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RELATIONSHIP BETWEEN BODY COMPOSITION AND BONE MASS IN ELDERLY EGYPTIAN WITH PRIMARY OSTEOPOROSIS

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Abstract: *Objectives:* To detect the relationship between body composition and primary osteoporosis in elderly Egyptian. *Method:* A case control study performed among 100 elderly participants divided into two groups; a case group comprised 50 elderly patients with osteoporosis and 50 elderly as control group. Each participant was subjected to clinical examination, evaluation of bone mineral density (BMD) and body composition, laboratory investigations to exclude secondary osteoporosis. *Results:* Body Mass Index (BMI) was significantly more among the control group (P< 0.5). Total fat mass (TFM), fat percentage (FP) was significantly more among the control group. On the other hand lean percentage was significantly higher among cases (P<0.05). Significant correlations between; TFM with BMD in L2-4, and BMD of neck femur and BMD in L2-4(P<0.05) were found. Highly significant correlation between serum albumin and calcium and femur T score. *Conclusion:* BMD is highly correlated with weight and BMI and elements of body composition including total fat mass and fat percentage. There is positive correlation between serum calcium and albumin level with BMD.

Key words: Body compositions, bone mass, elderly, osteoporosis.

Introduction

Weakness, falls, functional limitations and osteoporotic fractures are considered serious problems among elderly individuals. Several studies discussed the link between decline in musculoskeletal mass and those problems. It has been reported that loss of the skeletal muscle mass occurs with advancing age. Furthermore, skeletal muscle mass loss in men is masked by weight stability resulting from corresponding increase in fat mass (1).

Both cross sectional and longitudinal studies have shown age-dependent body composition changes, with increase in fat mass especially visceral fat and decrease muscle mass in both men and women (2).

Studies have reported that in both sexes' fat mass increases with age whereas there is a decline in bone mass (osteopenia) and muscle mass (sarcopenia) (3, 4).

Despite the well established relationship between the body weight and bone mass, however , it remains unclear which body mass compartment (i.e. fat versus lean mass) is truly correlated to bone mass. Douchi et al 1997(5) reported that fat body mass (FBM) but not lean body mass (LBM) was important in determining bone mass.

The aim of this study was to detect the relationship between body composition and primary osteoporosis in elderly Egyptian.

Subjects and methods

The study enrolled 100 patients (14 males and 86 females), with age ranging from 60-80 years (table 1) recruited from outpatient clinic and inpatient wards of Ain Shams University Hospital. All participants were subjected to; detailed history, complete physical examination, and functional assessment by assessing the participant ability to perform activities of daily living (6) and instrumental activities of daily living (7) followed by assessment of bone mineral density (BMD) by dual-energy X-ray absorptiometry (DEXA) scans at the left femoral neck and lumbar spine.

N. B. BMD were assessed by a Lunar DPX-L-MD+ (DPX-NTX) brand BX-1L 2550. It was recalibrated daily, and a daily quality assurance test was performed according to manufacturer's instructions.

Then body composition of the patient were assessed using the bio electrical impedance analysis using body fat

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analyzer model BT-905 to identify fat percentage (FP), total fat mass (TFM), lean percentage (LP) , total lean mass, total body water where two electrodes are placed on metacarpophalangeal joint and the wrist joint of the same hand, and another two electrodes are placed on the lower limb of the same side of the body one on the metatarsophalangeal joint and another one on the ankle joint and then data was entered on the device including the age, sex, weight and height.

After that a venous blood sample was withdrawn from the patient and centrifugation was done using a centrifuge with speed (400rpm for 15 min). Then the serum was aspirated and stored at -80 ºC. The following laboratory testes was performed; blood urea nitrogen (BUN), serum creatnine, aspartate aminotransferase(AST), alanine aminotransferase (ALT), calcium, phosphorus, albumin and total protein using EGY THEM kits. Hormonal assessment was done using ELISA technique and cortisol accubind ELISA Microwells , Thyroid stimulating hormone (TSH) accubind ELISA Microwells and testosterone accubind ELISA Microwells; ; aiming at excluding secondary osteoporosis.

