

## Bone Mineral Density value among Postmenopausal Women and it's correlation with body mass index in Sulaimani Governorate

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### Abstract:

**Background:** Osteoporosis is a multifactorial skeletal disease that is characterized by reduced bone mineral density (BMD). BMD values depend on several factors such as age, age at menopause & duration of menopause.

**Aim:** The present study is conducted to assess bone mineral density measured by DEXA scan among post -menopausal women in Sulaimani governorate and to assess the association between BMI with status of BMD. **Method:** This study selected 390 postmenopausal women, from 1500 after exclusion of those at risk of secondary osteoporosis. The data gathered was age, age at menopause, duration of menopause, height and weight for body mass index (BMI) calculation. Bone mineral density measurements were carried out using Lunar iDXA, Encore 14, model 2008. The data were analyzed using SPSS package.

**Results:** Among the 390 post-menopausal women 39% has osteoporosis, 45% osteopenia which is much more than the neighboring regions. There was a significant negative association of BMD with age, duration of menopause, and low BMI with BMD both in spine (L1-L4) & dual femur region. BMD value was higher among overweight and obese than the normal weight participants.

**Conclusion:** postmenopausal women in our region suffer from osteoporosis and osteopenia higher than those from other neighboring country, also that duration of menopause, aging and lower BMI are important risk factors for the occurrence of low BMD.

**Keywords:** Bone Mineral Density; Body Mass Index; Age; Menopause; osteoporosis; sulaimani.

### I. Introduction:

Osteoporosis is a public health problem worldwide and is a common disease in the older population, especially in the postmenopausal women [1]. It's a multifactorial & systemic disease characterized by reduced bone mineral density (BMD) along with deterioration of the micro-architectural structure of bone tissue, and consequent increase in bone fragility and fracture risk. Osteoporotic fractures affect the quality of life and are associated with premature mortality [2]. The disease is classified clinically to be either primary or secondary osteoporosis.

Primary osteoporosis, refers to both bone loss occurring in post-menopausal women and bone loss owing to the normal ageing process. Secondary osteoporosis refers to bone loss that ensues as a secondary effect of other diseases or drug treatment [3]

Menopause is commonly associated with rapid bone loss, beginning 2–3 years before and continuing for up to 3–4 years after menopause [4].

Bone mineral density (BMD) is a quantitative measure of bone mass and represents the total mineral in a selected volume of bone in the hip or in the spine [3]. BMD is an important clinical measure of bone strength and health; Dual-energy X-ray absorptiometry (DXA) is a widely used technique to assess bone mineral density (BMD) at different skeletal sites and therefore suitable to stratify individuals with low bone mass who are at risk of osteoporosis and associated fractures [5].

Several studies have shown that in addition to the risk factors such as aging, lack of physical activity, smoking, premature menopause, family history, poor diet and low intake of calcium and vitamin D; other factors, including body weight and Body mass index (BMI) are also important in the risk assessment tools, which contribute to osteoporosis and osteoporotic fracture risk<sup>1</sup>. Low BMI and low weight are also interrelated with the occurrence of osteoporosis [2], and Low BMI is regarded as a good indicator for referral of women less than 60 years for measurements of BMD [5,7,8]. Daily calcium requirement might increase with increasing age due to age related reduction in renal tubular and intestinal absorption of calcium [7].

A number of studies have been done in the countries of the Middle East; the prevalence of osteoporosis in Lebanon is estimated to be 31% among women according to WHO criteria. In Kuwaiti women it was about 18%. In Jordan 13% of the females above 40 years of age were osteoporotic. In Saudi Arabia, the prevalence of osteoporosis among the Saudi population was estimated in the range 35%–48%. In another study it was as the following: over 31 years was 0%–7%, whereas it was about 28% among women over 50 years [9].

Measurement of body mass index is an inexpensive and valuable technique to guide public health policy, clinical decisions, and evaluation of nutritional status. Considering the exponential rise in the number of fractures and risk factors of bone mass loss among older adults, early diagnosis and identification of the factors associated with bone loss and its complications could be effective in the management of disease and therapeutic decisions of those with risk factors of low BMD [1]. Quantifying the association between BMI and bone health status and its relationship with BMD enables physicians to provide postmenopausal women with proper advice on lifestyle improvement [6].

