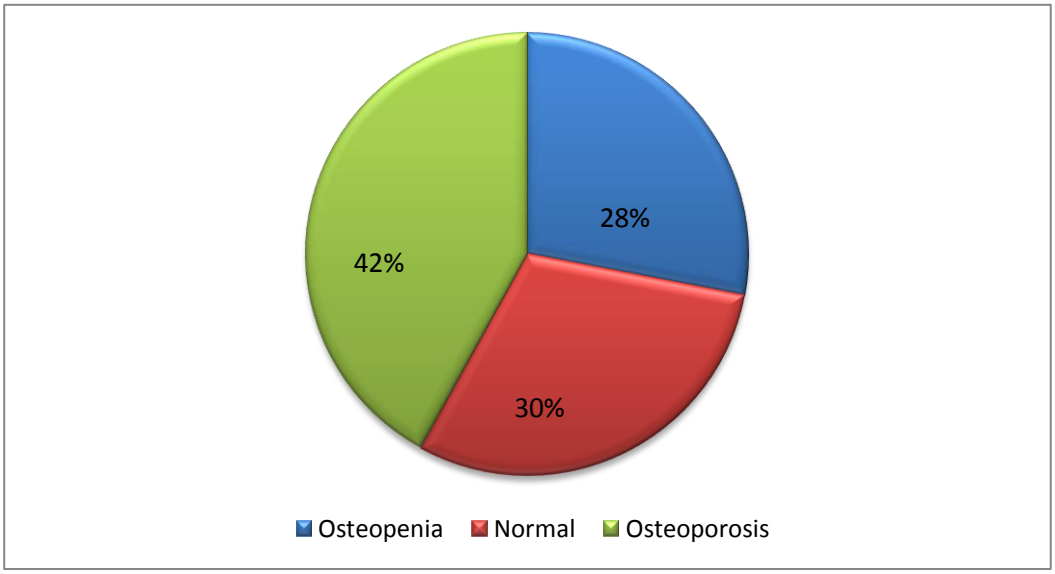
RESULTS

In this series of 100 patients were evaluated. Following are the observations made.

Table 1: BMD Distribution

Normal (%)	Osteopenia (%)	Osteoporosis (%)
30	28	42

The overall prevalence of osteoporosis was 42%, osteopenia 28% and women with normal BMD were 30%.

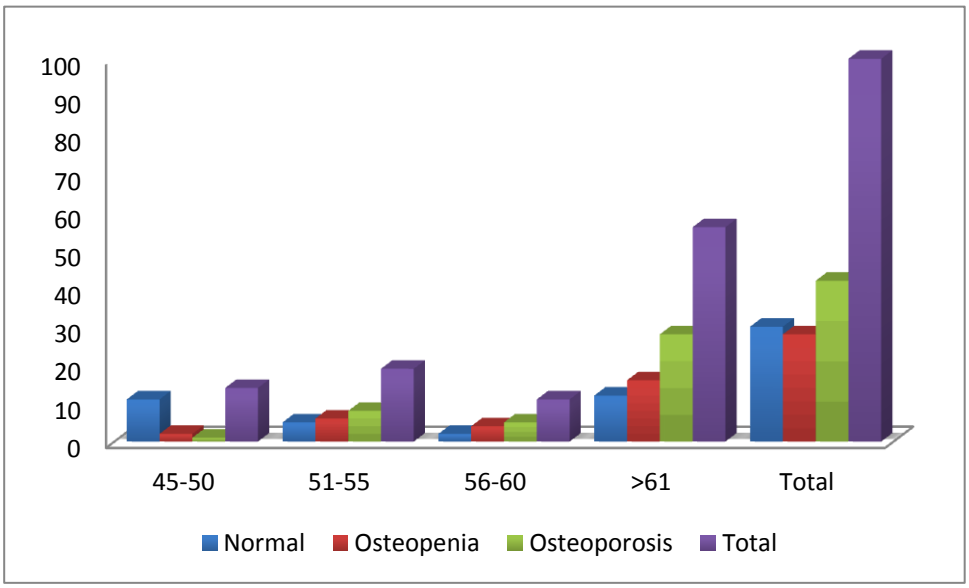


Graph 1 : BMD Distribution

Table 2: Age & BMD

AGE	Normal n (%)	Osteopenia n (%)	Osteoporosis n (%)	Total
45-50	11(78.6)	2 (14.3)	1(7.1)	14
51-55	5 (26.3)	6 (31.6)	8 (42.1)	19
56-60	2 (18.1)	4 (36.3)	5 (45.6)	11
>61	12 (21.4)	16 (28.6)	28 (50)	56
Total	30	28	42	100

Age of all the patients in this study was above 45 years. Majority of the patients were aged > 60 years . 14 patients (14%) were in the age group 45 to 50 years. There were 19 patients (19 %) in the age group of 51 to 55 years, 11 patients (11%) in age group 56 to 60 years and 56 patients aged more than 60 years(60 %). Highest number of osteoporotic individuals 28 were aged more than 61 years. 11 patients out of 14 had normal BMD values in the age group 45-50.

