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Risk factors associated with Osteoporosis- A population based study using p-Dexa technique

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***Abstract*- Background and Objectives**: Osteoporosis is a global problem occurring in every geographic area and affecting 150 million men and women worldwide. Osteoporosis is defined as a reduction of bone mass (or density) or the presence of a fragility fracture. Based on recommendation of a WHO committee, osteoporosis is defined as a bone density that falls 2.5 standard deviation (SD) below the mean for young healthy adults of the same race and gender also referred to as T-score of -2.5. Those who fall at the lower end of the young normal range (a T-score of >1SD below the mean) are defined as osteopenic having low bone density and are considered to be at increased risk of osteoporosis.**Materials and methods:** This population based cross sectional study attempts to measure the peripheral ie. heel bone mineral density (BMD) by p-DEXA technique in adults **Measurement of BMD**:In the DEXA technique two X-ray energies are used to estimate the area of mineralised tissue and the mineral content is divided by the area, which partially corrects for body size. **Results**: Among total of 173 individuals (106 women and 67 men) Women had 137 risk factors and men had 71 risk factors. Among them there are 39 people who had no risk factors and 134 people had one or more risk factors. Among 134 individuals 65 people (50%) had one risk factor and 69 people(50%) had two risk factors. **Conclusion**: Identification of people at risk of osteoporosis by p-DEXA method was useful in adults and we can implement preventive strategies to improve bone health and reduce the personal and economic burden of osteoporosis.

***Index Terms*-** Peripheral - dexa, calcaneus, bone mineral density.

I. INTRODUCTION

Magnitude of the Problem and Geographical Variation: Osteoporosis is a global problem occurring in every geographic area and affecting 150 million men and women worldwide. Ethnicity and race are well known determinants of skeletal health and bone mineral density.

Osteoporosis is a condition characterized by decreased bone strength. Women are four times likely to develop osteoporosis than men. It is prevalent in post-menopausal women but also occurs in men and women with underlying conditions or major risk factors associated with bone demineralization. Its chief clinical manifestations are vertebral and hip fractures, although fractures can occur at any skeletal site. Osteoporosis ranks as one of the 5 costliest diseases of aging after diabetes, hyperlipidemia, hypertension and heart diseases. As age advances, the incidence of osteopenia and osteoporosis increase and with the progressive aging of the world's population, there will be a resultant increase in the osteoporotic fractures. It is a matter of great concern that although the effects of osteoporosis are seen in the elderly population particularly women, the roots of osteoporosis are laid much earlier in life. Thus osteoporosis has been described as a condition dealt with by geriatrician but with roots in pediatrics.

Osteoporosis is defined as a reduction of bone mass (or density) or the presence of a fragility fracture. Based on recommendation of a WHO committee, osteoporosis is operationally defined as a bone density that falls 2.5 standard deviation (SD) below the mean for young healthy adults of the same race and gender also referred to as T-score of -2.5. Those who fall at the lower end of the young normal range (T-score of >1SD below the mean) are defined as osteopenic having low bone density and are considered to be at increased risk of osteoporosis.

Risk factors associated with generalized osteoporosis:

Non modifiable
- Personal history of fracture as an adult
- History of fracture in first degree relative
- Female sex
- Advanced age
- Caucasian race
- Dementia

Potentially modifiable
- Current cigarette smoking
- Low body weight (<58kg, 127lb)
- Estrogen deficiency
  - Early menopause (<45yrs) or bilateral ovariectomy
  - Prolonged premenstrual amenorrhea (>1year)
- Low calcium intake
- Alcoholism
- Impaired eye sight
- Recurrent falls
- Inadequate physical activity
- Poor health / frailty

Measurement of bone mass:

Several non invasive techniques are now available for estimating skeletal mass or density. These include Dual X ray

Absorptiometry(DEXA), Single Energy X-ray Absorptiometry(SEXA), Quantitative Computed Tomography (CT) and Ultrasound.

