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Bone Mineral Density in 10 to75 Year-Old Iranian Healthy Women: Population Base Study

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Abstract

Osteoporosis is a major public health problem in Iran. Bone densitometry is used to diagnose osteopenia and osteoporosis and if necessary, prevent bone fractures, especially that of femoral neck. Bone density is related to several factors including race, age, sex, environmental factors and nutrition. No comprehensive study has been performed in Iran, yet. Among the 10 to 75 year-old population living in Tehran, after excluding those who suffered from conditions affecting bone metabolism, 600 people were randomly selected from 50 clusters. All participants underwent a clinical examination and lumbar and spinal densitometry using DXA method. Prevalence of osteoporosis and osteopenia in women older than 50, was 28.1% and 53.3%, respectively. Prevalence of osteopenia and osteoporosis was higher in our study population. Peak bone density in the 25-35 -year-old population could be useful in policy-making for prevention and treatment of osteoporosis.

Keyword: *BMD, Peak bone mass, Osteoporosis, Osteopenia*

Introduction

Adults' bone density depends on both peak bone mineral density obtained during the evolution in youth, and the gradual reduction of bone density in older ages. Many factors influence bone mass including race, age, sex, endocrine hormones, calcium intake, sunlight exposure and physical activity (1-3). After the bone density reaches its peak, it remains unchanged for years, and then, reduces. In women, this bone mass reduction starts before menopause, and in men, it starts in their thirties to fifties (2, 3).

When menopause starts, bone density reduction increases rapidly. Furthermore, in the first 5-10 years of menopause, trabecular bone and cortical bone are lost by 25-30% and 10-15%, respectively (1, 2). In general, women lose 35-50% of bone mass during life, depending on the bone region (4, 5). Some studies show that 1 out of every 6 white women suffers pelvic fracture in her life; and in older ages, 1 out of every 3 white women and 1 out of every 6 men suffers pelvic fracture (6).

Osteoporosis has been defined as a disease characterized by low bone mass and micro-architectural deterioration of bone tissue, which leads to enhanced bone fragility and increased fracture risk (7). Practically, osteoporosis is defined as a bone density reduction at more than 2.5 (BMD) below the average bone mass (*T*-score≤-2.5) in young healthy sex-and race-matched adults (7-9). Osteoporosis prevalence in white women aged over 30 is estimated to be 30%. Bone mineral density in Asian and Caucasian people is reported to be lower than in other people, because they have smaller bodies than others. Prevalence of fracture and

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osteoporosis increases with the increase in life expectancy and in the number of older people. It has been estimated by WHO that 530 million people of the Asian population will be over 65 by the year 2050, and this rise in population, as well as such risk factors as, low calcium intake and low physical activity make osteoporosis one of the most important health problems in these countries (10).Osteoporosis is usually asymptomatic, unless it causes fractures. Fractures are usually shown to occur in vertebra, wrist, hip and rib (7). Hip fracture is of the most important fractures resulting from osteoporosis, 20% of which would lead to mortality within the first year, and 50% would never regain their pre-fracture abilities (8). Hip fractures greatly affect the quality and manner of performance of the affected person (10). The annual cost of health care and reduction of production power due to osteoporosis has been estimated to be over $ 13 billion in the U.S.(10-12).The direct cost of osteoporosis fractures was estimated to be about $ 13.8 billion in 1995, while it was annually 5-6 $ billion in the past 10 years (11,12).

In a comprehensive study performed on Tehran healthy residents in EMRC, the bone density was measured in the age group of 10 to75 year-olds in order to obtain the reference values for determination of bone density and natural pattern variation thereof.

Materials and Methods

The subjects consisted of women of 10-75 y of age from Tehran, capital of Iran, except for those who were affected by rheumatoid arthritis, hyper thyroids, hypo thyroids, hyper parathyroid, hypo parathyroid, hyper adrenalin and hypo adrenalin, diabetes mellitus, renal insufficiency, severe hepatic insufficiency, and any type of cancer.

The following cases have led to the exclusion of people from the study:

Menstrual disorders including the start of menstrual period after the age of 18, permanent menopause or menopause in the last three months for persons younger than 40;

Less than 5 months of menstruation in last year for a woman below the age of 40;

Uphorectomy below the age of menstruation, infertility and pregnancy, or lactation during the period of study;

Smoking more than 10 cigarettes a day, and drinking more than one glass a day of alcohol for more than 5 y;

Drug addiction;

Doing exercises in a professional manner;

Lumbar spine fracture, fracture due to simply falling down on the ground, spine deformity, and having been hospitalized for the last two weeks due to a disease;

And complete bed rest for 3 consecutive months.