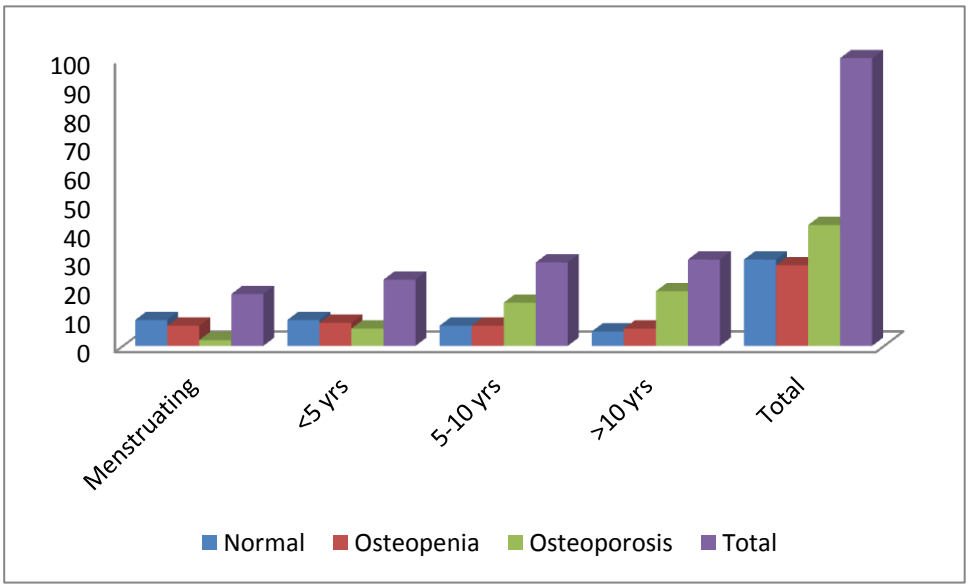


Graph 2: Age & BMD

Table 3: Time since menopause & BMD

Time Since Menopause	Normal n (%)	Osteopenia n (%)	Osteoporosis n (%)	Total
Menstruating	9(50)	7(38.9)	2(11.1)	18
< 5 yrs	9(39.1)	8(34.8)	6(26.1)	23
5-10 yrs	7(24.1)	7(24.1)	15(51.8)	29
>10 yrs	5(16.7)	6(20)	19(63.3)	30
Total	30	28	42	100

Increase in age & time since menopause was associated with increased of osteoporosis. 19(63.3%) of 30 women with over 10 years since menopause had osteoporosis where as 6 (26.1%) of 23 women with less than 5 years of menopause had osteoporosis.

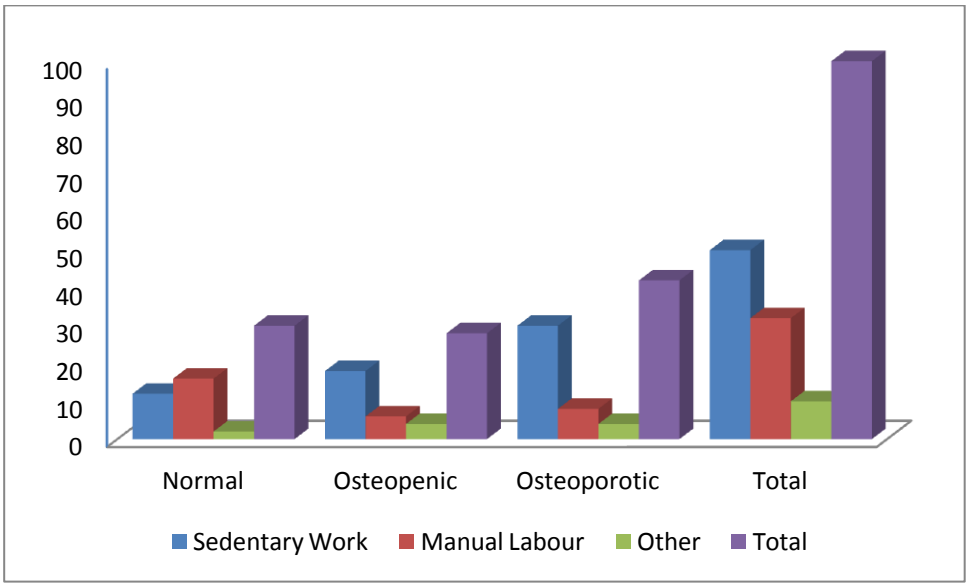


Graph 3 : Time since menopause and BMD

Table 4: Occupation & BMD

Occupation	Normal n (%)	Osteopenic n (%)	Osteoporotic n (%)	Total
Sedentary work	12 (24)	18 (36)	30 (60)	50
Manual Labour	16 (50)	6 (18.8)	8 (25)	32
Other	2 (20)	4 (40)	4 (40)	10
Total	30	28	42	100

The prevalence of osteoporosis was highest among women involved in sedentary work (housewives, office work) where in 30 women (60%) had osteoporosis. 50% of women among manual Labour group had normal BMD . Women who had other occupation were 10% in this study and 40 % osteoporosis prevalence.

