VITAMIN D, BMD CORRELATION IN WOMEN DIAGNOSED WITH POSTMENOPAUSAL OSTEOPOROSIS AND BONE FRACTURE

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ABSTRACT

Purpose: The purpose of the present study was to determine the correlation between vitamin D values and Bone Mineral Density (BMD) in women diagnosed with early postmenopausal osteoporosis and accompanying bone fractures.

Materials and Methods: The study had a retrospective design. The data were scanned retrospectively for 1 year. Postmenopausal female patients aged 46-72 years and diagnosed with fractures were evaluated. The vitamin D measurements and simultaneous bone densitometry measurements of the patients were measured and recorded at the same center. Correlation and regression analyses were performed on the measurement results. T Score and BMD were evaluated and blood vitamin D values were compared.

Results: Vitamin D and T Score and BMD Vitamin D and T Score: $r = 0.169$, $p = 0.066$ were in the correlation analysis. A positive relationship was detected between vitamin D levels and T Score (statistically significant at borderline). A positive relationship was found between vitamin D levels and BMD Vitamin D and BMD: $r = 0.133$, $p = 0.148$. Although a correlation was detected between vitamin D level, BMD, and T Score values, no significant correlation was found with age. No significant results were found in the regression analysis.

Conclusion: Low vitamin D levels cause decreased bone density and easy fractures in women diagnosed with postmenopausal osteoporosis and with bone fractures at an early age and without additional chronic diseases. Expanding the sample size by associating the subject with sunlight and studying in different regions will be more meaningful in treatment and follow-up.

Keywords: Vitamin D, Osteoporosis, T Score, Bone Mineral Density

INTRODUCTION

Vitamin D is responsible for the intestinal absorption of calcium, magnesium, and phosphate and various biochemical reactions as a fat-soluble secosteroid group. It functions in different chemical structures in different tissues in the human body. The most active chemical forms in humans are vitamin D3 (cholecalciferol) and vitamin D2 (ergocalciferol) (1, 2, 3).

The main source of the vitamin is sunlight. Cholecalciferol is synthesized in the lower layer of the epidermis through a chemical reaction dependent on UVB radiation. Cholecalciferol and ergocalciferol can be obtained from diet and supplements (1). Vitamin D obtained from diet or skin synthesis has a biologically inactive chemical structure and is activated by hydroxylation with two enzyme-proteins in the liver and kidneys (1, 3). It provides the activation of the vitamin D pro-hormone with its active form calcitriol, rather than being defined as a vitamin because it can be synthesized in sufficient amounts by the body if sunlight is sufficient, and therefore, it is considered a hormone rather than a vitamin. The hormone provides its effect through different nuclear receptors in the human body (3).

The form of vitamin D measured in serum is called the vitamin D metabolite 25-hydroxyvitamin D or 25(OH)D. Calcifediol is hydroxylated by the kidneys and some immune system cells to form calcitriol (1,25-dihydroxycholecalciferol), which is the biologically active form of vitamin D. Calcitriol circulates in the blood as a hormone with important roles in regulating calcium and phosphate concentration and supporting healthy growth and remodeling of bone (1). Calcitriol also improves cell growth, and neuromuscular and immune functions, and reduces inflammation (2).

The chemical structure of vitamin D3 was defined in 1935 and it was reported that 7-dehydrocholesterol was formed from sunlight. Calcitriol, which is the active metabolite of vitamin D, has biological effects by binding to the vitamin D receptor (VDR) in the nuclei of target cells (4). Binding to the VDR acts as a transcription factor that modulates the gene expression of VDR transport proteins (e.g., TRPV6 and calbindin) involved in calcium absorption in the intestine (5). The vitamin D receptor belongs to the nuclear receptor superfamily of steroid/thyroid hormone receptors, and VDRs are expressed by cells in most

organs (including the brain, heart, skin, gonads, prostate, and breasts). It also ensures the preservation of calcium, phosphorus (with parathyroid hormone and calcitonin), and bone content (1, 5).

Vitamin D also has important roles in bone modeling as a strong bone resorption stimulator. Deficiency may cause low Bone Mineral Density (osteoporosis) or increase the risk of bone fractures. As well as bone mass, bone microarchitecture and bone quality are also very important for osteoporosis and fracture risks (6, 7).