The studied sample were than further divided into two groups; The case group; 50 elderly Patients (60 years and over) diagnosed to be osteoporotic by DEXA and participants were considered to be osteoporotic if T score ≤ -2.5 and normal BMD if T score ≥-1 and osteopenic ranging from -1.1 to -2.4(8). The control group; 50 elderly subjects (60 years and over) diagnosed to be with normal BMD by DEXA.

Patient with any of the following condition were excluded:

1. diseases (bronchial asthma - rheumatoid arthtritis - liver disease - kidney disease - hypothyroidism - hyperthyroidism – cushing disease – immobility – disease affecting the gonads - crohns disease- multiple myeloma – hypopitutarism and any type of malignancy)
2. patient receiving the following medication (anti-convulsant – glucocorticoids – thyroxine therapy-anti-coagulant and chemotherapy)
3. Major surgery may cause metabolic consequences.

The study design was approved by the council of geriatrics and gerontology department, faculty of medicine, Ain Shams University and each participant was subjected to informed consent.

Data Management and Analysis

The collected data was revised, coded, tabulated and introduced to a personal computer using Statistical package for Social Science (SPSS 15.0.1 for windows; SPSS Inc, Chicago, IL, 2001). Data was presented and suitable analysis was done according to the type of data obtained for each parameter; Mean and Standard deviation (± SD) than analytical statistics were present in the form of student T Test, Correlation analysis (using Pearson's method).

N.B. levels of significance according to P- value were
-P>0.05: Non significant (NS).
-P< 0.05: Significant (S).
-P<0.01: Highly significant (HS).

Results

The study was carried out to detect the relationship between body composition and primary osteoporosis in elderly Egyptian. The study enrolled 100 patients (14 males and 86 females). The case group included 50 osteoporotic patients with age range from 60-80 years. The cases were matched with the controls for age and sex. (Table 1).

Table 1
Demographic data of the studied groups

		Case		Control		X^2	P	Sig
Age groups		N	%	N	%		0.965	NS
	60-69	39	78.0%	40	80.0%	0.071		
	70-79	9	18.0%	8	16.0%			
	80-89	2	4.0%	2	4,0%			
Sex	males	6	12%	8	16.0%	0.332	0.564	NS
	females	44	88%	42	84.0%			

*chi square test

The comparison between the two groups revealed that body mass index (BMI) was significantly more among the control group. Similarly TFM (28.12±12.59 in cases and 41.06±14.78 in controls) and FP were significantly more among the control group (41.89±12.77 in cases and49.55±14.78 in controls) with P<0.05.

On the other hand lean percentage was significantly higher among cases (58.21±12.81 in cases and 50.23±14.57 in controls) (P<0.05) (Table 2).

Table 2
Comparison between cases and controls as regard elements of body composition

Elements of body composition	Cases Mean	Control Mean	P
BMI	27.09±6.11	33.18±6.17	0.0001
TFM	28.12±12.59	41.06±14.78	.0001
F.P	41.89±12.77	49.55±14.78	.007
TLM	37.10±8.75	40.80±12.33	.087
L.P	58.21±12.81	50.23±14.57	.004
BMR	1300.7±188.50calories per day	1384.70±277.57calories per day	.080
Total body Water	26.64±6.55 pints	29.60±9.55 pints	.074

*Student t test,HS=high significance, NS=no significance, BMI = Body Mass Index, TFM= total fat mass, FP =fat percentage, TLM = total lean mass, LP = lean percentage, BMR = basal metabolic rate

Meanwhile significant correlations between TFM with BMD in L2-4 ($P<0.05$) and significant correlation between TLM and BMD in L2-4 were found.

On the other hand non-significant correlations between FP and BMD of neck femur and in L2-4 were reported. Similarly no significant correlations between BMR and water content with BMD of neck femur ($P>0.05$) could be detected, while the correlation is significant with BMD in L2-4 (Table 3).

