

Relationship between Vitamin D Levels and Body Mass Index and Fasting Blood Glucose in Non-Obese Non-Diabetic Women

Obez ve Diyabetik Olmayan Kadınlarda Vitamin D Düzeyi ile Beden Kitle İndeksi ve Açlık Kan Şekeri Arasındaki İlişki

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Abstract

Introduction: Obesity is one of the most critical health problems in the world. Obesity is in the etiology of various chronic diseases, thus causes mortality and morbidity. Especially in recent studies, 25 hydroxyvitamin D₃ (25-OH D₃) deficiency has been associated with many different diseases and became a significant health problem. Although studies are suggesting an association between obesity and 25-OH D₃ deficiency, there is no consensus yet. This study investigates the relationship between 25-OH D₃ levels and blood glucose level and body mass index in non-obese and non-diabetic women.

Methods: In this study, the data of female patients aged between 18–84 years, who were applied to the internal medicine outpatient clinic between 2016 and 2018 and whose heights and weights were recorded, were retrospectively analyzed. The study included 201 female patients.

Results: There was a negative correlation revealed between vitamin D levels and body mass index ($r=0.222$, $p<0.01$).

Discussion and Conclusion: According to these results, 25-OH D₃ deficiency should be considered in patients with a high body mass index.

Keywords: Body Mass Index; Obesity; Vitamin D Deficiency

Obesity is one of the leading health problems of the last half-century. Obesity may trigger diabetes and cardiovascular diseases, becoming the most important cause of morbidity and mortality.^[1,2] The number of obese individuals has tripled since 1975 all over the world. Currently, 1.9 billion people are overweight, and more than 30% are

obese.^[3] Various studies have shown decreased vitamin D levels in obese individuals, but the possible mechanisms have not been fully elucidated.^[4,5] However, the relationship between body mass index, waist circumference, blood triglyceride levels, and vitamin D in non-obese patients has gained importance.

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25-hydroxy vitamin D₃ (25-OH D₃) is a vitamin whose deficiency is common all over the world and in our country. This vitamin, which is closely related to bone and calcium balance, is also associated with metabolic abnormalities.^[6] Vitamin replacement in patients with 25-OH D₃ deficiency may cause a decrease in waist circumference, decreased triglyceride and LDL levels, and increased HDL levels.^[7-9] Factors affecting 25-OH D₃ level include age, nutritional status, exposure to sunlight, and external intake of vitamin D.^[10] In addition to these, physical activity also affects blood 25-OH D₃ level.^[11]

This study investigates the relationship between 25-OH D₃ levels and blood glucose level and body mass index in non-obese and non-diabetic women.

Materials and Methods

In this study, the data of female patients aged between 18–84 years, who were applied to the internal medicine outpatient clinic between 2016 and 2018 and whose heights and weights were recorded, were retrospectively analyzed. A total of 201 female patients were included in the study. The ethics committee of Lokman Hekim University University approved this study with decision number 46/2019. All patients included in the study simultaneously had provided fasting blood glucose, 25-hydroxy vitamin D₃ levels, hemoglobin levels, vitamin B12 levels, free T3, Free T4 and TSH levels, alanine aminotransferase (ALT), aspartate aminotransferase (AST) levels for various reasons. Urea and creatinine levels were also recorded. Patients with a body mass index above 30 kg/m², fasting blood glucose of >125 mg/dl and HbA1c level >6.5%, patients under antidiabetic medications, using vitamin D preparations for any reasons, having thyroid dysfunction, liver dysfunction, or kidney disease were excluded from the study.

Statistical Analyses

All statistical analyzes were performed using Statistical Package for Social Sciences 20.0 (SPSS) for Windows. Fisher's Exact test calculated the demographic characteristics of the patients included in the study. The Pearson correlation test calculated the correlation between values. Results are given as ± standard deviation. P<0.05 was considered statistically significant.

Results

Table 1 shows demographic characteristics and laboratory results of the patients included in the study.

There was a negative correlation between the patients' vitamin D levels and body mass indexes ($r=-0.222$, $p=0.002$).