### Aim of this study

The present study is conducted to assess bone mineral density measured by DEXA scan among post -menopausal women in sulaimani governorate and to assess the association between BMI with status of BMD.

## II. Method:

### 2.1 Patients and methods:

From 1500 patients who were referred for measurement of bone mineral density to the DEXA scan department from January - December 2015 formed the study subjects, 390 post-menopausal women met our inclusion criteria.

**Inclusion criteria:** post-menopausal women with no secondary causes of decreased BMD or any other chronic illnesses such as hyperthyroidism, diabetes mellitus, renal or liver disease, rheumatoid arthritis or a history of treatment with Levothyroxine, furosemide, heparin, phenytoin, phenobarbital, vitamin K, ranitidine, corticosteroids, alcohol consumption, those having history of fractures, bone deformity and surgical operations.

Since it is a retrospective study, "agree to participate" statement did not arise.

BMD was performed two certified technicians, Lunar iDXa, (Encore 14, model 2008).

BMD was assessed at the lumbar spines AP (L<sub>1</sub>-L<sub>4</sub>) and femoral neck. Based on WHO classification, individuals with T-score values higher than -1 were classified as normal, those with T-score between -1 and -2.5 as osteopenic, and those with T-score less than -2.5 as osteoporotic [10]. Weight and height were measured through standard methods and BMI was calculated by dividing weight (kilogram) by square height (square meter). A thorough history was taken from each patient.

### 2.2 Statistical analysis:

Statistical Package for Social Sciences (SPSS) version 22, which is a statistical software program, and Microsoft excel spreadsheets (2013) were used for data entry, calculations, and data interpretations. Descriptive statistics and up-to-date statistical methods were used in the evaluations. To describe most of our data, we have used mean and standard deviation (SD). Two sample t-test was used to evaluate degrees of associations, and to determine the difference between proportions chi-squared test was used. All the P-values less than (0.05) were considered statistically significant.

## III. Results:

A total of 390 postmenopausal women who met the inclusion criteria were included in this study. Their age was between 44 & 95 years old on the test date Mean  $\pm$  SD = 63 $\pm$ 9.1 years) and had been postmenopausal for a mean of 14.4 years (SD = 9.6). Their mean weight and height were 69.2 kg (SD = 14.6) and 154.8 cm (SD = 7.9), respectively, and their mean body mass index (BMI) was 28.7 (SD = 5.5) as shown Table 1.

**Table 1: Anthropometric parameters**

<b>Age of the participants</b>		
range (years)		44.1-95
mean $\pm$ SD (years)		63 $\pm$ 9.1
<b>Age at menopause</b>		
range (years)		35 $\pm$ 56
mean $\pm$ SD (years)		48.6 $\pm$ 4.3
<b>Menopausal years</b>		
range (years)		0.1 - 43
mean $\pm$ SD (years)		14.4 $\pm$ 9.6
<b>Weight</b>		
range (Kg)		35 - 120
mean $\pm$ SD (Kg)		69.2 $\pm$ 14.6
<b>Height</b>		
range (cm)		55 - 173
	mean $\pm$ SD (cm)	154.8 $\pm$ 7.9
<b>BMI (kg m<sup>-2</sup>)</b>		
	range	14.95 - 49.8
	mean $\pm$ SD	28.7 $\pm$ 5.5

Of the 390 participants, 15.6% ( $n = 61$ ) had normal BMD values ( $T$ -score  $> -1$ ), 45.4% ( $n = 177$ ) had osteopenia with 39% ( $n = 152$ ) having osteoporosis. The mean calculated overall BMD value at the spine L1-L4 was 0.892 g/cm<sup>2</sup> (SD = 0.17), & with mean  $T$  score of -1.74 (SD = 1.36).

Dual femur BMD, at Right femur neck was 0.76 g/cm<sup>2</sup> (SD = 0.14), with  $T$  score of -1.37 (SD = 1.11), nearly the same BMD value was found at the left femur neck 0.76 g/cm<sup>2</sup> (SD = 0.13), and the mean  $T$  score was -1.47 (SD = 1.15).