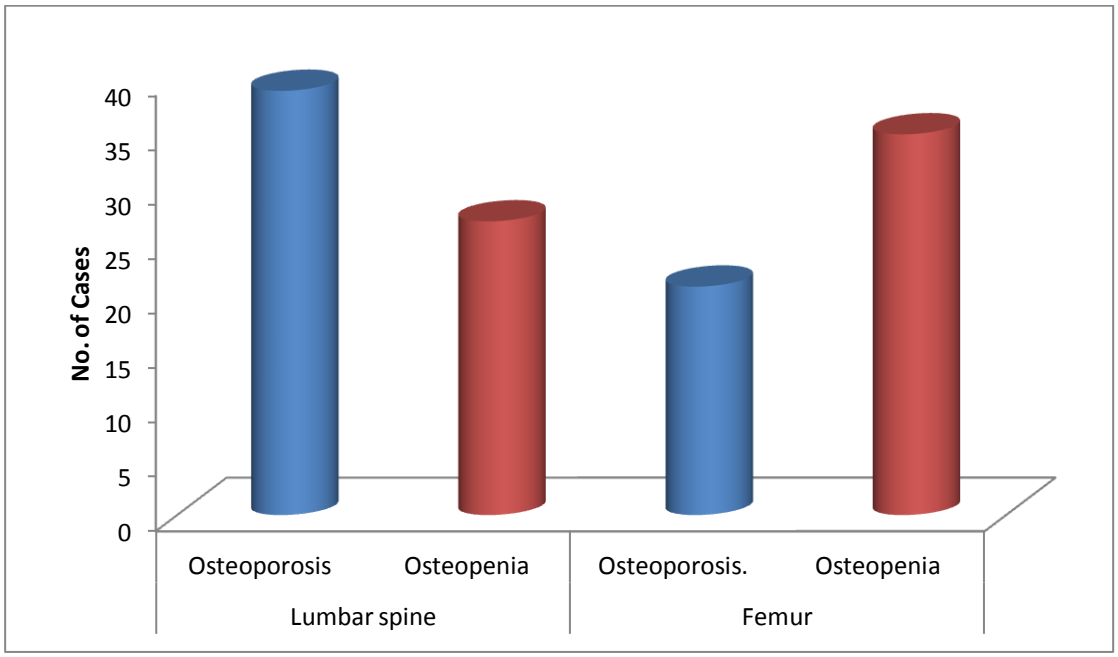


Graph 4: Occupation & BMD

Table 5: Percentage of Study Subjects with Osteoporosis and Osteopenia at Various Anatomic Sites

Lumbar Spine		Femur Neck		Osteoporosis at any site
Osteoporosis	Osteopenia	Osteoporosis	Osteopenia	
39	27	21	35	42

Determination Of BMD at Lumbar spine was more sensitive for osteoporosis with 39 women having osteoporosis , where as dual hip joint DEXA evaluation showing 21 women with osteoporosis.

