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Comparison of lean body mass& body fat mass in pre and postmenopausal women in Baghdad teaching hospital with their impact on bone mineral density

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Abstract:

Background: the body composition is changed with aging involving fat mass (FM), lean mass (LM) and bone mineral density(BMD).

Objectives: to evaluate the changes of fat mass, lean mass and bone mineral density in postmenopausal subjects and to determine whether fat mass or lean mass affect bone mineral density.

Methods: A case control study to determine the differences between FM&LM in pre and postmenopausal control study was carried out for a period of one year in Baghdad teaching hospital

Results:a highly significant lower BMD of lumbar spine and both femurs were found in postmenopausal group.Although the mean of areas of ribs, lumbar spine, pelvis, legs and total body fat mass were higher in postmenopausal subjects but no significantly differences of body fat mass g⁄cm² measured by DXA between the postmenopausal and premenopausal subjects. A highly significant difference of LM g⁄cm² measured by DXA between the postmenopausal and premenopausal subjects (p-value0.0004-0.001) in measurements of total LMand anatomical areas.Significant effects were found of total FM and total LM on BMD of lumbar spine and neck of both femurs in postmenopausal subjects but LM had more effect than FM.

Conclusion: A highly significant lower BMD and LM were found with increased adiposity among postmenopausal women.Both FM and LM affect BMD of lumbar spine and both femurs but LM had more effect.

Recommendations :mechanical loading by exercises leading to a positive relationship with BMD.

Keywords:bone mineral density, fat mass, lean mass, postmenopausal

INTRODUCTION:

Aging, an inevitable and normal physiological process and commonly associated with changes of body composition that characterized by decrease in lean mas (LM) and bone mineral density(BMD) with increment of adiposity and higher incidence of osteoporosis particularly in postmenopausal women(1-3) .Body weight is mainly made up of two components: fat mass (FM) and LM; or fat-free mass. The relative impact of each of the two components on BMD variation is extremely contentious(4).Obesity and osteoporosis are major health problem with rising prevalence worldwide and share common features such as multifactorial etiology and consequent high health care costs with concomitant clinical complications(5).A diagnosis of osteoporosis often is established by measurement of BMD by dual X-ray absorptiometry (DXA) which is the first choice and golden clinical modality for the diagnosis and severity assessment of osteoporosis (5-7). DXA is widely available, fast, simple, noninvasive technique with high accuracy and reproducibility and presently the scanning of hip and spine used as the gold standard by clinicians(8,9).BMD is affected by numerous factors, including body mass (10). A number of studies have revealed that higher body mass or body mass index (BMI) relates with higher BMD (4, 11).Moreover, low body mass is known as an important risk factor for osteoporosis (12, 13).However, there is some suggestion that the direct relationship between body mass and BMD does not essentially reflect an advantageous effect of fat mass(FM) on bones (5).On the other hand, it is well recognized that lean mass applies a positive effect on BMD, principally by consequences of mechanical loading on bones (14-16).Other researchers have concluded that both LM and FM were significantly affects BMD (4). The effect of FM alone on the BMD or in combination with LM remains controversial and an important argument has established and concentrated on whether being the overweight and obesity can have protective or unfavorable effect on health of human skeleton. To best of our knowledge, this is first study in Iraq discuss the relationship of FM and LM with BMD in women.

PATIENTS AND METHODS

This case control study was conducted on (120) postmenopausal female subjects with mean age 59.93±6.88 and mean BMI 32.31±5. 27 and (120) premenopausal female subjects with mean age 46.36±4.07 and mean BMI 31.9±5.40 with total of 240 females were randomly selected from the patients attending DXA unit in Baghdad teaching hospital from November 2016 to December 2017. The postmenopausal female subjects were defined as individuals with menopause at least one year since the last natural menstruation (17,18).Osteoporosis was diagnosed according to WHO criteria T-score was used for postmenopausal subjects and Z-scores for premenopausal subjects (19,20). Women were excluded from the study if they had malignancy, chronic inflammatory, endocrine diseases, renal impairment, gastrointestinal diseases, previous gastrointestinal surgery environmental factors, and diseases with altered activity or patients on one or more of the following medications: warfarin, heparin, vitamin K, thiazolidinedione, thiazide diuretics, cancer chemotherapy, anticonvulsants, barbiturates, estrogen, GnRH (gonadotropin releasing hormone agonists), methotrexate, glucocorticoids, vitamin D or osteoporosis medications. Pregnant and lactating premenopausal individuals at time of BMD measurement also excluded from this study .The study protocol was approved by the ethics committee of Baghdad University, informed consents were taken from the participants, and they were assured of privacy of data and to be used only for scientific research.Demographic data were collected and family history of osteoporosis or fragility fracture and history of pervious personal fragility fracture were recorded. Weight and height were measured with standard apparatus in DXA unit by measuring the weight with tape measure from the side of the patient without shoes in standing position, weight was taken by electronic scale and the patient in standing position with light clothes and without shoes . Blood samples were aspirated for complete blood picture, fasting blood sugar, serum calcium, serum phosphorus, renal function test, liver function test. DXA scanning of lumbar spine (L1-4) and both femurs by Strous densitometer with pencil-beam technology.Assessment of body composition by same equipment to measure total and anatomical FM and LM.