DEXA is highly accurate X-ray technique that has become the standard for measuring bone density. Though it can be used for measurements at any skeletal site, clinical determinations are usually made of the lumbar spine and hip.

Portable DEXA machines have been developed that measure the heel (calcaneus), forearm (radius and ulna) or fingers (phalanges). In the DEXA technique two X-ray energies are used to estimate the area of mineralised tissue and the mineral content is divided by the area, which partially corrects for body size. However, this correction is only partial since DEXA is a two dimensional scanning technique and cannot estimate the depth or posteroanterior width of the bone, thus small people tend to have lower than average bone mineral density.

Objectives of the study

This prospective randomised study attempts to evaluate the influence of a peripheral-DEXA (p-DEXA) heel bone mineral density (BMD) measurement in adults and a patient education program on osteoporosis. It also aims to study the effect of age, height, weight, menopause, physical activity, food habits on BMD. Men and women who were found to have heel BMD T-scores of < -0.6 (suggested by the World Health Organization) were considered osteopenic and <-1.6 was considered as osteoporotic. Year of menopause onset, pharmacotherapy for osteoporosis, calcium, vitamin D, presence of DM / HTN, other clinical disorders, steroid intake and physician intervention were assessed.

II. METHODOLOGY

Study Setting: This study is population based observational study conducted in Orthpaedics department, Kasturba Medical College, Attavar, and Tejaswini hospital, Mangalore. In this health camp apart from consultants there were nurses, nutritionists, pharmacists, health care professionals who worked in this programme providing patient care.

Subjects: We measured BMD in 173 individuals of both genders who came to health camp for BMD testing. Among them, there were 106 females and 67 males. Their age was ranging from 25 to 85 years.

Place : Orthopaedic Health Camp held in KMC Attavar and Tejaswini hospital , Mangalore.

Materials : Height & Weight measuring apparatus, BMD chart.

P-DEXA (PIXI machine made by the Lunar Corporation) for heel BMD testing.

Data collected: Data collected from patients include name, age, gender, height, weight, activity level, menopause, history of DM/HTN, smoking, alcohol, medications (steroids), joint problems, bone related complaints, thyroid disorders and any other risk factor for osteoporosis.

Procedure to measure BMD

The patient was made to sit on a chair and asked to place his or her ankle on the machine.After jelly was applied to ankle the probes were pressed gently upon ankle to measure BMD.The BMD value printed on machine was noted. This was plotted on BMD chart and calculated for T- score by plotting against age of the patient. According to the T-score, the diagnosis of osteoporosis, osteopenia were made.

Note:

The heel has a slower bone loss rate than other sites in the body, such as the hip, spine, or forearm. This means that the T-score used from other skeletal are as may underestimate BMD loss if the same standards are used to measure the heel. The World Health Organization (WHO) T-score for hip, spine, and forearm is defined as normal at greater than -1, low bone density (osteopenia) at a reading between -1 and -2.5, and osteoporosis at a T-score less than -2.5. The WHO equivalent for heel BMD includes >-0.6 for a normal T-score, -0.6 to -1.6 for osteopenia, and less than -1.6 for osteoporosis[1,2]. Men and women who were found to have heel BMD T-scores of <-.6 (suggested by the World Health Organization) were considered osteopenic and <-1.6 was considered as osteoporotic and > -0.6 were considered as norma

Table.1
Presence of Selected Risk Factors and Test Results Among Study Subjects

Risk Factors	Women	Men
Postmenopausal	41	-
Inactivity	7	-
Hysterectomy(ovariectomy)	7	-
Cigarette smoking	0	3
Alcohol use	1	4
Hypothyroidism	4	
Fractures	0	
Early menopause	3	-
Family history of osteoporosis	1	-
Joint disorders	9	6
Low body weight	10	6

Steroid therapy	3	-
Diabetes mellites type II	6	5
H/o bone related complaints	45	47
Total	137	71