Sampling was performed in a random manner in the metropolitan city of Tehran. Samples distribution was selected in equal age decades at the recalling stage, letters of invitation were delivered to the intended people, and the volunteers got together at the BMD unit in EMRC in Shariati hospital. After receiving the testimonials, questionnaires were completed and physical exams including weight and height measurement, bone deformity, muscular tenderness, and spine deformity were done. Any one who had one of such disorders was excluded. In case a man had used radioactive material or radio pact substance, or a drug containing calcium during 5 d before the interview, BMD was postponed to 5 d later.

BMD was measured through DXA method by (lunar) densitometer. This machine was regularly checked by daily standard and a phantom specialized for control and direction of measurement. In order to measure the BMD, the related scanner first evaluated the area of lumbar vertebrae (2^{nd} to 4^{th}) from the front to the rear, and the beginning part of the thigh bone (neck, trocanter, ward and total femoral area) and then, the density values were obtained in scale of gr/cm2.

Questionnaires were filled for each of the samples, including general identification, past disease history, drug use, physical activity, and duration of sun exposure.

There was also a nutrition questionnaire for estimating calcium and vitamin D intake (in which, foods containing calcium and vitamin D, manner of their use in a week and a month, and the amount used in each meal, were questioned).

All information was saved on a data bank of SPSS program (11.5 versions), and then the statistical analysis was performed. *T*-test and variance analyses were used to compare the mean values obtained in groups. K2 test was used for comparing the frequency of each factor in groups, and linear and logistic regressions were used to evaluate the relationship between the variables of study. Differences with a *P* value less than 0.05 were considered as significant.

In order to evaluate the bone mass disorders, the B.M variation curve was first drawn at the hip and vertebral column areas. Then, the maximum amount of bone mineral density was estimated in age reach limit to this PBC.

T-score of density variation was calculated by dividing the different of amount measured from the reference amounts obtained, by the standard deviation of variation of bone density for each individual. *T* score≤-2.5 was considered as osteoporosis, -2.5< *T* score<-1 as osteopenia, and *T* score> -1 as normal.

Results

A total of 600 women aged between 10 and 76 years, participated in this study. In the variance analysis, the calcium average intake among the different age groups did not show a significant difference, while a significant difference was seen in vitamin D intake, which reduced as the age increased ($P<0.01$). Lumbar bone density reaches peak bone mass in the age of 25-35, and then, the bone mass reduction gradually starts at the age of 40, and a rapid reduction of bone density is observed until the age of 55y. After the age of 55y, speed of bone density reduction decreases (Fig. 1). Hip density at the age of 30-35 reaches its maximum and then, the bone mass reduction speed increases after the age of 45 (Fig. 2). Lumbar and hip peak bone densities were 1.19±0.12 and 1.02±0.12 gr/cm^2, respectively.

Based on the reference amount, 28.1% and 53.3% of women older than 50 y suffered from osteoporosis and osteopenia, respectively. Lumbar spine and hip bone mineral density had a significant relationship with age and BMI on linear regression model ($P<0.01$).

Between the ages of 65 and 75, the bone mass density shows a 24.53% reduction at the lumbar spine, and a 20.35% reduction at the hip area, compared to younger ages.

No significant difference was seen in BMD of those who had a calcium intake more or less than 1gram per day ($P=0.5$), and those who had a vit D intake more or less than 100 units per day in lumbar spine and pelvic.

Also, the difference between the amount of vitamin D and calcium in osteporotic and non-osteporotic women was not significant. In evaluating the relationship between osteoporosis and its risk factors in women aged over 50; such as, cigar smoking, alcohol use, and physical activity, vitamin D and calcium intake in osteporotic and non osteporotic women didn't show a significant difference.