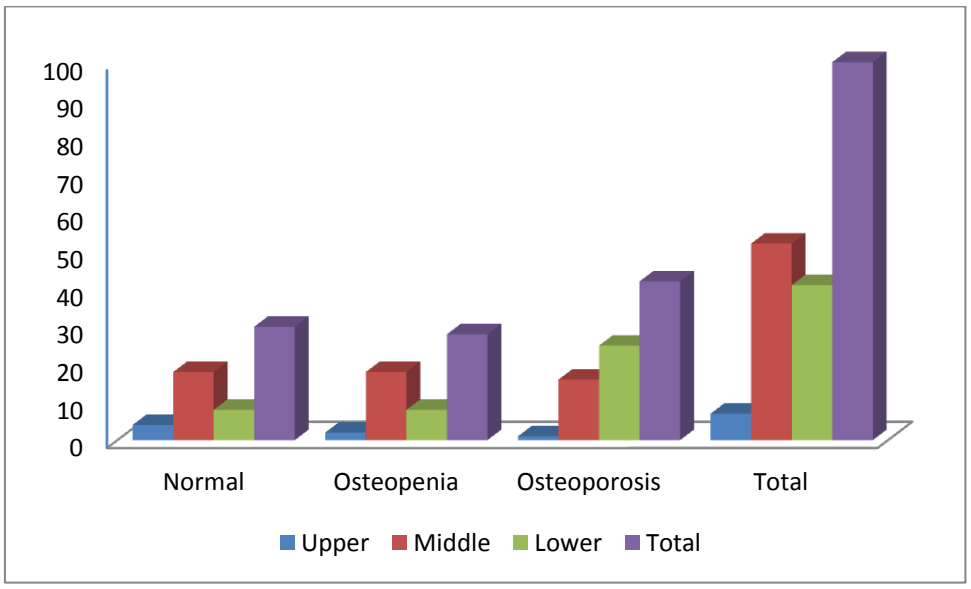


Graph 5 : Osteoporosis and Osteopenia at Various Anatomic Sites

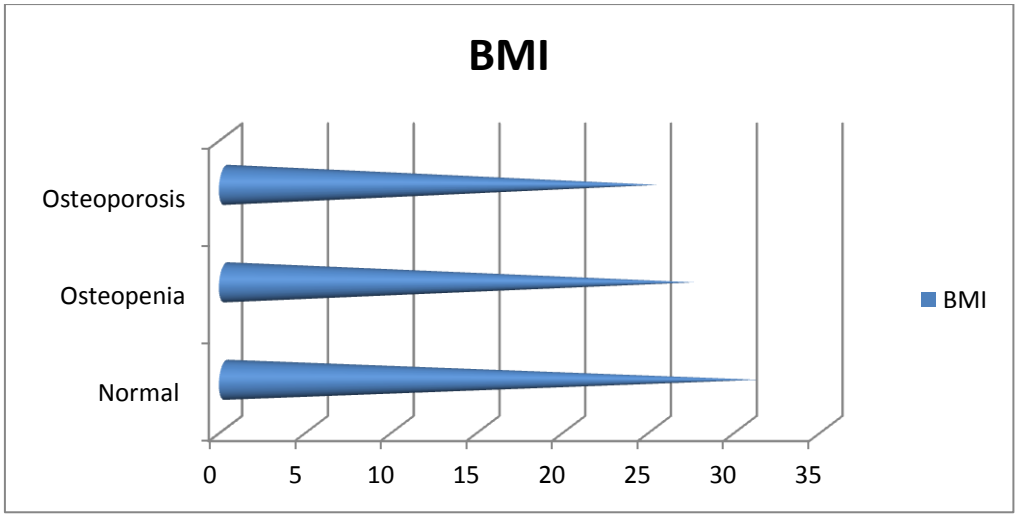
Table 6 : Socioeconomic status and BMD

Socioeconomic status	Normal	Osteopenia	Osteoporosis	Total
Upper	4 (57%)	2 (28.6%)	1(14.4%)	7
Middle	18(34.6%)	18(34.6%)	16(30.8%)	52
Lower	8 (19.5%)	8(19.5%)	25(61%)	41
Total	30	28	42	100

The number of osteoporotic women in the lower socio economic group was the highest 25 (61%). Percentage of women having normal BMD was highest in the upper socio economic group (57%).

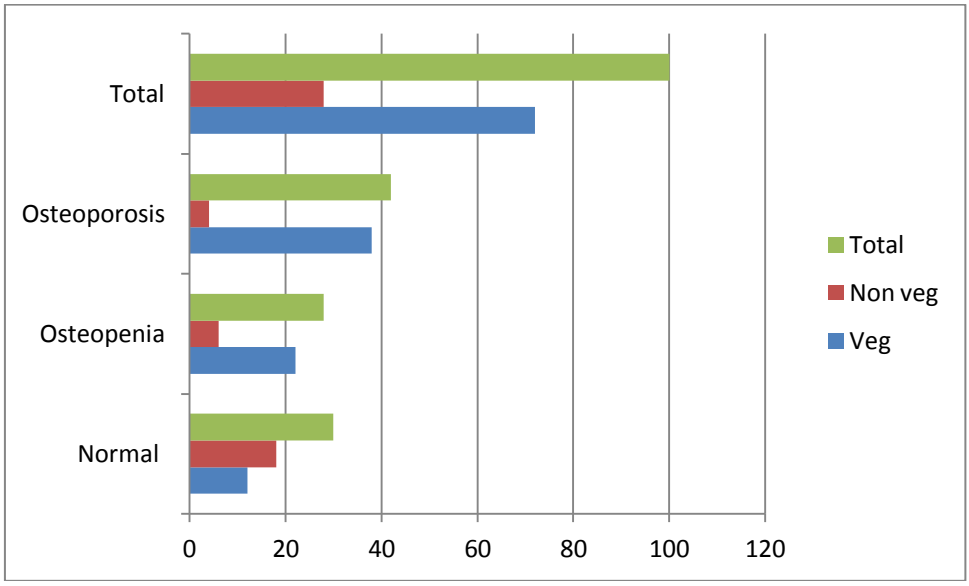


Graph 6: Socioeconomic status & BMD



Graph 7 : BMI and BMD

Body Mass Index ranged from 17.7 to 35.6. Women with higher body mass index had lower incidence of osteoporosis. Highest number of women with osteoporosis had lower BMD values



Graph 8: Diet and BMD

Highest percentage of women of with osteoporosis were in the vegetarian group (52.3%). The non veg group had the higher number of women with normal BMD (64.3%).

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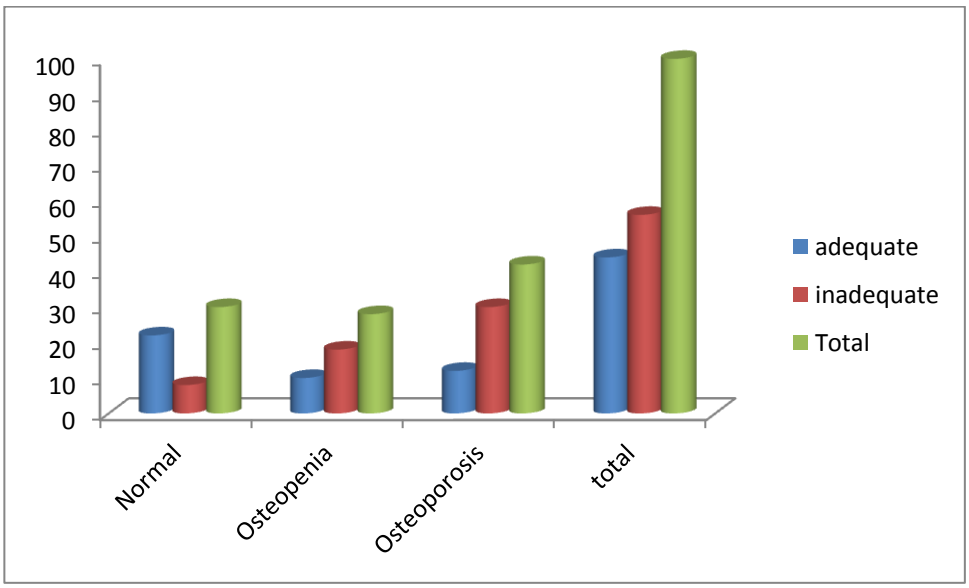

Graph 9 : Sunlight exposure and BMD

The number of women with adequate amount of exposure of sunlight(1 ½- 2 hrs) were 44 and women with inadequate exposure of sunlight(< 1 ½) was 56. The prevalence of osteoporosis was higher among the group with inadequate exposure to sunlight. The number women with normal BMD was highest among the group with adequate exposure to sunlight.