Among total of 173 individuals (106 women and 67 men) Women had 137 risk factors and men had 71 risk factors.On average they reported one osteoporosis risk factor . Among them there are 39 people had no risk factors and 134 people had one or more risk factors. Among 134 individuals 65 people (50%) had one risk factor and 69 people(50%) had two risk factors

Positive screening Tests		
P-dexa Osteopenia	53(50%) women	39(50%) men
p-dexa Osteoporosis	24(25%) women	9(15%) men
n = 173		

Table. 2: Effect of menopause on BMD and T-score

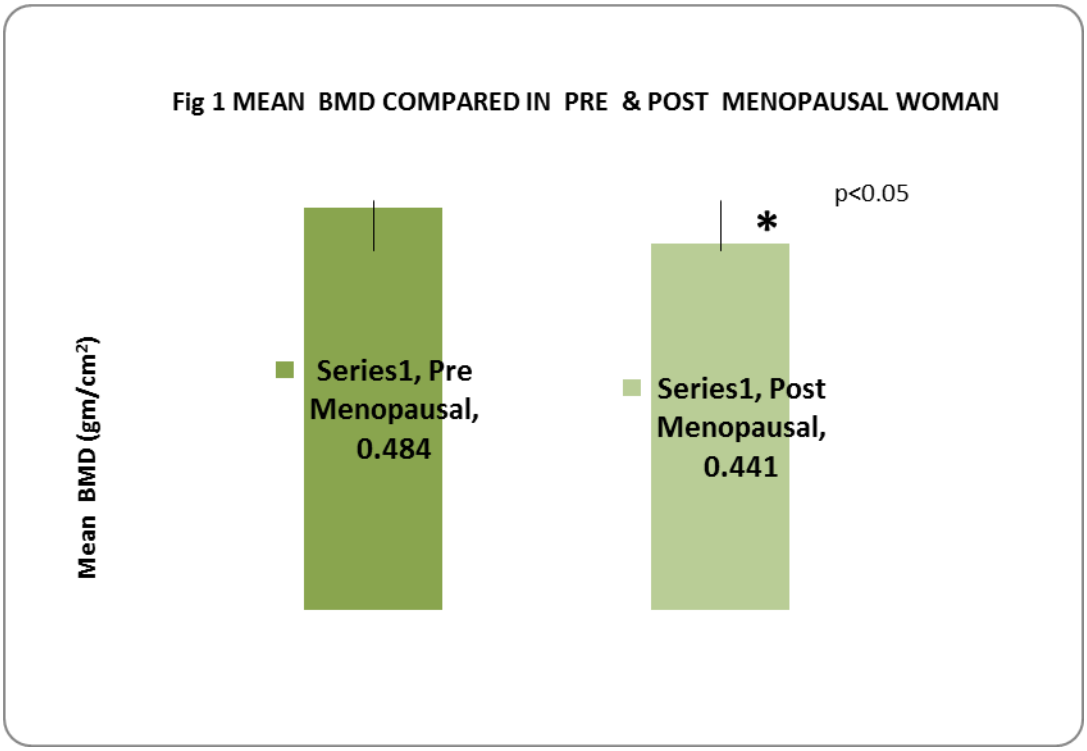
Variables	Groups		P value
	Premenopausal N_1=65	Postmenopausal N_2=41	
BMD (gm/cm^2)	0.48± .09	0.44 ± 0.1	0.027*
T-Score	-0.9 ± 0.86	-1.2± 0.83	0.06 (NS)

Values are expressed as Mean±SD (P Value <0.05 is considered statistically significant)

Among all(n=106)females, women who attained menopause(N_2=41), had mean BMD of 0.44 gm/cm^2 and women who didn't attain menopause (N_1=65) had mean BMD of 0.48gm/cm^2 (Fig 1). Post menopausal women had significantly lower BMD than pre menopausal women. P <0.05 (significant)

As shown in Fig 1, premenopausal women had mean T-score of -0.9 and post menopausal women had mean T- score of -1.2 proving increased risk of fractures in postmenopausal women but not statistically significant.