**Table 2. Bone mineral density (BMD) status among participants**

Parameter	Frequency (%)	Mean $\pm$ SD	Range
Normal BMD	61 (15.6)		
Osteopenia	177 (45.4)		
Osteoporosis	152 (39.0)		
Spine BMD (L <sub>1</sub> -L <sub>4</sub> ) (g cm <sup>-2</sup> )		0.89 $\pm$ 0.17	0.5-1.46
T-score		-1.74 $\pm$ 1.36	-4.9 to 4
<i>Femoral neck:</i>			
Right neck BMD (g cm <sup>-2</sup> )		0.76 $\pm$ 0.14	0.24-1.205
T-score		-1.37 $\pm$ 1.11	-3.8 to 2.3

Left neck BMD (g cm <sup>-2</sup> )	0.76±0.13	0.43-1.185
T-score	-1.47±1.15	-4.2 to 2.1

After classifying the age groups, the bone mineral density decreased with increasing age at both the spine and femur neck significantly after the age of 55years.as shown in table 3.

**Table3. Differences of Mean ±SD among the age groups**

Parameter	44.1-55 years	56-65 years	66-75 years	76+ years
Height (cm)	156.5±4.7	155.2±6.5	154±11.6	150.8±5.9***
Weight (kg)	75±12.5	70±13.5**	66.8±15.8***	56.3±11.2***
Age at menopause (years)	47.6±3.7	48.8±4.8*	49.1±3.7**	48.4±4.1
Menopausal years	4.4±3.5	12.1±5.8***	21.3±5.3***	32.2±4.8***
BMI(kg m <sup>-2</sup> )	30.6±4.97	29±5.1*	27.7±5.9***	24.85±5.32***
Spine BMD (L <sub>1</sub> -L <sub>4</sub> ) (g cm <sup>-2</sup> )	0.98±0.16	0.89±0.15***	0.85±0.16***	0.80±0.15***
T-score	-1.0±1.42	-1.81±1.24***	-2.1±1.28***	-2.39±1.17***
Right neck BMD (g cm <sup>-2</sup> )	0.84±0.14	0.77±0.12***	0.7±0.11***	0.65±0.15***
T-score	-0.66±1.0	-1.3±0.97***	-1.9±0.88***	-2.3±1.2***
Left neck BMD (g cm <sup>-2</sup> )	0.84±0.13	0.76±0.11***	0.7±0.11***	0.63±0.11***
T-score	-0.87±1.36	-1.37±0.91***	-1.93±0.94***	-2.5±0.9***

\*P< 0.05, \*\*P< 0.01, \*\*\*P< 0.001

Women who reported menopause at >50year of age were less likely to have osteoporosis compared to those who reported menopause at age <50years However this relationship was statistically not significant.

**Table 4 . The association between age at menopause and the measured variables (age at menopause between 35-46 years is considered the control)**

Parameter	35-46 years		47-50 years		51-56 years	
	R	Difference (95% CI)	R	Difference (95% CI)	R	Difference (95% CI)
Duration of Menopause(years)	R	-3.3(-5.3 to -1.30)**	R	-9.1(-11.4 to -6.8)***	R	4.5(0.94 to 8.06)*
Weight (kg)	R	0.4(-2.4 to 4.0)	R	1.3(-0.04 to 2.6)	R	0.04(-0.002 to 0.08)
BMI(kg m <sup>-2</sup> )	R	0.1(-1.3 to 1.47)	R	0.03(-0.004 to 0.06)	R	0.02(-0.01 to 0.05)
Spine BMD (L <sub>1</sub> -L <sub>4</sub> ) (g cm <sup>-2</sup> )	R	0(-0.04 to 0.04)	R		R	
Right neck BMD (g cm <sup>-2</sup> )	R	-0.01(-0.042 to 0.02)	R		R	
Left neck BMD (g cm <sup>-2</sup> )	R	-0.02(-0.05 to 0.01)	R		R	

R: reference; \*P< 0.05, \*\*P< 0.01, \*\*\*P< 0.001

BMD decreased with increasing menopausal years, being highly significant at both spine and femur neck..(Table 5)