DISCUSSION

Osteoporosis is the commonest metabolic bone disease in clinical practice, is a major public health problem worldwide and its prevalence is increasing with rise in the ageing population.

In this cross sectional study 100 women were evaluated with a DEXA scan for the presence of osteoporosis and various risk factors were assessed. This was significant as no other studies were carried out in this region to determine the prevalence and risk factors.

The overall prevalence of osteoporosis in this study was 42%, osteopenia was 28% & women with normal BMD values were 30%.

A study done in another semi urban region in southern India showed prevalence of osteoporosis to be 48%. This was comparable with the prevalence rate of osteoporosis in our study.[95]

Age of all the patients in our study ranged from 45 to 85 years. Average age of the women in this study was 65 years. This was significant as women in the perimenopausal age group and post menopausal age group both were included in the study. Highest number of osteoporotic women (28%) were aged more than 61 years.

In comparative studies they concluded that age correlated inversely with BMD values and fracture threshold reduces with age. Anburanjan et al prospectively studied the rate of loss of BMD per annum. They concluded that rates of BMD loss at the age of 65 years were 0.91%, 0.84%, 0.72%, 0.78%, 1.66%. per annum respectively for the neck of femur, trochanter, intertrochanteric region, total hip and Ward's triangle.[93]

Osteoporosis is predominantly a disease of the women. The burden of morbidity from osteoporosis has significant medical, social and financial implications.

Life style factors form the cornerstone of prevention. These include regular exercise, adequate dietary calcium (1- 1.5 Gm/day), adequate vitamin D (800 1.4./day) and cessation of smoking and alcohol intake.

In our study the prevalence of osteoporosis was highest among women involved in sedentary work (housewives, office work) where in 30 women (60%) had osteoporosis. Cross sectional studies show weight bearing exercises have beneficial impact on the bone mass, development of peak bone mass and reduces the bone loss and the mechanical stress.[50] Thus lower rate of osteoporosis prevalence was seen among women involved in laborious professions in our study. The cohort studies showing Physical inactivity in the old age populations are responsible for decline of bone mass and the major risk factor for Osteoporosis fractures.[49]

Osteoporosis itself has no specific symptoms; its main consequence is the increased risk of bone fractures. Osteoporotic fractures are those that occur in situations where healthy people would not normally break a bone; they are therefore regarded as fragility fractures. Typical fragility fractures occur in the vertebral column, rib, hip and wrist. The most common complaints the patients presented with in our study with was backache (56%).Rest had complaints of knee pain, sciatica, generalized weakness & diffuse body ache.

The number of osteoporotic women in the lower socio economic group was the highest 25 (61%). This high prevalence rate was significant as another study done e to assess bone status of Indian women from a low income group in 289 women in

the 30-60 year age group using DEXA Scan showed the prevalence of osteoporosis at the femoral neck was around 29%.[97]

In the world, average age for women reaching menopause is around 52 years, but in India is comparatively less and more hysterectomy were reported in urban India . In our study the average age of menopause was 49 years.

Most of the women in our study had attained menopause (82) of which 30 women had attained menopause for more than 10 years. Increase in time since menopause was associated with increased risk of osteoporosis in our study.

Kadam et al showed BMD at all three sites of measurement (Spine, Hip & wrist) was significantly lower in post menopausal then pre menopausal women ($p< 0.001$) . Prevalence of osteoporosis was highest at the lumbar spine (25.8%) in post menopausal women, while prevalence of osteopenia was high in pre menopausal women (44.3%).[97] Unni et al in their study found that increasing age and time since menopause was associated with increased risk of osteoporosis.[100]

Several risk factors contribute to low bone mass. These include non-modifiable factors like female sex, old age, small thin built, Caucasian/Asians and family history of fractures. Ethnic differences in bone mineral density (BMD) are strongly influenced by body weight.

Body Mass Index of the women in our study ranged from 17.7 to 35.6. Women with higher body mass index had lower incidence of osteoporosis. Literature shows low Body mass index (BMI), a measure of body composition, may be associated more number of osteoporosis fractures, and osteoporosis.[55]

Epidemiological studies shows low body weight is the one of the main determinant and risk factor for hip fractures.[57]

It was found that highest percentage of women of with osteoporosis were in the vegetarian group (52.3%). Various Indian studies have shown that vegetarians have 50% risk of osteoporosis and 98.82% are osteopenic.[47]

Important modifiable risk factors include calcium and vitamin D deficiency, sedentary life style, smoking, excessive alcohol and caffeine intake. Only 4 women in this study gave history of drinking alcohol of which 2 were osteopenic. One women gave history of smoking she had osteopenia. Prospective and cohort studies show smoking decreases the bone mineral density and leads to the risk of osteoporosis fractures in both men and women and also studies demonstrating that quitting smoking may help to reduce the fractures.[64]

The prevalence of osteoporosis was higher among the group with inadequate exposure to sunlight. The number women with normal BMD was highest among the group with adequate exposure to sunlight. The multi centric and cross sectional studies show there is a strong association between less exposure to sun light leading to the hip fractures in the age groups of above 50 years.[58]

Genetic factors have a role on Bone mineral Density at the age of 20-30 and bone mineral loss at post menopause period.[19] Fifty percent of the Peak bone mass, bone geometry, bone strength, bone architecture depends on genetic predisposition.[20] In our study 6 women had positive family history for fracture of the hip and wrist after trivial fall and all the 6 women had osteoporosis in this study.