P value 0.061 (non significant)



III. DISCUSSION

In the present study, bone mineral density testing was done using peripheral (calcaneal) - DEXA scan to assess the strength of bones and the probability of fractures was assessed in persons at risk for osteoporosis using T- scores.

A study by Ravn et al (1994)[3] confirmed that low BMI constitutes a potential risk factor for osteoporosis. Sharon et al observed that BMD was closely associated with increasing quantities of each weight measures (total weight, BMI, lean mass, fat mass) and percentage of fat mass than with other body size measures (waist hip ratio, height). Similarly our study showed that obese women with high BMI are at lesser risk for osteoporosis as compared to lean women

Aoki T T et al (2000)[4], in his study on 625 postmenopausal women showed that incidence of osteoporosis increases from 15.5% in women less than 50 years of age to 59.6% in those older than 69 years of age. Similar results were obtained in our studies as there is significant reduction in BMD in post menopausal women when compared to premenopausal women and hence significant increase in fracture risk in them.

B. Lawrence et al (1986)[5] concluded that the rapid phase of bone loss in early postmenopausal women was caused mainly by loss of direct restraining effects of estrogen on bone cell activity, whereas the slow phases in late postmenopausal women and in aging men were mainly caused by loss of the calcium-retaining effects of estrogen on the gut and the kidney.

Prominslow J H et al (2002)[6] observed a positive relation between high animal protein intake and increase in BMD. In our study people having mixed diet have more BMD compared to vegetarians. Understanding that osteoporosis varies in various ethnic population, our data and that obtained by other Indian investigators (Pande KC, Johansen K B et al 2001)[7] revealed that Indian women have 5-15% lower bone mass compared to Caucasians. Such a variation also occurs among Asian women residing in America (Reddy PG, and Mithal et al (2002)[8]. Studies in different ethnic populations reveal that individual population should use their own reference range T-scores to avoid misdiagnoses of osteoporosis and osteopenia by DEXA.

Earlier studies done by using DEXA had predicted that one in every eight men and one in every two women over age 50 years will have osteoporosis related fractures in his or her life time (Brunner L. C and Eshillion Ostes et al 2003)[9], which means women are 4 times at risk for fracture compared to men after 50 years of age. According to our studies one in every six men and one in three women had osteoporosis related risk of fractures. Shah Rashmi, Savardekar et al (2004)[10] have shown that type I osteoporosis which occurs typically between 55-75 years of age and affects women more than men ratio being 6:1. In our study this ratio has reduced to 2:1 which can be attributed to prophylactic use of calcium and vit D tablets and increased health awareness in women of this particular georaphical area.

Earlier studies have concluded that normally bone mineral density is 10-15% lesser in females when compared with males of similar age groups (Pacifici R et al 1987)[11]. According to our study there is 2-4% decrease in bone mineral density in females when compared with BMD of males of same age group.

IV. CONCLUSIONS

In summary, low BMD and low T- Score has been demonstrated in our study as an important predictor of future fracture risk both in men and women. Osteopenia patients can be treated prophylactically to prevent osteoporosis in future. We have also evaluated from this study the potential clinical risk

factors related to osteoporosis. We have witnessed the role of heel bone density scanners in identification of high risk individuals. This study also demonstrates the utility of p-DEXA in screening for osteopenia and osteoporosis due to its cost effectiveness, low X-ray dose, immediate results and no clothing restrictions. Other data support the accuracy and precision of this peripheral-DEXA machine.

Significant reduction in BMD was observed in elderly and in post menopausal women. In hysterectomised women, there was reduction in BMD but not statistically significant. BMD was more in men compared to women, also in individuals having more than 50 kg weight, in exercising people and in nonvegetarians. Patients having bone related comlaints like body ache, weakness, leg pain had less BMD.

Thus, identification of people at risk of osteoporosis by population based screening programmes and implementation of preventive strategies are the measures to improve health related quality of life and reduce the personal and economic burden of osteoporosis.

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