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BONE DENSITOMETRY OF MENOPAUSAL WOMEN IN TEHRAN

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ABSTRACT

Using a cluster sampling method, a group of menopausal women from three geographic areas in Tehran were asked to participate in the study. Demographic data was obtained using a questionnaire. Subjects were than referred to perform bone mass densitometry (BMD). The relationship between various variables (i.e. age of menarche, number of years of endogenous estrogen exposure,...) with mineral density of the lumbar spine and femur were sought. Results showed that the incidence of bone loss during menopause was high among these women. Earlier age of menarche and longer reproductive years, higher BMI, previous usage of OCP and HRT are likely to increase BM. Being active at home and doing household chores can greatly influence the BMD of the femur. Poor dietary calcium intake may be the main reason for low BMD among the studied subjects.
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INTRODUCTION

Life expectancy has increased dramatically in developing countries such as Iran. Menopause as a relatively recent phenomenon for women brought about new challenges for health care providers. Early and late complications of menopause arising after the reproductive years can greatly affect a woman's quality of life. A study has shown that the BMD of the lumbar spine and femoral neck in Iranians are lower compared to the international standards in all age groups and in both sexes.[1] Menopause as one of the most accelerating factors of bone loss in women adds to the problem. While there are no menopausal clinics to take care of these women's needs, study of the basic information seemed to be a necessity. This information can then be used by policy makers to provide better health for this group of women.

MATERIALS AND METHODS

Tehran was divided into 3 different geographic areas, each of which were handled by one major university including Tehran, Shahid Beheshti and Iran Universities. The estimated number of menopausal women in Tehran was obtained from a National Reproductive History Study, 1998. Sample size was calculated considering the probable incidence of menopausal complications from similar studies in other developing countries. Addresses were randomly drawn from the population register (from the Ministry of Health in Tehran). Subjects were visited at their home address. Jones' standard questionnaire[2] was filled out by face to face interview. Demographic data including age, age of menarche, age of menopause,... were asked. Other information obtained was as follows: HRT and OCP usage, history of any diseases, drug usage, dietary calcium intake, exercise, housework activity, smoking habit, fracture history, stroke history, medical history, medication usage and the age of menopause for other first class family members. In this undergoing study, so far 150 subjects have been interviewed. Subjects were given an invitation letter to refer for BMD measurement. An appointment was fixed for each subject. The subject was reminded by phone calls twice if she had not attended the BMD clinic.

Overall 98 subjects attended the BMD clinic. Their height and weight was measured and their Body Mass Index (BMD)

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calculated. All of the women were clearly informed about the screening process. A copy of the reports was sent for subjects to their home addresses. Each BMD study in Iran costs arc 200000 Rials, equal to about 114.28 US $ (governmental currency) and is considered an expensive test with no insurance coverage. For participants in this study, BMD was performed free of charge. Financial support was provided by the Ministry of Health, Deputy Ministry of Research Affairs, National Research Center for Reproductive Health.

BMD was measured by dual energy X-ray absorptiometry (DXEA, LUNAR DPX-IQ) on L1-L4 (lumbar spine) and the femoral neck (neck and total). A computerized curve for each site was drawn. Then the results were compared with the international normal standards. Based on the reading of Bone Mineral Content (BMC), a BMD value was calculated using an estimate of the cross-sectional area obtained by extrapolation from the measured width. Machine-specific units were converted to grams per square centimeter by multiplying with an appropriate constant.[3] Precision was checked using a ^{153}Gd radionuclide source on a phantom stimulating a spine or femur. Measurement with the DPX system was repeated on a spine phantom and a femur phantom to assess precision. The standard deviation (SD) was about 0.01g/cm^2 for L2-L4 (BMD= 1g/cm^2). The precision error for femur was about 0.015g/cm^2 for the neck region, or about 1.5% at a typical density of 1g/cm^2. The internal variation was checked regularly by an everyday calibration routine using a phantom.

General exclusion criteria were disease, drugs and other major determinants known to affect bone metabolism.[4-6] Thus we exclude subjects with gastrectomy, intestinal resection, recent hyperthyroidism or hyperparathyroidism and treatment with corticosteroids. Those who were using estrogens earlier during at least 2 years after menopause or who were taking estrogens for more than 6 months were also excluded from the study.

Inclusion criteria was as follows: those who reported cessation of menstruation for at least 1 year prior to study, without any medical reason, were classified as naturally menopausal (the mean age of the participants shows that many of the subjects had passed menopause about a decade ago and thus, the period for bone loss to be detected would seem sufficient). Those who indicated cessation of menstruation due to hysterectomy, with or without oophorectomy, were considered surgically menopausal (n=8) and were excluded from the final study group.