Table 3
Correlations between elements of body composition and BMD among all participants

		BMD L2-4	BMD of Neck Femur
BMI	R	.287	-0.51
	P	.007	.643
	Sig	HS	NS
TFM	R	.266	-0.32
	P	.013	0.772
	Sig	S	NS
F.P	R	.95	.24
	P	.382	.827
	Sig	NS	NS
TLM	R	.273	-0.074
	P	.011	.501
	Sig	S	NS
L.P	R	-0.126	-0.024
	P	.250	-.830
	Sig	NS	NS
BMR	R	.267	.072
	P	.013	.510
	Sig	S*	NS*
Water	R	.280	.071
	P	.009	.520
	Sig	HS*	NS

*Student t test, HS=high significance, NS=no significance, BMI = Body Mass Index, TFM= total fat mass, FP =fat percentage TLM = total lean, mass LP = lean percentage BMR = basal metabolic rate

Although evaluation of cortisol level, TSH, total proteins, albumin, liver enzymes, calcium, phosphorus, createnin and blood urea nitrogen were done to exclude secondary osteoporosis. The study showed that there are no significant correlations between the laboratory measurements done and BMD and there were high significant correlation between serum albumin and femur T score and significant correlation between calcium and femur T score.

Meanwhile comparing both groups as regards functional capacity revealed no significant difference between study groups as regard ADL and IADL (Table 4).

Discussion

The current study was carried out to detect the relationship between body composition and primary osteoporosis in elderly Egyptian. It was found that there was a highly significant correlation between body weight and BMI with BMD. This confirms that relation which had been studied by several authors (9, 10) in spite of different samples as regards sex and race.

Table 4
Comparison between cases and controls as regard functional status (ADL and IADL)

		Cases		Controls		Chi square	
		N	%	N	%	X^2	P
ADL	Not impaired	48	96.0%	48	96.0%	1.333	0.513(NS)
	Impaired	2	4.0%	2	4.0%		
IADL	Not impaired	47	94.0%	44	88.0%	1.599	0.450(NS)
	Impaired	3	6.0%	6 1	2.0%		

ADL= activity of daily living,IADL= instrumental activity of daily living

Here an important question should be taken in consideration; which element of the body composition is significantly related to BMD. Our study resulted in a highly significant difference between the two studied groups regarding total fat mass, fat percentage and lean percentage. On the other hand no significant difference in total lean mass between cases and controls was found .This confirms that relations which had been studied by several methodologies and among different groups of participants (11-13). The correlation between BMD and fat mass revealed a positive correlation in several research work (14) and our study supported that result in L2-4 BMD.

Thus we can say that TFM has a positive correlation with BMD and the TLM has a significant correlation in the site of L2-4. Meanwhile LP was not correlated with BMD.

From the previous points we can consider assessment of body composition in elderly as an important measure to evaluate and predict primary osteoporosis. It is also advisable to identify the mediators that mediate this action to promote the best action in osteoporotic patients.

As regard the laboratory measurement (BUN-creatnine-AST-ALT-Calcium-Phosphorus-albumin-total protein) also hormonal assays (TSH-Cortisol-testosterone for male) which are done there was proofed to affect the BMD and cause secondary osteoporosis. But it was found that within the normal ranges calcium and albumin have a positive correlation with BMD.

Most of the studies that are correlating BMD with calcium is detecting the effect of its supplementation (15, 16) where no significant effect for calcium supplementation on BMD were detected.

In the current study although the laboratory measures were performed to exclude secondary osteoporosis and the values of all the measures are within normal ranges, a significant correlation between the t score of in the neck

of femur with both serum albumin and calcium level . This issue had been discussed within limited research studies (17) but it spot lights on the possible relation between BMD and serum level of albumin which can be used as indicators for nutritional state also the relation between calcium level and BMD which can be points of further studies.

This study can direct Geriatric practice toward the value of assessing body composition in elderly which can help in early detection of osteoporosis.

In conclusion; osteoporosis is highly correlated to weight and BMI and elements of body composition including total fat mass and fat percentage are highly related to BMD. There is positive correlation between calcium and albumin level and BMD.

Assessment of body composition can be an important consideration in geriatric practice.

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