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The correlation between clinical biochemical parameters and bone mineral density in postmenopausal women

Meral Tugba Cimsir [1], Hakan Cimsir [2], Hasan Basri Savas [3]*, Fazli Demirturk [4]

[1] Department of Obstetrics and Gynecology, Sifa Medical Center, Antalya, TURKEY
[2] Department of Obstetrics and Gynecology, Alanya Research and Education Hospital, Antalya, TURKEY
[3] Department of Medical Biochemistry, Faculty of Medicine, Mardin Artuklu University, Mardin, TURKEY
[4] Department of Obstetrics and Gynecology, Faculty of Medicine, Gaziosmanpasa University, Tokat, TURKEY
***Corresponding Author:** hasan.savas@alanya.edu.tr

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ABSTRACT

Objective: Menopause is characterized by the end of reproductive ability in the female life cycle, and which is the permanent cessation of menstruation. After menopause, the ovaries cut off the production of estrogen, after which important symptoms and diseases occur for women's health due to estrogen deficiency. The aim of this study is to investigate the clinical, hormonal and biochemical parameters on bone mineral density (BMD) in postmenopausal women.

Method: 535 postmenopausal women were included in the study. Demographical parameters, biochemical, and hormonal serum levels were investigated. These values were statistically analyzed with Pearson correlation test with BMD values.

Results: Significantly positive correlation is detected between patient's height and lumbar T score (LtotT), lumbar Z score (LtotZ), and femoral T score (FtotT) (p=0.00, p=0.001, and p=0.00). Positive correlation was detected between patient's weight and body mass index, and LtotT, LtotZ, FtotT, and femoral Z score (FtotZ) scores (p=0.00). Significantly negative correlation was detected between patient's aspartate transaminase (AST) values and FtotT and FtotZ scores (p=0.002, p=0.004). Positive correlation was detected between patient's phosphate (P) values, and FtotT and FtotZ scores (p=0.012, p=0.030). Negative correlation was detected between patient's magnesium (Mg) values, and LtotT and LtotZ scores (p=0.016, p=0.032).

Conclusions: BMD values are positively related with height, weight, serum phosphate levels, and negatively related with serum AST and Mg levels in postmenopausal women.

Keywords: osteoporosis, menopause, medical biochemistry, clinical laboratory

INTRODUCTION

Menopause is characterized by the end of reproductive ability in the female life cycle, and which is the permanent cessation of menstruation, occurs at the age of 51 years on average. The etiology of postmenopausal osteoporosis is generally considered to be the decline in ovarian function and the decrease in estrogen levels [1]. After menopause, the ovaries cut off the production of estrogen, after which important symptoms and diseases occur for women's health due to estrogen deficiency. It affects women's health biologically, psychologically and socially.

The objective of this study was to investigate the clinical, hormonal and biochemical parameters on bone mineral density (BMD) in postmenopausal women.

Menopause age is reported as 46.15±4.60 (mean±SD) in Turkish society. The average female life expectancy in our country is nearly 81.3 years. In this case, women will spend more than a third of their lives in the postmenopausal period [2]. Osteoporosis is a systemic disease characterized by low bone mass, changes in the micromarchia of the bone, and consequently an increase in bone fragility. It is the most common cause of fracture in old population in today's world. Bone fractures caused by osteoporosis occur two-four times more in women than in men [3].

Nowadays, chronic diseases are becoming more and more effective as a result of the increasing population of the elderly. It is important to follow up common chronic diseases in order to protect the quality of life and health of the elderly population. The frequency of osteoporosis in our country, according to a research conducted in Turkey were found to be 12.9% [4]. Osteoporosis is becoming an important health problem as a result of the increasing life expectancy and the increase in the elderly population. Post-menopausal osteoporosis should be considered especially because it is common in elderly women, adversely affects the quality of life and health, and is easy to treat. As a result of the decrease in bone strength, an important skeletal disorder occurs osteoporosis and bones become prone to fractures.

Osteoporosis can be diagnosed on spontaneous fractures or low BMD measured by dual-energy X-ray absorptiometry.