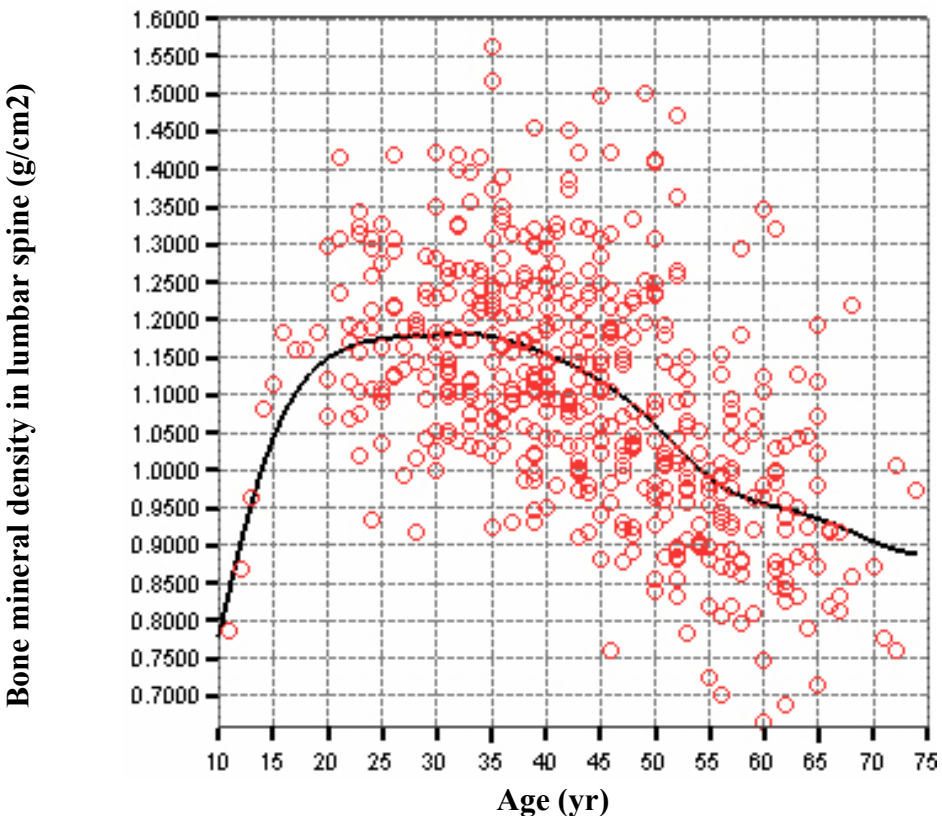

Fig. 1: Bone mineral density in lumbar region according to the age.