It is important to distinguish between diagnostic and prognostic use of bone mineral density measurement. As a diagnostic tool, it gives information concerning the presence or absence of the disease with the cut off values chosen. Its potential as a prognostic tool is to determine the future probability of osteoporosis.

Central DEXA, a proven technology for the diagnosis and management of bone mineral loss, is now widely used all over the world.

As the diagnosis and long term treatment of osteoporosis and consequent fractures are expensive for the individual as well as the health system, there is a need for careful consideration in determining the risk factors as well as the future course of action on scientific evidence.

The presence of a key risk factor should alert the physician to the need for further assessment and intervention, pharmacologic as well as non pharmacologic, to prevent fracture.

Like most other public health problems of widespread magnitude, treatment alone cannot help a society or nation to cope with the scourge of osteoporosis. Also, since no therapy fully restores lost bone mass, the importance of prevention cannot but be underscored.

Life style factors form the cornerstone of prevention. These include regular exercise, adequate dietary calcium (1- 1.5 Gm/day), adequate vitamin D (800 1.4./day) and cessation of smoking and alcohol intake.

Osteoporosis and related fractures have a multifactorial genesis; as a result their management is complex. The goals of treatment of established disease are to

arrest bone loss, maintain skeletal integrity and prevent fragility fracture. All this necessitate early intervention.

Global research on treatment and prevention of osteoporosis in the past decade employing randomized controlled trials has made it possible to apply various therapeutic options. These options include non-pharmacologic approaches for all groups of patients and specific drugs for different subgroups.

CONCLUSION

In this cross sectional study 100 women were evaluated with a DEXA scan for the presence of osteoporosis and various risk factors were assessed.

The overall prevalence of osteoporosis in this study was 42%, osteopenia was 28% & women with normal BMD values were 30%.

Age of all the patients in this study ranged from 45 to 85 years. Average age of the women in this study was 65 years. Highest number of osteoporotic women (28) were aged more than 61 years.

The number of osteoporotic women in the lower socio economic group was the highest 25 (61%). Percentage of women having normal BMD was highest in the upper socio economic group (57%).

The most common complaints the patients presented with was backache (56%).Rest had complaints of knee pain, sciatica, generalized weakness & diffuse body ache.

In our study 45 women were house wives, 5 women did office work & 32 women worked in the fields. The prevalence of osteoporosis was highest among women involved in sedentary work (housewives, office work) where in 30 women (60%) had osteoporosis.

Most of the women in our study had attained menopause (82%) of which 30% women had attained menopause for more than 10 years. Increase in time since menopause was associated with increased risk of osteoporosis. The average age of menopause in this study was 48 years.

Body Mass Index ranged from 17.7 to 35.6. Average BMI of women in this study was 26.5. Women with higher body mass index had lower incidence of osteoporosis.

The number of women who were vegetarian in this study were 72 and non vegetarian were 28. Highest percentage of women of with osteoporosis were in the vegetarian group (52.3%). The non veg group had the higher number of women with normal BMD (64.3%).

The number of women with adequate amount of exposure of sunlight(1 ½- 2 hrs) were 44% and women with inadequate exposure of sunlight(< 1 ½) were 56%. The prevalence of osteoporosis was higher among the group with inadequate exposure to sunlight. The number women with normal BMD was highest among the group with adequate exposure to sunlight.

Only 4% women in this study gave history of drinking alcohol of which 2% were osteopenic. One women gave history of smoking, she had osteopenia.

6% women positive family history for fracture of the hip and wrist after trivial fall and all the 6% women had osteoporosis in this study.

SUMMARY

In this study 100 women aged above 45 years were evaluated to determine the prevalence of osteoporosis using a DEXA scan.

A structured questionnaire was used to assess the risk factors leading to osteoporosis. 42 women were found to be osteoporotic, 28 were osteopenic and 30 women had normal bone mineral density values.

Highest numbers of osteoportic women were above 60 years of age. Thus increasing age was significant risk factor for osteoporosis.

Other significant risk factors were increase in time since menopause and lower body mass index. Increased time since menopause correlated directly with increased risk of osteoporosis and lower body mass index was a significant risk factor for osteoporosis.

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ANNEXURE I

INFORMED CONSENT

Mr/Mrs/Ms_____

You are invited to participate in this study.

"A HOSPITAL BASED ONE YEAR CROSS SECTIONAL STUDY TO KNOW THE PREVALENCE OF OSTEOPOROSIS IN WOMEN AGED MORE THAN 45 YEARS USING DUAL ENERGY X-RAY ABSORPTIOMETRY SCAN (DEXA)"

Principal Investigator: BL0109002

Why am I being asked to take part in this study?