RESULTS

A total of 240 subjects were included in this study, they were divided into 2 groups: the first group included 120 postmenopausal subjects and the second group included 120 premenopausal subjects. Significant differences of bone mineral density of lumbar spine and both femurs between postmenopausal and premenopausal subjects as shown in table (1). Areas of femoral neck and total hip for both femurs were measured. T-score was used for postmenopausal subjects and Z-score for premenopausal subjects.

Although the mean of areas of ribs, lumbar spine, pelvis, legs and total body fat mass were higher in postmenopausal subjects but no significantly differences of body fat mass g/cm² measured by DXA between the postmenopausal and premenopausal subjects. Moreover; the mean of areas of arms and dorsal spine were higher in premenopausal subjects as shown in table (3).

Significant effectswere found of total body fat mass and total lean body mass on BMD of lumbar spine and neck of both femurs in postmenopausal subjectswith effect of LM more than FMas shown in table (4).

A highly significant differences of lean body mass g/cm² measured by DXA between thepostmenopausal and premenopausalsubjects (p-value0.0004-0.001) in all areas of measurements:left and right arms,left and rightribs, dorsal and lumbar, pelvis, left and right legs and total lean body mass as shown in table (2).

Table (1): Comparison of bone mineral density of Lumbar spine and femurs in pre and postmenopausal subjects.

DXA scanned area	WHO classification of BMD	Postmenopausal		Premenopausal		Total		
		N0	%	N0	%	N0	%	P.V
Total Lumbar spine BMD (g/cm²)	normal	19	15.83	86	71.67	105	43.75	0.0001*
	osteopenia	64	53.33	30	25.00	94	39.17	
	osteoporosis	37	30.83	4	3.33	41	17.08	
	Total	120	100.00	120	100.00	240	100.00	
Right femoral neck BMD (g/cm²)	Normal	51	42.50	116	96.67	167	69.58	0.0001*
	Osteopenia	65	54.17	4	3.33	69	28.75	
	Osteoporosis	4	3.33	0	0	4	1.67	
	Total	120	100.00	120	100.00	240	100.00	
Total right hip BMD (g/cm²)	Normal	55	45.83	110	91.67	165	68.75	0.0001*
	Osteopenia	61	50.83	10	8.33	71	29.58	
	Osteoporosis	4	3.33	0	0	4	1.67	
	Total	120	100.00	120	100.00	240	100.00	
Left femoral neck BMD (g/cm²)	Normal	49	40.84	114	95.00	163	67.91	0.0001*
	Osteopenia	67	55.83	6	5.00	73	30.42	
	Osteoporosis	4	3.33	0	0	4	1.67	
	Total	120	100.00	120	100.00	240	100.00	
Total left hip BMD (g/cm²)	Normal	54	45.00	114	95.00	168	70.00	0.0001*
	Osteopenia	62	51.67	6	5.00	68	28.33	
	Osteoporosis	4	3.33	0	0	4	1.67	
	Total	120	100.00	120	100.00	240	100.00	

Table (2): Comparison of lean body mass in pre and postmenopausal subjects.

Lean body mass g/cm²	Groups	No	Mean	SD	p-value
Left armg/cm²	postmenopausal	120	4.09	0.42	0.0001*
	premenopausal	120	4.42	0.45	
Right armg/cm²	postmenopausal	120	4.16	0.44	0.0001*
	premenopausal	120	4.58	0.59	
Left ribg/cm²	postmenopausal	120	9.90	0.74	0.0001*
	premenopausal	120	10.42	0.90	
Right ribg/cm²	postmenopausal	120	9.89	0.86	0.0001*
	premenopausal	120	10.57	0.95	
Dorsal spineg/cm²	postmenopausal	120	11.69	0.96	0.0001*
	premenopausal	120	12.47	1.04	
Lumbar spineg/cm²	postmenopausal	120	13.43	1.20	0.001*
	premenopausal	120	13.97	1.17	
pelvisg/cm²	postmenopausal	120	10.88	1.15	0.004*
	premenopausal	120	11.30	1.02	
Left legg/cm²	postmenopausal	120	5.60	0.53	0.0001*
	premenopausal	120	6.01	0.52	
Right legg/cm²	postmenopausal	120	5.53	0.53	0.0001*
	premenopausal	120	5.92	0.52	
Total lean body massg/cm²	postmenopausal	120	7.01	0.57	0.0001*
	premenopausal	120	7.46	0.58	
Total lean body (kg)	postmenopausal	120	38.86	5.56	0.0001*
	premenopausal	120	42.62	5.16	

Table (3): Comparison of body fat mass in pre and postmenopausal subjects.