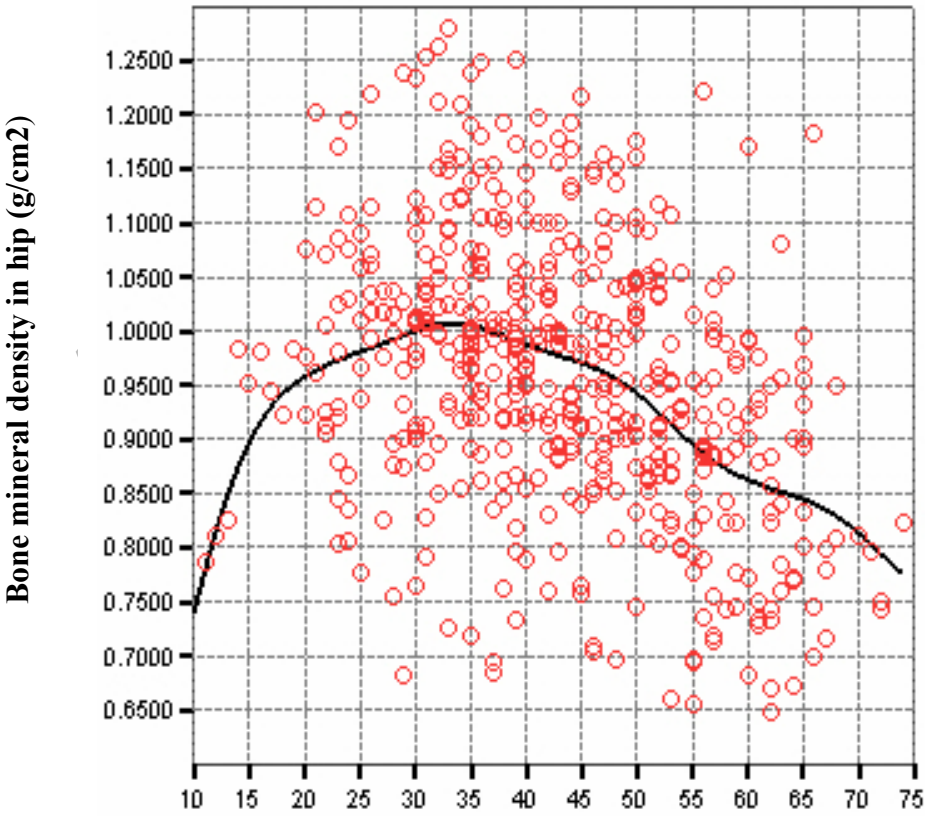

Table1: char

Fig. 2: Bone mineral density in hip region according to the age

Age	38.93 ± 15.26 year
BMI (Body Mass Index)	26.55 ± 5.78 kg/m2
Housewife	67.4%
Frequency of smokers	5%
Frequency of Alcohol users	0.8%
Physical activity (2-3 times/ week)	6.8%
Direct sun exposure (below 45 minutes)	64.7%
Direct sun exposure (below 30 minutes)	40.7%
Direct sun exposure (below 15 minutes)	12.3%
Calcium average intake (daily)	604.86± 352.64 mg
Vitamin D average intake (daily)	55.58± 53.64 unit

Table 2: BMD reduction in different age groups

Age groups (years) / **BMD Reduction (percent)**	35-45	45-55	55-65	65-75
Lumbar spine bone mineral density reduction in relation to the previous age group	2.7	9.6	8.64	6.4
Hip bone mineral density reduction in relation to the previous age group	2.96	4.46	7.8	5.89

Discussion

Prevalence of osteoporosis is reported to be about 13%-38% among white women aged over 50 in different studies, which confirms the results of this study. Bone mineral density in Asians and Caucasians has been reported to be lower than other races that are because of their smaller bodies. Bone mineral density in participants of this study was 3.9% higher than that of Japanese women, but 1.9%-2.8% lower than Belgian, English, and French women (13, 14). In case of femoral bone, although the peak bone mass in our study was higher than Canadian women, but it was 4.48% lower than that of the American women (15). Bone density loss in both femoral and lumbar areas depends on age. The BMD loss speed in Iranian women is similar to Canadian, English, and American women till menopause, but it is similar to that of Canadian, and to some extent, Tiavanian and Honcongian women after menopause (15-17). When menopause starts, BMD reduction speed increases several times, so that in the first 5-10 years after menopause, women lose 25-30% trabecular, and 10-15% cortical bone (18, 19). On the whole, women lose 35%-50% of their bone mass throughout life, which depends on the bone location (20, 21). These reports are in accord with our study results. This study shows that the peak of femoral bone density is later than vertebral column because peak of cortical bone density is later than trabecular bone density (22-24).

On the whole, although PBM acquired in this study is upper than some other populations, it is lower than that obtained in many studies performed on all age groups of women. On the other hand, the B.M loss speed is equal or even more than the results of these studies (13, 17). Thus, this has led to an increase in osteoporosis and osteopenia prevalence. Investigations show that P.B.M has a determinative role on osteoporosis prevalence, and depends, itself, on genetics, nutrition pattern, physical activity, and hormones. Genetics is a major factor that justifies the low bone mass in our study. Also, calcium and vitamin D intake are lower than the recommended limit. Calcium is a main element in bone metabolism; insufficient intake or malabsorbsion of which would lead to osteoporosis. Investigations show that insufficient intake of calcium is a major risk factor for osteoporosis (25).

Also, deficiency of this vitamin in Iran (about 80% in some areas), and insufficient physical activity, especially among young girls, can be the cause of low bone density in the ages of 20-39. A significant relationship was seen between BMI and BMD, which is in agreement with other studies (26). This study showed an increased osteoporosis and osteopenia prevalence among the subjects in Tehran. Low PBM between the ages of 20 and 39 helps to determine a good strategy in this regard. Many factors influence PBM, including genetics, physical activity, sufficient calcium and vitamin D intake. Sufficient nutrition pattern containing calcium and vitamin D is a factor, among others, that can influence PBM. In this regard, EMRC has designed and executed a project in the field of enrichment of foods with vitamin D. Results of this study also showed rapid BMD reduction in the first ten years after menopause, which put an emphasis on practicing proper treatments in pre- and post menopause ages.

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