Research Paper

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Effect of Body Weight on Bone Mineral Density- A Population Based Study Using p-Dexa Technique

Physical Education

KEYWORDS : Peripheral - dexa, calcaneus, bone mineral density

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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. 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 mineralized tissue and the mineral content is divided by the area, which partially corrects for body size. Results: The results are expressed as Mean ± SEM (Standard Error of Mean) using bar diagrams. Predictive value of ≤ 0.05 is considered to be statistically significant. The Bone Mineral Density is in linear correlation with Body Weight.

INTRODUCTION

Magnitude of the Problem: 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.

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. One of the major modifiable risk factor associated with generalized osteoporosis is Low body weight (<58kg, 127lb) [3]

Measurement of bone mass:

Several noninvasive 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 mineralized tissue and the mineral content is divided by the area, which partially corrects for body size.

METHODOLOGY

This prospective randomized 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 body weight 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.

Study Setting: This study is population based observational study conducted in Orthpaedics department, Kasturba Medical College, Attavar, and Tejaswini hospital, Mangalore.

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.

Materials : Weight measuring apparatus, BMD chart. P-DEXA (PIXI machine made by the Lunar Corporation) for heel BMD testing.

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 normal.

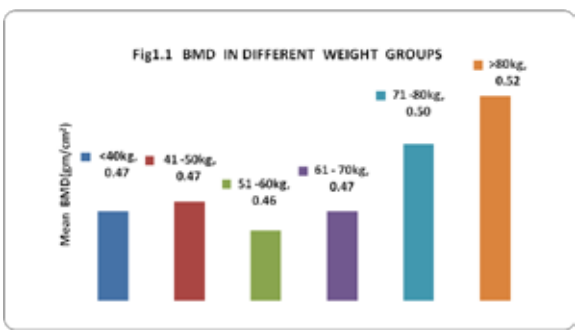
RESULTS:

Table 1: Effect of Body Weight on BMD and T-Scores

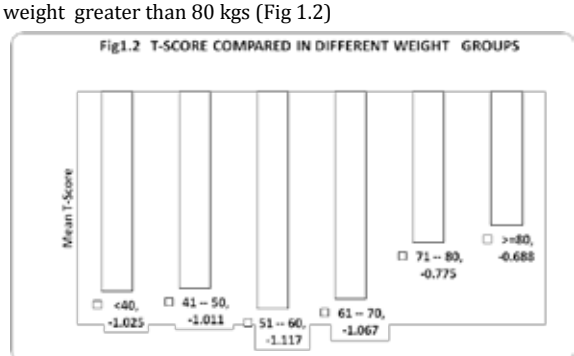
Variables	Groups						P value
	<40kg N_1=4	41-50kg N_2=37	51-60kg N_3=64	61-70kg N_4=43	71-80kg N_5=16	>80kg N_6=8	
BMD (gm/cm^2)	0.47±0.05	0.47±0.1	0.46±0.08	0.47±0.1	0.5±0.1	0.52±0.09	NS
T-Score	-1.0± 0.38	-1.0± .9	-1.1± .83	-1.1± .8	-0.6± .8	-0.67± 0.7	NS

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

Study subjects weighing from minimum of 35 kgs to maximum of 93.5 kgs were divided in six subgroups. In the first two subgroups BMD values were constant (0.47 gm/cm^2). From the third group a gradual increase in BMD from 0.46gm/cm^2 to 0.52 gm/ cm^2 (Fig 1.1)



Mean T- scores was found to increase from -1.1 in subjects with body weight 51 – 60kgs to -0.67 in subjects with body weight greater than 80 kgs (Fig 1.2)



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.

It was previously believed that obesity and osteoporosis were two unrelated diseases, but recent studies have shown that both diseases share several common genetic and environmental factors. Body fat mass, a component of body weight, is one of the most important indices of obesity, and a substantial body of evidence indicates that fat mass may have beneficial effects on bone. The common precursor stem cell that leads to the differentiation of both adipocytes and osteoblasts, as well the secretion of adipocyte - derived hormones that affect bone development, may partially explain these associations.[4]

A study by Ravn et al (1994**)** [5]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 individuals with bodyweight of more than 60kg are at lesser risk for osteoporosis as compared to lean individuals.

Similar effects were shown by Fujiwara et al (1998) [6] and Caranza Lira et al (2002) [7]. Their results showed that with increasing age, the BMD decreases. Their studies have also shown that high body mass index (BMI) had a positive effect on the bone density of the lumbar spine. Even in our studies weight has positive correlation with BMD as shown in fig1.1.

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 factor (low body weight) 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.

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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