**Table5. The effect of duration of menopause on bone mineral density**

Parameter	0.1 - 4.9y	5-9.9Y	10-14.9Y	15-19.9Y	20-24.9Y	25+Y
Age (years)	53.2±3.9	56.7±4.6***	61.2±3.9***	65.3±3.7***	68.8±4.8***	77.7±5.6***
Height (cm)	157.5±5.4	155.4±5.6*	155.2±6.1	154.3±13.4	154.1±6.8**	151.3±6.3***
Weight (kg)	76.3±12.1	72.9±12.7	69.5±12.8	68.9±16.3**	66.7±14.3***	57±12.5***
Age at menopause (years)	50.7±3.4	49.3±4.3*	49±4.1**	48±3.4***	46.6±4.7***	46.8±4.5***
BMI(kg m-2)	30.8±4.9	30.1±4.7	28.9±5*	30.5±17.7	27.9±5**	24.9±5.1***
Spine BMD (L <sub>1</sub> -L <sub>4</sub> ) (g cm <sup>-2</sup> )	1.01±0.15	0.91±0.15***	0.88±0.14***	0.88±0.18***	0.85±0.14***	0.79±0.16***
T-score	-0.78±1.30	-1.65±1.2***	-1.9±1.1***	-1.9±1.4***	-2.1±1.1***	-2.5±1.3***
Right femur neck BMD (g cm <sup>-2</sup> )	0.86±0.13	0.81±0.12*	0.75±0.1***	0.73±0.12***	0.72±0.1***	0.65±0.13***
T-score	-0.52±0.94	-1.0±0.99**	-1.5±0.82***	-1.6±1***	-1.7±0.8***	-2.3±1.1***
Left femur neck BMD (g cm <sup>-2</sup> )	0.86±0.11	0.78±0.12***	0.74±0.1***	0.72±0.11***	0.72±0.1***	0.64±0.12***
T-score	-0.68±1.33	-1.21±0.98**	-1.52±0.88***	-1.8±0.9***	-1.7±0.8***	-2.4±1.0***

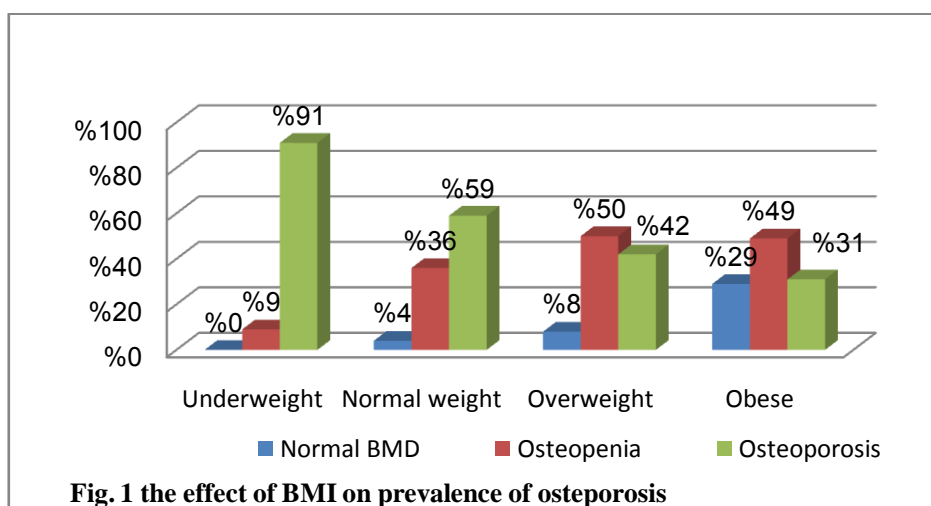
\*P< 0.05, \*\*P< 0.01, \*\*\*P< 0.001

According to WHO classification of BMI 23% of the participant had normal BMI, 33% overweight, 41% obese and only 3% were underweight.Osteoporosis was significantly less frequent in over weight and obese women as shown in Table (6) and Fig. 1 while underweight women have significantly lower bone mineral density.