If blood serum 25 OH vitamin D level is 20 ng/ml and above, it is defined as normal/sufficient, if it is between 10-20 ng/ml, it is defined as vitamin D deficiency, and if it is below 10 ng/ml, it is defined as lack of vitamin D. It is preferred that vitamin D be above 30 ng/ml for its extra-bone effects.

Low serum vitamin D levels were associated with falls and low bone mineral density. However, it was reported in studies that taking vitamin D as medication does not seem to change the risk (8,9).

Bone Densitometry (BMD)

If the primary effect of vitamin D is associated with bone formation and bone density, the second important examination in patient follow-up, in addition to the blood serum vitamin D level, is Bone Densitometry, which is an imaging method that measures and scores the mineral density of bones.

BMD is a non-invasive test employed to measure BMD as a measurable form of bone strength. It is used to diagnose osteoporosis, predict the risk of fracture, and monitor treatment.

Characteristics of the Bone Densitometry Method

Measurement of areal (2D) density (g/cm^2), the ease of the procedure, the low radiation received, and the short duration of the procedure.

Many bones are evaluated in measurements, but the BMD value in the femur or lumbar vertebrae is used alone because this also provides information about the BMD (Bone Mineral Density) in other bone tissues.

Precautions can be taken for possible cracks and fractures that may occur in high-risk bones (low BMD value) because each bone density and score can be determined when approaching the patient.

MATERIAL METHOD

Postmenopausal women between the ages of 48-72 were evaluated in the disease group. Approximately 450 patients were screened retrospectively in 1 year. Patients who had female gender, age factor, and simultaneous vitamin D levels and bone densitometry measurements, and those who had a diagnosis of bone fracture were selected for the group. The age scale was narrowed to obtain more significant data. Considering that the decrease in bone density in advanced age is multifactorial, chronic diseases and age-related organ failures are an expected process in the bone structure. Decreased bone density accompanied by low vitamin D at an early age is more significant. For this reason, patients who were diagnosed with osteoporosis at an early age and did not have accompanying chronic diseases and had secondary osteoporosis (i.e., Diabetes Mellitus, Hyperparathyroidism, Chronic Renal Failure, etc.) were excluded from the study and 120 patients were included in the analyses.

Patient serum was used as a sample to determine vitamin D levels. The sera were worked on a Siemens Adviacentaur XPT 250/hour device.

A bone densitometry device was used to determine bone density. The bone densitometry device was a DMS brand Stratos DR model device.

These values were used in the evaluations of the bone mineral content in bone densitometry, especially because the BMD value in the femur or lumbar vertebrae is significant and provides data about the BMD in other bone tissues. For BMD values in different places, the correlation coefficient must be used (0.7).

<u>The following values are used in the BMD classification</u>

T score ≥ -1 (normal value)

T score -1 -2.5 (osteopenia)

T score < -2.5 (osteoporosis)

RESULT

In the statistical analyses, correlation analysis was used to evaluate the relationships between age, vitamin D levels, Bone Mineral Density T scores, and BMD values. Pearson Correlation Coefficient (r) and p-values (p) were used to determine the direction and significance of the relationships between the variables. The data from 120 participants were taken into account in the analysis. The average age was found to be 61 years.

TABLE 1 : Correlation Analysis

		AGE	D-VIT	T-SCORE	BMD
AGE	r	1	-0.020	-0.036	-0.077
	p		0.832	0.693	0.406
	n	120	120	120	120
D-VIT	r		1	0.169	0.133
	p			0.066	0.105
	n		120	120	120
T-SCORE	r			1	.893 **
	p				0.000
	n			120	120
BMD	r				1
	p				
	n				120

Relationships Between Age and Other Variables

Age and Vitamin D: r = -0.020, p = 0.832. These results showed that there was a weak negative relationship between age and vitamin D levels, which was not statistically significant.

Age and T Score: r = -0.036, p = 0.693. There was a weak and not statistically significant negative relationship between age and T Score.

Age and BMD: r = -0.077, p = 0.406. The relationship between age and BMD was weak and not statistically significant.

Relationship Between Vitamin D and T Score and BMD

Vitamin D and T Score: r = 0.169, p = 0.066. A positive relationship was detected between vitamin D levels and T SCORE and the relationship was statistically significant at borderline.

Vitamin D and BMD: r = 0.133, p = 0.105. A positive relationship was detected between vitamin D levels and BMD, and the relationship was statistically significant at borderline.