Table 1. Demographic characteristics of the patients

Feature	Mean±SD
Age	52.94±12.0
Height (cm)	159±3.36
Weight (kg)	72.32±13.2
Body mass index (kg/m ²)	28.5±3.2
Fasting blood glucose (mg/dl)	94.2±17.6
25-OH D ₃ (µg/L)	19.81±7.2

SD: Standard Deviation.

There was a positive correlation between fasting blood glucose and body mass index ($r=0.197$ $p=0.006$). There was no significant correlation between fasting blood glucose and 25-OH D₃ levels of the patients ($r=-0.024$, $p=0.741$).

Discussion

25-OH D₃ is the main regulator of calcium, phosphorus, and bone metabolism. Vitamin D deficiency is very common in both obese and non-obese populations in our country. In order to increase the 25-OH D₃ level to a sufficient level, vitamin replacement is the first and most common treatment plan in primary care. In some studies, the vitamin D dose required to increase 25-OH D₃ levels in people with high body mass index was 2–3 times higher than that of the normal-weight population.^[12] The reason for this is that vitamin D dissolves in fat and goes to the adipose tissue as a target organ after intake.^[13] Even if the person is not obese, the increase in subcutaneous and visceral adipose tissue affects the blood level of the preparations given for the treatment. Various studies have previously shown a negative correlation between the amount of subcutaneous and visceral adipose tissue, body mass index and waist circumference, and vitamin D levels.^[14,15] There was a negative correlation between vitamin D level and waist circumference in a study conducted by Eun Young Lee et al.^[16] in patients over 65 years of age in Korea. Vitezova et al.^[17] found high triglyceride levels and low HDL levels in patients with low vitamin D levels and showed that these patients had a significantly wider waist circumference. In this study, an increase in waist circumference was associated with a significant decrease in 25-OH D₃ levels. On the other hand, in a study conducted in Pakistan in 2019, Khan et al.^[18] could not detect a significant relationship between body mass index and vitamin D levels. Studies have shown that 25-OH D₃ inhibits adipogenic transcription factors and inhibits fat accumulation.^[13] Thus, fat accumulation would be more difficult in people with normal 25-OH D₃ levels. However, studies show that 25-OH D₃ increases insulin secretion via peroxisome prolifer-

erator-activated receptor delta (PPAR-delta).^[19] In parallel with this, it also increases glucose uptake by reducing insulin resistance in skeletal muscle cells. Increased glucose degradation can also be considered a factor in reducing fat accumulation. In addition, 25-OH D₃ reduces apoptosis in pancreatic beta cells.^[20] Decreased need for food with increasing insulin may be effective in decreasing body mass index. As another mechanism, secondary hyperparathyroidism develops in vitamin D deficiency. Parathormone increases intracellular calcium in adipocytes, increasing the fatty acid synthesis and lipid storage.^[21] Therefore, while 25-OH D₃ deficiency causes an increase in body mass index, increased body fat rates cause a decrease in vitamin D levels. Consistent with this result, when 25-OH D₃ and calcium replacement was applied to patients with 25-OH D₃ deficiency, a significant decrease was found in body fat ratio compared to the control group.^[22]

Lifestyle changes and appropriate diet are the first-line treatments for people with a high body mass index. There was a positive correlation between physical activity and 25-OH D₃ levels.^[10] Studies show that physical activity has a positive effect on 25-OH D₃ levels, especially in studies conducted with women.^[23] The fact that bone mineral density also increases with physical activity supports this hypothesis. There are also studies showing that there is a significant increase in bone mineral density with physical activity.^[24] A decrease in body mass index is expected with exercise. The increased vitamin D levels in these people are attributable to outdoor physical activity, where people are exposed to more sun. In addition, 25-OH D₃ absorption from the intestines increases with exercise, increasing vitamin D levels.^[23,25] In both cases, an inverse relationship occurs between body mass index and 25-OH D₃ levels. In our study, parallel to these studies, a negative correlation was found between vitamin D level and body mass index. In conclusion, there is a negative correlation between vitamin D level and body mass index in this study. Vitamin D deficiency and related symptoms should be questioned in obese patients with a body mass index above 25 kg/m².

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