Body fat mass g/cm²	Groups	No	Mean	SD	p-value
Left armg/cm²	postmenopausal	120	3.62	1.04	0.927
	premenopausal	120	3.63	1.09	
Right armg/cm²	postmenopausal	120	3.71	0.85	0.178
	premenopausal	120	3.88	1.01	
Left ribg/cm²	postmenopausal	120	8.09	1.94	0.937
	premenopausal	120	8.07	2.44	
Right ribg/cm²	postmenopausal	120	8.19	1.90	0.741
	premenopausal	120	8.11	2.34	
Dorsal spineg/cm²	postmenopausal	120	7.96	1.72	0.931
	premenopausal	120	7.98	2.23	
Lumbar spineg/cm²	postmenopausal	120	10.14	2.55	0.290
	premenopausal	120	9.73	3.32	
pelvisg/cm²	postmenopausal	120	9.71	2.29	0.305.
	premenopausal	120	9.38	2.74	
Left legg/cm²	postmenopausal	120	5.18	0.95	0.728
	premenopausal	120	5.13	1.09	
Right legg/cm²	postmenopausal	120	5.43	0.94	0.847
	premenopausal	120	5.41	1.08	
Totalbody fat massg/cm²	postmenopausal	120	6.21	1.27	0.837
	premenopausal	120	6.16	1.54	

Table (4): Correlation oftotal body fat mass and total lean body mass with bone mineral densityinpostmenopausal subjects.

Total body fat mass (kg)	Mean	Std. Deviation	No	Pearson Correlation	Sig. (2-tailed)
	34.83	9.65	120		
Right femoral neck BMD (g/cm²)	0.76	0.11	120	0.374(**)	0.0001*
Left femoral neck BMD (g/cm²)	0.77	0.101	120	0.392(**)	0.0001*
Total Lumbar spine BMD (g/cm²)	0.84	0.128	120	0.352(**)	0.0001*
Total lean body mass (kg)	38.86	5.56	120	Pearson Correlation	Sig.(2-tailed)
Right femoral neck BMD (g/cm²)	0.76	0.11	120	0.390(**)	0.0001*
Left femoral neck BMD (g/cm²)	0.77	0.101	120	0.874(**)	0.0001*
Total Lumbar spine BMD (g/cm²)	0.84	0.128	120	0.492(**)	0.0001*

** Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

The body composition is change with aging by a variety of factors;physical activity, nutrition, menopausal status and disease (21). The data of this study confirmed a higher BMD in premenopausal than postmenopausal subjects in consistent with other studies that reporting the BMD of mean total body, lumbar spine, and femoral neck were higher in premenopausal subjects than postmenopausal (5, 22).The current study showed significant diminution of lean mass among postmenopausal subjects in comparison to control group in addition to a lower BMD in agreement with several studies that concluded significant association between sarcopenia and osteoporosis and reported that a low lean mass loss is associated with lower BMD (23,24).The risk of sarcopenia may decrease bone strength by decreasing the mechanical loading to the skeleton. Such reduction of mechanical stimulation may result from reduced maximal force that produced by weak muscles and/or less time of skeleton exposure to mechanical loaded caused by relative immobility of individuals and thus bone formation is reduced (25).We also measured FM in both groups and found a higher mean of body fat mass in postmenopausalsubjects in comparison to premenopausal but statistically not significant and these findings related to high BMI in premenopausal females.After appropriate adjustment of fat mass to BMI it was found a significant difference of fat mass between two groups.Several studies revealed increased adiposity with aging (5, 26, 27).One of the most significant current discussions in assessment of body composition is whether the FM is important than LM as a determining factor of BMD.The current study revealed significant effects of total body fat mass and total lean body mass on BMD of lumbar spine and neck of both femurs in postmenopausal subjects lean mass had more effect than fat mass on BMD as the mean of lean mass was higher than mean of fat mass (38.86±5.56 vs 34.83±9.65) in agreement with other studies that suggested a positive influence of lean mass on BMD (4, 28, 29, 30).

In conclusion: A highly significant lower BMD and LM were found with increased adiposity among postmenopausal women.Both FM and LM affect BMD of lumbar spine and both femurs but LM had more effect.

Recommendations :mechanical loading by exercises leading to a positive relationship with BMD.

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