All women attending Ortho OPD and IPD aged 45 years and above are eligible to participate in this study. As you fall under this age group you are eligible to participate. Other women of the same age group are participating in this study. The decision to participate is entirely your own. The study is being done to find out the prevalence rate and factors affecting osteoporosis as mentioned in the objectives. BL0109002 is the principal investigator.

PROCEDURE

If you consent to be in this study, the relevant data is collected as per the proforma provided to you. BMD (Bone mineral density) measurement would be done using Central DEXA Scan (Dual energy X ray absorptiometry) of make GE Wipro and 2008 Lunar model. You will undergo a DEXA Scan after ruling out all the exclusion criteria. This test is painless and can be performed within 5 to 15 minutes. You will be asked to undergo this procedure only once.

BENEFITS

To the patient in the study.

1. It will act as a diagnostic tool for the patients in the study by providing information regarding the presence of the disease.
2. Will help to initiate therapy for osteoporosis once the diagnosis is confirmed.
3. As a prognostic tool it will help to determine future probability of osteoporosis.

To the community at large.

1. The data obtained from the study will help to provide information on the epidemiology of the osteoporosis which will be then basis for initiation for various programs for osteoporosis prevention.
2. It will help create awareness regarding osteoporosis.

RISKS

There are no risks associated with this study.

ALTERNATIVES

If you decline to participate decision it will not change the present or future health care or other services that you will receive. The treatment given out to you will be the standard treatment for your condition.

WITHDRAWING / REMOVAL FROM THE STUDY:

You can withdraw from the study during anytime you want and you will not be penalized for the same. You can be removed from the study if you do not fulfill the inclusion criteria.

PRIVACY AND CONFIDENTIALITY:

All information about the subject during the course of the study will be kept confidential to the extent permitted by law. The code numbers will identify the subject in this research record. Information from this study may be published but the subject's identity will be confidential in any publication.

COSTS

Cost of each DEXA Scan will cost around Rs 750/- to 1000/-. There will be no reimbursement for your expenses.

QUESTION

If any enquiries in the future or in case of study related problems you may contact principle investigator.

STATEMENT OF CONSENT:

The details of the research study in which I am expected to participate, for which I have to undergo DEXA Scan have been explained to me. I willingly, under no pressure from the researcher agree to take part in this study, and agree to participate in all investigations. I may withdraw at any time. I am not giving up any of my legal rights by signing this form.

My signature below indicates that I have read this entire consent form or it has been read to me, and had all my questions answered. I will be given a copy of this consent form.

Signature of the participant or legally authorized representative

Participants Name : Signature :

Name of the legally : Signature :

authorized representative

Witness's name : Signature :

Investigators Name : Signature :

Date:

Place:

ANNEXURE II

STUDY TITLE: "A HOSPITAL BASED ONE YEAR CROSS SECTIONAL STUDY TO KNOW THE PREVALENCE OF OSTEOPOROSIS IN WOMEN AGED MORE THAN 45 YEARS USING DUAL ENERGY X-RAY ABSORPTIOMETRY SCAN (DEXA)"

I.P/ OPD NO:

Name: Age:

Address: Phone no:

1. What kind of work do you do on a daily basis? Name of the activity ☐

a. Household b. Manual labour c. Office work

d. Others specify_____

2. Do you have any of the following complaints? ☐

a. Backache b. Easy fatiguability c. Fractures after trivial fall.

d. Others specify._____

3. Do you use any medications? ☐

a. Yes b. No

If yes then specify _____

4. Have you been diagnosed with any of the following conditions? ☐

a. Chronic liver disease b. Chonic kidney disease

c. Chronic skin disease d. Rheumatoid arthritis

e. Diabetes mellitus f. Hypertension

g. Malignant conditions

5. Whether you consume alcohol? ☐

a. Yes b. No

If yes then how much quantity per day? _____

6. Do you smoke cigarettes? ☐

a. Yes b. No

If yes then how many per day? _____

7. Do you consume milk and milk products daily? ☐

a. Yes b. No

If yes then quantity per day._____

8. Do you take any calcium / Vitamin D supplements? ☐

a. Yes b. No

If yes then dosage per day._____

9. Are you a vegetarian or non vegetarian? ☐

a. Vegetarian b. Non Vegetarian

10. Have you stopped having your periods for duration of 12 months? ☐

a. Yes b. No

11. Did you attain menopause before 45 years of age? ☐

a. Yes b. No

12. Have either of your parents been diagnosed with osteoporosis or broken a bone after a minor fall (a fall from standing height or less)? ☐

a. Yes b. No

13. Did either of your parents have a hunchback? ☐

a. Yes b. No

14. Determination of Body Mass Index

Height: - _____m.

Weight: - _____Kg.

BMI: - wt (kg)/Ht (m^2)_____.