Relationship Between T Score and BMD

T Score and BMD: r = 0.893**, p < 0.001. A strong, statistically significant, and positive relationship was detected between T SCORE and BMD, which shows that an increase in Bone Mineral Density indicates a similar increase in BMD values.

TABLE 2 : Regression Analysis

Dependent	**Independent**	**Beta**	**t**	**p**	**R2**	**F**	**p**
BMD	AGE	-0.074	-0.810	0.420	0.023	1.386	0.254
	DVIT	0.131	1.439	0.153			
T-SCORE	AGE	-0.033	-0.363	0.717	0.030	1.779	0.173
	DVIT	0.168	1.844	0.068			

Regression analysis was used to evaluate the effects of age and vitamin D (D-VIT) values on BMD and Bone Mineral Density (T-SCORE). The analysis quantitatively expresses the relationships between the variables and yields the effects of independent variables on dependent variables. The effect of age and vitamin D values was not statistically significant on BMD as the Effect of Age and Vitamin D Values on the T Scores (Table 2).

DISCUSSION AND CONCLUSION

Vitamin D has important roles in calcium metabolism (1). The discovery of vitamin D resulted from the search for nutrient deficiency in children with rickets (the juvenile form of osteomalacia). Vitamin D supplements are provided to treat or prevent osteomalacia and rickets. Evidence for other health effects of vitamin D supplementation is non-consistent. Vitamin D supplements may have little benefits to musculoskeletal or general health Other than preventing rickets and osteomalacia in high-risk groups. Low serum vitamin D levels were associated with fractures and low bone mineral density (8). However, it was reported in some studies that taking vitamin D as medication did not seem to change the related risks (9, 13, 14).

A USA Institute of Medicine (IOM) report said “No contribution was identified between calcium or vitamin D intake and cancer, cardiovascular disease, hypertension, diabetes, metabolic syndrome, falls, physical performance, immunity, autoimmune disorders, infections, neuropsychological function, and preeclampsia”. Some researchers argue that the IOM was too precise in their recommendations and made a mathematical error in calculating the blood levels of vitamin D associated with bone health. IOM members argued that they used a “standard procedure for dietary recommendations” and that the report was based on solid data (15).

Vitamin D supplementation is a reliable method to prevent or treat rickets. The effects of vitamin D supplementation on extraskeletal health are not clear yet. The effect of supplementation on non-skeletal disease rates, the development of myocardial infarction, stroke or cerebrovascular disease, cancer, bone fractures or knee osteoarthritis is questionable, other than a transient decrease in mortality rates in the elderly in a previous study.

A case-control study that employed cortical and trabecular bone of patients with common major osteoporotic fractures is evaluated below a sample of case studies conducted worldwide.

A female patient, who was 51 years old with a BMI of 20 kg/m² and menopausal age 49, had no history of chronic disease, had a Colles Fracture 10 years ago, smoked 15 cigarettes a day, had normal alcohol consumption, and had a dietary calcium intake of 600 mg/day, was evaluated with bone densitometry. Bone densitometry results were analyzed with a total hip T-Score of -2.3 (Osteopenia), a probability of Osteoporotic fracture of 6.7%, and a probability of

hip fracture of 3.6%. The patient developed a hip fracture 5 years later during the follow-ups (16).

We can argue that osteoporosis values in bone densitometry indicate an increased risk of fracture because of low trabecular bone density and provide insight into making a medical decision to start pharmacological treatment before it is too late, or to continue, change, or discontinue the treatment. Briefly, it may help predict fractures and better manage “high-risk” patients (16).

Female patients who were admitted to the hospital in 2023, diagnosed with postmenopausal osteoporosis at an early age (48-72) with an average age of 61, and had fractures in any of their bones were evaluated in our study. Patients who had chronic diseases were not included in the group. Vitamin D blood-serum levels and bone density, total BMD, and T-Score values were also measured.

No statistically significant correlations were found between age and blood vitamin D levels, bone densitometry BMD, and T Score values in the correlation analysis in the present study. However, a correlation was detected between blood vitamin D levels, bone densitometry BMD, and T Score values. Low vitamin D levels cause a decrease in bone density and fractures. Patients in this group must receive early follow-up and treatment.

Although our country is a Mediterranean country and the duration of exposure to sunlight is longer throughout the year, low Vitamin D value is a general problem and there are many domestic studies conducted on this issue (18).

Analyzes must be performed in regions of the world with different climates and sunlight, involving longer-term and larger populations to obtain more meaningful results.

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