Table 1. The mean and standard deviation values of the parameters of all cases

	Minimum	Maximum	Mean	Standard deviation
Age (years)	40.00	83.00	55.6879	10.43016
Height (cm)	135.00	175.00	155.6000	5.96911
Weight (kg)	41.00	121.00	73.6168	12.50471
BMI (kg/m^2)	18.43	52.37	30.4341	5.08588
TSH (μU/ml)	0.00	32.13	2.1744	2.84885
FSH (mIU/mL)	40.02	200.00	74.0664	23.93816
E2 (pg/mL)	5.00	111.70	16.6129	13.54293
Calcium (mg/dL)	7.20	87.00	9.7897	3.74544
Phosphate (mg/dL)	2.20	10.30	3.8364	0.74666
Magnesium (mg/dL)	1.40	3.30	2.0877	0.23276
ALP (U/L)	31.60	237.00	99.3472	30.56167
PTH (pg/mL)	6.75	914.10	61.5008	64.17774
ALT (U/L)	17.00	243.00	40.2188	14.74730
AST (IU/l)	9.00	79.00	22.4683	8.09444
GH (ug/L)	0.05	8.40	0.6079	1.13519
Testosterone (nmol/L)	2.00	60.87	22.9449	12.53460
Cortizole (μg/dL)	5.31	31.40	14.0453	5.85798
(DHEA)-SO4 (μg/dL)	5.00	324.40	1.1758	61.70881
LtotT	-5.70	9.70	-1.3957	1.37924
LtotZ	-3.70	11.90	-0.2275	1.34220
ftotT	-5.10	3.70	-0.5855	1.10947
ftotZ	-3.40	4.20	0.2109	1.03009
Time of menopause (years)	6	25	14	4

Note. TSH: Thyroid stimulant hormone; FSH: Follicle stimulant hormone; E2: Estradiol; ALP: Alkaline phosphatase; PTH: Parathormone; ALT: Alanine transaminase; AST: Aspartate transaminase; GH: Growth hormone; DHeaSO4: De hydro epi androsterone sulphate; LtotT: Lumbar T score; LtotZ: Lumbar Z score; ftotT: Femoral T score; & ftotZ: Femoral Z score

Most women with osteoporosis are asymptomatic [5]. For this reason, it is important to investigate routine clinical laboratory parameters related to osteoporosis. In the event of a possible relationship between routine laboratory parameters and osteoporosis, osteoporosis diagnosis may be considered in patients who are asymptomatic, but whose routine biochemical analyzes are performed for different reasons.

The aim of this research article is to determine the possible correlation between the clinical, biochemical, hormonal parameters and BMD in postmenopausal women.

MATERIAL AND METHODS

Ethical Issue

Ethical approval was obtained from Tokat Gaziosmanpasa University Local Ethical Committee (ethical approval no. 2010/5, 4/11/2010). Signed informed consents was obtained from all participants. The study protocols were designed in accordance with the principles of the Helsinki Declaration and in adherence to the local guidelines for good clinical practice.

Study Design

535 women with FSH (follicle stimulant hormone) values of 40 IU / L and above and who had their last menstruation more than one year ago were included in the study. None of the patients used any other medication that would affect BMD and received hormone replacement therapy in the postmenopausal or perimenopausal period. Patients with endocrine and metabolic diseases (azotemia, hyper parathyroid, hyperthyroid, hypertension, chronic liver disease, and chronic kidney failure), and other additional systemic diseases that lead to BMD change were not included in the study. Height (cm), weight (kg), BMI, are measured. FSH, E2 (estradiol), calcium (Ca), phosphate (P), magnesium (Mg), ALP (alkaline phosphatase), and thyroid stimulant hormone (TSH) after at least 12 hours of fasting period. Bone mineral densities were determined by the DEXA (dual energy X-ray absorptiometry) method. T and Z scores, lumbar and femoral region BMD values (gr/cm^2) were measured in patients whose whole-body densitometers were studied. T-score indicates the criterion that compares the patient's BMD value with the young adult BMD value. T-score=(patient BMD-young normal mean BMD)/standard deviation (young normal). Z-score indicates the criterion that compares the BMD value of the patient with her age group BMD value. Z-score=(patient BMD-own age group mean BMD)/standard deviation (young normal).

Biochemical data of all patients included to the study were studied in our hospital biochemistry laboratory. Biochemical and hormonal parameters were viewed using the COBAS 6000 tool and commercial kits.