ANNEXURE III

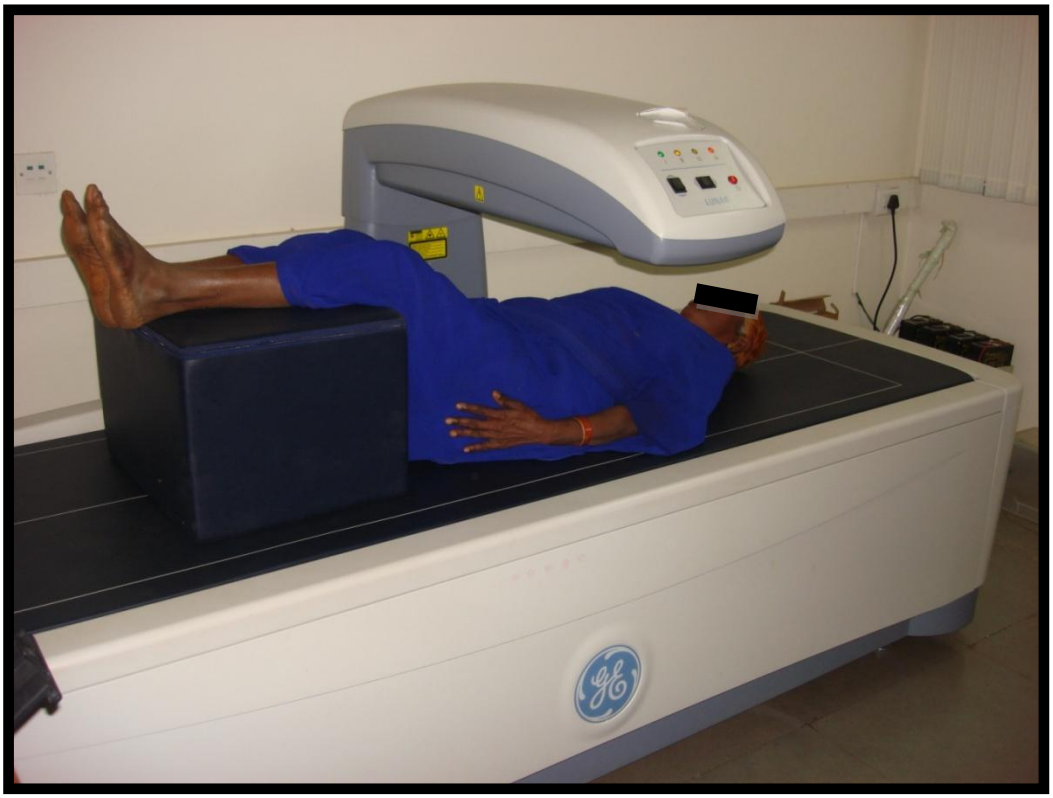

Fig 6 : DEXA SCAN OF LUMBAR SPINE

Fig 7: DEXA SCAN OF DUAL HIP

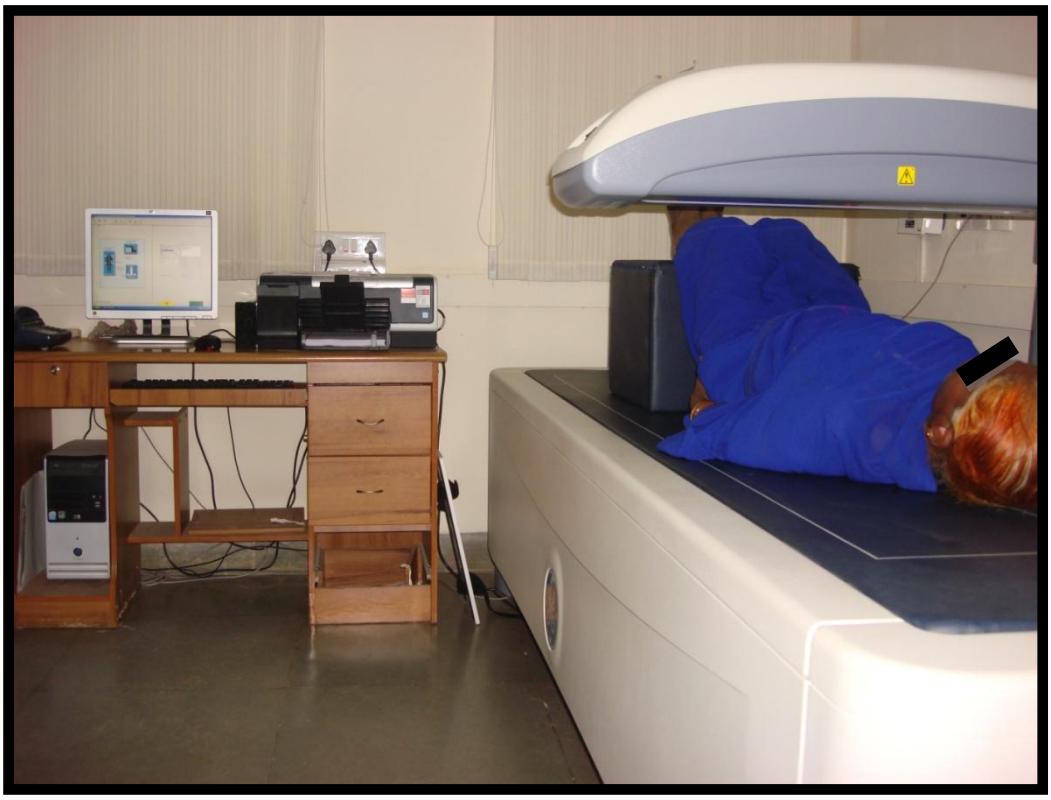

Fig 8: DEXA EVALUATION APPARATUS