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Research Article

Obesity is associated with lower levels of vitamin D

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ABSTRACT

Aim: In this study we aimed to compare the 25(OH) vitamin D level of obese patients and the serum 25(OH) vitamin D level of healthy individuals who have normal weight; and also to evaluate the relation between 25(OH) vitamin D level and body mass index (BMI), waist circumference, hip circumference, body fat ratio.

Methods: Among the patients who went into Okmeydani Training and Research Hospital Internal Medicine polyclinic and the patients hospitalized at the Internal Medicine clinic between the dates December 2012 - May 2013 and whose ages range between 18 and 70; total 105 individuals took part in the study. 62 individuals whose BMI is ≥30 formed the patient group, while 43 individuals whose BMI is between 18, 5 and 25 formed control group. Vitamin D level of the patient group and control group was measured. The data obtained was statistically analyzed.

Results: The weight, BMI, waist circumference, hip circumference, body fat ratios of the patients in the case group were significantly higher than the ones in the control group ($p<0.05$). The 25 (OH) vitamin D level of the patients in the case group was significantly less than the ones in control group ($p=0.03$). There was statistically significant negative correlation between 25 (OH) vitamin D value and weight ($r=-0.26$ $p=0.01$), waist circumference ($r=-0.23$ $p=0.02$), and BMI ($r=-0.26$ $p=0.01$).

Conclusion: Physicians should consider in treatment of vitamin D deficiency that, serum vitamin D levels are higher in obese compared to lean subjects and correlated negatively with BMI, weight and waist circumference.

Keywords: Obesity; 25(OH) vitamin D; waist circumference; body fat ratio; body mass index.

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Introduction

Obesity is one of the most important health problems in today's world. Since it's frequency increasing year by year, many government developed anti-obesity programs to decrease obesity rates. Metabolic syndrome, the most important complication of obesity, is the main cause type 2 diabetes mellitus and cardiovascular diseases, which cause enormous morbidity and mortality worldwide [1].

Recent evidence suggest that vitamin D may be associated with many bodily functions besides its action in calcium and bone metabolism. One of these conditions is obesity. Interestingly, serum vitamin D levels are decreased in patients with metabolic syndrome or obesity.

In present study, we aimed to compare serum vitamin D levels of lean and obese subjects and to observe association between vitamin D and body mass index (BMI), waist circumference (WC), hip circumference (HC), body fat proportion.

Methods

Serum vitamin D levels and other anthropometric measurements obtained from patients whom presented to internal medicine outpatient clinics of our institution between December 2012 and May 2013. Informed consent from participants and ethical approval from local ethics committee were obtained before initiation of the study. Study cohort grouped into obese and control groups according to the classification of world health organization 1998 criteria [2]. According to these criteria, a BMI equal to or greater than 30kg/m2 were classified as obese, and lower than 30 were classified as control groups.

Exclusion criteria were as follows: chronic kidney disease (serum creatinine >1,4mg/dl), chronic liver failure, subjects receiving vitamin D supplements, a history of medications that may interfere with calcium and vitamin D metabolism.

Body weight was measured with a CPS -106 model of Conti weighbridge (Conti, 2012, China). Height, WC and HC were measured with a measure of Hobby (Hobby, 2012, Germany). Body fat proportion was calculated by bio-impedance assay with BF-306 model device of Omron (Omron, 2009, United Kingdom). Assay results were classified as low, normal, high or too high. Serum vitamin D assay was done with high performance liquid chromatography method. Lower than 20 ng/ml classified as insufficient, 20 to 30 ng/ml classified as low and higher than 30 mg/ml classified as normal.

Statistical Analysis

Statistical analyses were conducted with SPSS software (SPSS 15.0 for Windows, IBM Co., Chicago, Il, USA). Normal or not distribution of the variables among study groups were analyzed with Kolmogorov-Smirnov test. Variables with normal distribution were compared by t test and variables without normal distribution were conducted with Mann Whitney U test. Chi-square test used in comparison of categorical variables.

Results

Sixty-two patients (40 women and 22 men) between 18-70 years of age and with BMI ≥30 kg/m^2 in obesity group, and 43 controls (26 women and 17 men) with BMI between 18.5 and 25 kg/m^2 in control group were enrolled in the study. There was no statistically significant difference between the study and control groups in terms of age and gender distribution (*p=0.095, p=0.673, respectively*) (Table 1).

In the study group, body weight, BMI, waist circumference, hip circumference, body fat ratio were significantly higher than control group (*p <0.001, p <0.001, p <0.001, p <0.001, respectively*) (Table 2). The patients in the study group were significantly shorter than the control group (*p = 0.034*).