Statistical Analysis

Data analyze were applied SPSS software program (version 16.0, Chicago, IL, USA). Kolmogorov-Smirnov test was used for normality distribution of variances. All numeric values are given as an average±standard deviation. Statistical differences between numeric values were detected by the Pearson correlation test. p-value that smaller than 0.05 was considered as significant. The comparison of demographical and blood sample variables summarized in **Table 1** and **Table 2**.

RESULTS

Significantly negative correlation was detected between the ages of patients in the study group and LtotT and FtotT scores (p=0.00) positive correlation was detected between patient's ages and LtotZ and FtotZ scores (p=0.00, p=0.01).

Positive correlation was detected between patients' weight and BMIs and LtotT, LtotZ, FtotT and FtotZ scores (p=0.00).

Table 2. Correlation analysis of study patients

		LtotT	LtotZ	ftotT	ftotZ
Age (years)	Pearson correlation	-0.280	0.183	-0.332	0.108
	Sig. (2-tailed)	0.000	0.000	0.000	0.013
Height (cm)	Pearson correlation	0.278	0.145	0.166	0.045
	Sig. (2-tailed)	0.000	0.001	0.000	0.304
Weight (kg)	Pearson correlation	0.379	0.368	0.533	0.555
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
BMI (kg/m^2)	Pearson correlation	0.265	0.312	0.465	0.541
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
TSH (μU/ml)	Pearson correlation	0.037	0.014	0.093	0.072
	Sig. (2-tailed)	0.469	0.788	0.067	0.157
FSH (mIU/mL)	Pearson correlation	-0.016	-0.120	-0.144	-0.219
	Sig. (2-tailed)	0.843	0.141	0.075	0.006
E2 (pg/mL)	Pearson correlation	0.116	0.071	0.067	0.027
	Sig. (2-tailed)	0.156	0.386	0.413	0.745
Calcium (mg/dL)	Pearson correlation	-0.004	-0.006	0.032	0.031
	Sig. (2-tailed)	0.936	0.898	0.504	0.523
ALP (U/L)	Pearson correlation	0.013	0.025	0.040	0.062
	Sig. (2-tailed)	0.785	0.599	0.394	0.187
PTH (pg/mL)	Pearson correlation	-0.070	-0.003	-0.119	-0.053
	Sig. (2-tailed)	0.269	0.959	0.059	0.404
ALT (U/L)	Pearson correlation	0.001	-0.026	0.010	-0.017
	Sig. (2-tailed)	0.981	0.560	0.822	0.706
AST (IU/l)	Pearson correlation	-0.076	-0.050	-0.142	-0.129
	Sig. (2-tailed)	0.094	0.272	0.002	0.004
Phosphate (mg/dL)	Pearson correlation	0.021	0.000	0.122	0.105
	Sig. (2-tailed)	0.662	0.988	0.012	0.030
Magnesium (mg/dL)	Pearson correlation	-0.126	-0.112	-0.005	0.008
	Sig. (2-tailed)	0.016	0.032	0.919	0.880
GH (ug/L)	Pearson correlation	-0.026	0.023	0.013	0.051
	Sig. (2-tailed)	0.799	0.821	0.897	0.622
Testosterone (nmol/L)	Pearson correlation	-0.058	-0.120	0.048	0.003
	Sig. (2-tailed)	0.538	0.198	0.606	0.978

Note. Pearson correlation test; TSH: Thyroid stimulant hormone; FSH: Follicle stimulant hormone; E2: Estradiol; ALP: Alkaline phosphatase; PTH: Parathormone; ALT: Alanine transaminase; AST: Aspartate transaminase; GH: Growth hormone; DHeaSO4: De hydro epi androsterone sulphate; LtotT: Lumbar T score; LtotZ: Lumbar Z score; ftotT: Femoral T score; & ftotZ: Femoral Z score

Significantly positive correlation is detected between patient's height and LtotT, LtotZ, and FtotT (p=0.00, p=0.001, and p=0.00), no correlation was detected between FtotZ (p=0.304).

TSH, (DHEA)-SO4, testesterone, cortisol, GH, ALT, PTH, ALP, Ca, and E2 values were not seemed to be related with none of LtotT, LtotZ, FtotT, and FtotZ scores. When FSH values are rising and FtotZ is decreasing negatively (p=0.006). As the patient's weight and Body Mass Index (BMI) increases; LtotT, LtotZ, FtotT, and FtotZ scores are also increasing positively (p=0.00).