Statistical methods

Descriptive data was obtained using SPSS and STATA softwares. The variance of the material was checked for outliers, polymodality, excessive kurtosis and skewness. Multiple regression and logistic regression have been used for investigating the relation between dependent and independent variables. Probability of entering an independent variable in logistic regression model was pr= 0.15 and for removing a variable was pr=0.2. Entering and removing probability for multiple regression model were 0.05 and 0.1 respectively.

RESULTS

The mean age of all the participants was 59.48(±7.85). The mean value for the age of menarche and menopause were 13.40(±1.47) years and 48.44(±5.11) years respectively. Basic characteristics of subjects included in the study are given in Table I. As it is shown, height decreases with aging, whereas weight increases. However, these variations were not found to be significant. A reduction in weight is seen among the 4th group (age >70 years) which has had an effect on BMI too. Table II suggests that the level of femoral and lumbar bone mass has decreased dramatically by age.

Table I. Basic characteristics of the sample (mean±SD) according to their age group (n= 90).

Age group	Mean age (±SD)	Mean height (±SD)	Mean weight (±SD)	Mean BMI (±SD)
40-49	46.40 (±2.07)	158.40 (±6.58)	60.40 (±4.56)	24.25 (±3.50)
50-59	54.25 (±2.50)	157.33 (±6.03)	66.67 (±9.09)	26.97 (±3.62)
60-69	64.13 (±2.94)	155.33 (±4.77)	73.38 (±12.31)	29.28 (±4.89)
≥70	73.22 (±5.33)	154.11 (±4.76)	66.89 (±10.19)	28.09 (±3.34)

Table II. Mean, maximum and minimum of BMD for the femur and lumbar areas in 90 postmenopausal subjects.

Age group	Femoral BMD			Lumbar BMD		
	Mean	Max	Min	Mean	Max	Min
40-49	0.939	1.063	0.791	1.044	1.154	0.828
50-59	0.923	1.22	0.689	1.01	1.307	0.738
60-69	0.877	1.102	0.760	0.994	1.223	0.832
>70	0.801	1.082	0.653	0.883	1.006	0.776

A decrease in BMD of the femur was shown by a higher reproductive period (Table III). Past OCP and HRT users had a higher level of bone mass in both the spine and femur. Breast-feeding practice showed a decline in BMD of femoral and spine sites, but this difference was found to be significant only for the femoral site. Calcium intake more than 600 mg/day significantly increased the level of bone mass.

Multiple regression analysis showed that from various variables included in the model (exercise, housework, age of menarche and menopause, breast feeding practice, use of OCP and dietary calcium intake), earlier age of menarche and not exercising were found to be important in determining the lumbar spine BMD (Table IV). Final regression model was as follows:

Table III. Distribution of categorical variables in 90 postmenopausal women according to mineral density of the spine and femur.

Categorical variables	Bone Mineral Density	
	Spine (SD)	Femur (SD)
Reproductive period (Year)*		
<30	0.980 (0.10)**	0.915 (0.11)
30-39	0.991 (0.14)**	0.908 (0.13)
≥40	1.047 (0.14)**	0.892 (0.11)
Timing of menopause		
Early (age<49 years)	1.01 (0.13)	0.901 (0.11)
Late (age>49 years)	0.983 (0.14)	0.902 (0.13)
History of oral contraceptive use		
Present	1.01 (0.15)**	0.911 (0.14)**
Absent	0.988 (0.13)	0.892 (0.106)
History of HRT use		
Present	1.039 (0.14)**	0.925 (0.11)**
Absent	0.977 (0.13)	0.887 (0.12)
Breast feeding practice		
Present	0.987 (0.15)	0.894 (0.10)**
Absent	0.998 (0.14)	0.901 (0.12)
Smoking habits		
Smoker	0.984 (0.15)	0.899 (0.12)
Never smoked	0.996 (0.14)	0.895 (0.15)
Calcium intake (mg/day)		
Low <66	0.989 (0.15)**	0.891 (0.13)**
High ≥ 600	1.03 (0.15)	0.926 (0.11)

*Age at menopause minus age at menarche.
**$p<0.01$

Table IV. Multiple regression analysis for finding the interaction between lumbar BMD and various variables. Only exercise and age of menarche were fitted in the model.