**Table 6 the correlation between body mass index and bone mineral density**

Parameter	Normal BMI	Under weight	Overweight	Obese
Age (years)	(67.4±9.7)	(67.4±9.7)	(62.8±8.2)***	(60±7.85)***
Height (cm)	(153±12.2)	(154.6±5.9)	(156±6.2)*	(155.2±5.7)
Weight (kg)	(52.8±5.9)	(41.9±3.8)***	(67.5±6.5)***	(81.8±10.1)***
Age at menopause (years)	(48,3±4.4)	(46.5±4.2)	(48.4±4.3)	(49.1±4.1)
Menopausal years	(19.1±9.7)	(25.1±11.8)	(14.4±8.9)***	(11±8.3)***
BMI(kg m <sup>-2</sup> )	(22.34±1.67)	(17.5±1.0)***	(27.7±1.4)***	(33.93±3.5)***
Spine BMD (L1-L4) (g cm <sup>-2</sup> )	(0.81±0.16)	(0.66±0.10)	(0.88±0.14)***	(0.97±0.15)***
T-score	(-2.38±1.4)	(-3.47±1.06)*	(-1.88±1.17)**	(-1.14±1.2)***
Right neck BMD (g cm <sup>-2</sup> )	(0.69±0.14)	(0.65±0.08)	(0.74±0.11)**	(0.83±0.12)***
T-score	(-1.91±1.11)	(-2.54±0.7)	(-1.58±0.88)*	(-0.8±1.02)***
Left neck BMD (g cm <sup>-2</sup> )	(0.68±0.12)	(0.6±0.1)*	(0.74±0.10)***	(0.82±0.11)***
T-score	(-2.1±0.98)	(-2.75±0.84)*	(-1.56±1.9)*	(-0.94±1.2)***

Normal BMI values are considered as references, \*P < 0.05, \*\*P < 0.01, \*\*\*P < 0.001



**Fig. 1 the effect of BMI on prevalence of osteoporosis**

**IV. Discussion:**

Osteoporosis is a major public health problem all over the world. The epidemiology of osteoporosis is however not well known in our country and region. The present study is conducted at the Internal medicine Teaching hospital, Sulaimani, Iraq, to focus on bone mineral density in postmenopausal women, who have no risk of the secondary causes of osteoporosis. Considering the effect of age, age at menopause, duration of menopause & BMI on bone mineral density. Our data showed that the prevalence of osteoporosis among postmenopausal women is 39%, with 45.4% having osteopenia, which is much higher than that reported for some other populations. In Postmenopausal Caucasian women the prevalence of osteoporosis was (30%) as found by Genant et al. [11], (21.2%) in Swedish women aged 50–80 in the study of Kanis et al. [12]. It is also higher than that reported for women in some Arab countries Sadat et al. [13]: in Lebanon the prevalence of osteoporosis in women was reported to be 31%, in Kuwaiti women 18%, in Saudi Arabia it was 28% among women aged over 50 years and in Jordan it was estimated to be 13% of females over 40Y of age. The possible explanation for these discrepancies might be related to the population, research designs, sampling methods and methodological differences.

A significant correlation between age and bone mineral density is demonstrated, as the age increases especially after the age of 55Y, Bone mineral density decreases, this is consistent with other studies where osteoporosis is prevalent in women after 60 in Jordan [9]. Estrogen deficiency after menopause might be the reason to report age as a risk factor [12]. The findings of this study support a number of previous studies considering aging & menopause as the two major factors likely to be associated with increasing risk of bone tissue destruction [1,3,4,5,9,14].

Increased BMD in obese & overweight women was statistically significant, just like the study of Montazerifar et al. [1]. Also, older women with low BMI were at higher risk of low bone mass, that is in concordance to the results of several other studies [1, 4, 5, 6]. Despite numerous reports on the association between aging and BMI with bone mass, the exact mechanisms are not fully identified yet; however, some studies suggested that humoral factors related to body fat mass, in particular low ovarian estrogen production in postmenopausal women may affect lumbar spine BMD and bone loss (15).

We also demonstrated the negative effect of age and duration of menopause on bone mass, as previously described by Park et al. [4]. Our population who are more than 5 years in menopause had a lower BMD both at spine and femur neck

that was highly significant. It must be considered that these women were older and have less BMI; therefore the age related decline in ovarian estrogen production and muscle strength should be considered important factors.

#### **V. Conclusion:**

Our results indicate that postmenopausal women in our region suffer from osteoporosis and osteopenia higher than those from other neighboring country, so Necessary steps are needed so as to avoid osteoporosis and its complications.

Also that post menopause, aging and lower BMI are important risk factors for the occurrence of low BMD. Further studies are required to investigate the effect of other factors like exposure to sunlight, calcium intake, other habits like smoking, diet, exercise and the effect of supplement therapies.

#### **Acknowledgment**

The authors are heartily thankful to the department of Bone mineral density at the general teaching hospital for their cooperation during the study.

This study was supported by the ethic and scientific committee of the faculty of medical science/ university of sulaimani.

**Conflict of interest: there is no conflict of interest.**

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