Significantly negative correlation was detected between patient's aspartate transaminase (AST) values and FtotT and FtotZ scores (p=0.002, p=0.004).

Positive correlation was detected between patient's phosphate (P) values and FtotT and FtotZ scores (p=0.012, p=0.030). Negative correlation was detected between patient's magnesium (Mg) values and LtotT and LtotZ scores (p=0.016, p=0.032).

DISCUSSION

When the result of some studies in the literature on the evaluation of the relationship of osteoporosis and BMD with biochemical and hormonal values in postmenopausal patients, it is observed that the relationship between BMD and serum values is not very clear and different results are detected.

In a study on 75 postmenopausal women with Acar et al, they found negative and positive correlations with some parameters, but concluded that serum hormone levels are not useful parameters in assessing bone mineral status [6].

While it was found a negative relationship between BMD and BMI [6], we found this relationship as a positive relationship in our study, and although it was found positive correlation between testosterone and Ca in [6], we did not find a significant difference with both in our study. In [7], the researchers examined the effects of endogenous steroids on BMD and as a result revealed that E2 levels falling to seven pg/ml were sufficient for the continuity of BMD. In our study BMD was not related to E2 levels.

In [8], it was not detected a significant difference between the natural and surgical menopause groups they studied, and between the BMDs depending on the serum androgen levels. In our study, similar to the results of Kulak et al, we could not establish a significant relationship between serum androgen levels and BMD. It was found that ovaries were active in the postmenopausal period and were an important source of circulating testosterone and continued this function until 10 years after menopause [9]. This may be the reason why testosterone levels do not decrease in postmenopause. In our study, it was concluded that testosterone levels did not decrease in post menopause and did not affect BMD.

It was revealed that BMD screening should be done to these women, as the lack of age and estrogen prevents the protective

effect of obesity in postmenopausal women [10]. We could not find a relationship between the E2 levels of patients, but we revealed a positive correlation with BMI and BMD in our study

In [11], the researchers revealed that postmenopausal patients with primary hyperparathyroidism may play a pathological role in changes in bone mass if growth hormone deficiency is accompanied. In [12], it was stated that endogenous testosterone and estrogen are partially related to BMD. GH, endogenous testosterone, and estrogen did not seem to be in a correlation with BMD in our study.

It was shown that the decrease in BMD is associated with increased FSH and decreased estradiol. But there is no relationship between serum and urinary calcium and parathormone levels and BMD [13]. Similarly, it was found that high FSH values caused hypogonadal bone loss [14]. In [15], the researchers said that serum FSH levels may be associated with bone loss and osteoporosis. In the present study, we revealed a weak negative correlation between FSH and FtotZ, similar to [13, 15]. In [16], the author found that there was no relationship between BMD and bio elements in the study in which he investigated the relationship between bio elements and osteoporosis.

Magnesium plays an important role in disorders related to bone mineral metabolism [17]. In our study, we found a significantly negative correlation between magnesium levels and LtotT and LtotZ scores. Similar to our study, the researchers in [18] found that oral magnesium therapy suppresses bone turnover in osteoporotic women.

It was found that fat and non-fat body masses were associated with lumbar spine and femoral BMD [19]. The researchers found that while the most important determinant in lumbar spine BMD is fat mass, non-fat body mass is more important in femoral BMD [19]. The researchers in [20] said that increased body mass had positive correlation with BMD, which provided some skeletal protection in overweight postmenopausal women. In our study, we revealed a significantly positive correlation between patient's weight and BMIs and LtotT, LtotZ, FtotT, and FtotZ scores.

CONCLUSIONS

As a result, we discovered in our study that BMD values are positively related with height, weight, serum phosphate levels and negatively related with serum AST and Mg levels, in postmenopausal women. BMD values affected by many clinical biochemical and hormonal values should be followed to prevent bone fractures, especially in the postmenopausal period.

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Ethical statement: This research was carried out after obtaining permission from the Ethics Committee of the Gaziosmanpasa University, Tokat, Turkey.

Declaration of interest: No conflict of interest is declared by authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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