	B	SEB	Beta	T	P value
No Exercise	-0.67	0.31	0.24	2.21	0.03
Menarche	-0.26	0.01	0.27	2.48	0.01
Constant	0.375	0.14		2.61	0.01

$Lumbar_{BMD}$ = 0.38-0.068 no exercise -0.027 menarche

The same procedure was repeated for finding the relation between femoral BMD and defined variables. It was shown that higher calcium intake, history of OCP usage, earlier age of menarche, less activity at home and an increase in BMI may influence the femoral BMD. The final formula is as follows:

Femoral BMD= 0.55-0.11 no housework +0.32 BMI-0.2 menarche -0.9 no OCP+1.92 dietary calcium.

Backward stepwise logistic regression analysis also showed that the risk of occurrence of complications is 8 times greater in those who don't exercise in comparison with those who do even for less than 1 year (Table V). Also, using a higher amount of daily calcium may decrease the score of early complications at least by a factor of 2. Breast feeding may increase the risk of having complications by 7.9 times.

Complications= 1.49 -0.002 total calcium/day -2.079 exercise -2.79 breast feeding

DISCUSSION

This study investigated the incidence of bone loss among

Table V. Backward stepwise logistic regression showing the effect of some variables on complications.

Complications	Coef.	Std. Error	Z	P value
Use of dietary calcium/day	-0.002	0.001	-1.726	0.084
No exercise	-2.079	0.709	-2.934	0.003
Breast-feeding	-2.079	1.147	-1.813	0.070
Constant	1.49	0.761	1.959	0.050

menopausal women in Tehran. The relations of several factors to BMD were also examined. Generally there have been few studies in Iran on BMD measurement and menopausal complications. An available study has compared the BMD of different age groups of both men and women. The results show that BMD values for the lumbar spine and femoral neck in Iranians were lower compared to international standards. The mean difference was 25% among postmenopausal women. This very fact required planning a standard guideline especially for Iranian ladies. Therefore, all the measured values were standardized according to the normal population density and was reported separately as the percentage of Iranian young adults, and the Lunar standard.

Furthermore, the relation between several variables with BMD was investigated, from which earlier age of menarche was found to be important. It is known that the menopausal period is a time of rapid fracture risk.[7,8] Pregnancy and lactation may also result in increased calcium loss. Estrogen and progesterone enhance calcium absorption and restore body calcium. Thus, it is likely that a longer reproductive period, whether an early menarche, late menopause or both can increase exposure to endogenous estrogen which may in turn result in increased protection from calcium loss. Also, exogenous estrogen may have an influence on the content of the bone.

This study showed that a longer period of reproductive years was positively linked to an increased BMD. The early menarche was fitted in the regression model as an independent variable which determined both lumbar and femoral BMD.

This observation is similar to other published studies.[9-11] This study also suggests that past OCP and HRT usage can significantly increase BMD and can act as a protective factor for BMD. Altogether, it is concluded that increased exposure to estrogen can reduce BMD loss, hence reducing the incidence of fractures in postmenopausal women. BMI was also introduced in the regression model and found to have a positive effect on BMD. This is probably because of higher available estrogen levels in women with a higher BMI which correlates with a higher BMD.[12,13]

The effect of exercise on menopausal complications has been discussed previously.[14] Backward stepwise logistic regression model showed that the influence of exercise is such that it can decrease the level of complications 8 fold.

Daily calcium intake for menopausal women should be around 1200-1400 mg/day. Daily calcium usage calculated by consumption of milk, yoghurt and cheese was greatly below the expected and required intake (mean 432.5±190.33SD). This may be one of the main reasons for a lower BMD in postmenopausal women. Exercise and calcium intake were the two important contributors to the variance in lumbar BMD. Femoral BMD on the other hand was dependent on several variables including activity at home which seemed to be more important than other entered variables. Advising all postmenopausal women to exercise may not be practical for some women. Thus, it seems reasonable to rely on the effect of doing daily housework instead.

CONCLUSION

The incidence of bone loss among menopausal women was found to be high. Earlier age of menarche and longer reproductive years, higher BMI, previous usage of OCP and HRT are likely to increase the endogenous and exogenous exposure of estrogens to femoral and lumbar bones. Being active at home and doing housework can greatly influence the BMD of the femur. The fact that most Iranian women breast-feed their babies and have poor dietary calcium intake may be the main reasons for the low BMD of Iranian women. It is concluded that there is a great need for planning a careful health policy for this group of women. It is suggested that every health center (public or private) should establish a menopausal clinic which can take care of menopausal women, educate them and provide them with dietary and health guidelines to follow.

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