Serum 25 (OH) vitamin D levels of study and control groups were 17±8,62 ng/ml and

Table 1. Age and gender distribution of the groups.

Parameter		Study group (n, %)	Control group (n, %)	P
Age		42,93±11,12	39,60±7,97	0.095
Gender	Women	40 (64,5%)	26 (60,5%)	0.673 *
	Men	22 (35,5%)	17 (39,5%)	

*Values: Mean±SD. *t test/chi-square test.*

Table 2. Anthropometric measurements in study and control groups.

Parameter		Study group (n, %)	Control group (n, %)	P
Height (cm)*		162,56±8,99	166,21±7,91	0,034
Weight (kg)*		101,89±17,90	62,16±8,64	0,000
BMI (kg/m2)*		38,63±6,56	21,92±3,63	0,000
WC (cm)*		114,37±13,22	76,26±8,97	0,000
HC (cm)*		118,06±13,54	91,33±6,77	0,000
Body fat ratio (kg/%)*		47,33±2,08	24,80±9,04	0,002
Body fat measurement (kg/%)▲	E4	15 (24,2%)	0 (0,0%)	
	High	8 (12,9%)	7 (16,3%)	
	Low	0 (0,0%)	4 (9,3%)	
	Normal	0 (0,0%)	30 (69,8%)	
	Too High	39 (62,9%)	2 (4,7%)	

*Values: Mean±SD. *Independent samples t test / ▲chi-square test*

20,76±8,27 ng/ml, respectively. The difference was statistically significant (Table 3).

25 OH-D levels are significantly lower in women than in men. The mean 25 (OH) vitamin D in women was 17,13 ± 7,94 ng / ml while in men it was 20,94 ± 9,34 ng / ml.

There was a significant negative correlation between the 25 (OH) vitamin D level and body weight, waist circumference, BMI, and alkaline phosphatase levels. There was no significant correlation between 25 (OH) vitamin D levels and age, height, body fat ratio, hip circumference, phosphorus, albumin, PTH, glucose, AST, ALT, creatinine, urea, uric acid, HbA1c, 24 hour urine calcium value (Table 4). There was a negative correlation between the alkaline phosphatase and 25 (OH) vitamin D when analyzed by Pearson's correlation test, and this correlation was statistically significant (*r = -0.232, p = 0.017*).

Discussion

The emergence of relationships between vitamin D and the components of the metabolic syndrome, the most common and deadly complication of obesity, a century-old disease,

Table 3. Rate of vitamin D insufficiency and deficiency in study and control groups.

Vitamin-D level (ng/ml)	Study group	Control group
<20 (n, (%)	39 (%62,9)	24 (%55,8)
20-30 (n, (%)	19 (%30,6)	14 (%32,5)
>30 (n, (%)	4 (%6,4)	5 (%11,6)
Total (n, (%)	62 (100)	39 (100)

Table 4. Correlation between vitamin D levels and laboratory parameters.

Parameter		Age (years)	Height (cm)	weight (kg)	WC (cm)	BMI (kg/m2)	Body fat ratio (kg/%)	HC (cm)
25(OH)-D (ng/ml)	*r*	-0,123	-0,027	-0,258	-0,229	-0,257	-0,100	-0,164
	p	0,212	0,784	0,008	0,019	0,008	0,745	0,094
		Phosphorus (mg/dl)	Albumin (g/dl)	ALP(u/l)	PTH (pq/dl)	Glucose (mg/dl)	AST(u/l)	ALT(u/l)
25 OH-D vitamin (ng/ml)	*r*	-0,174	-0,053	-0,232	-0,158	-0,073	-0,087	-0,058
	p	0,076	0,590	0,017	0,107	0,459	0,378	0,560
		Creatinine (mg/dl)	urea (mg/dl)	Uric acid (mg/dl)	Insulin	HBA1C (%)	Urinary Ca (mg/24h)	Serum Ca (mg/dl)
25 OH-D vitamin (ng/ml)	*r*	0,026	-0,154	-0,039	-0,178	-0,021	0,187	-0,035
	p	0,790	0,118	0,695	0,069	0,829	0,057	0,720

Pearson correlation.

and even type 1 diabetes, suggests that Vitamin D is a hormone that needs further investigation. In this context, we also investigated the relationship between vitamin D level and its association with BMI, waist circumference, hip circumference, body weight and body fat ratio in obese patients.

The fact that the mean serum vitamin D level is normally low in a total of 105 individuals consisting of study and control groups, suggests that vitamin D deficiency may be extremely common in our society. The prevalence of low vitamin D levels can be attributed to the fact that the patients in the study were participated in the coldest season of Istanbul between December 2012 and May 2013. Of course vitamin D levels reflect not only sunlight but also environmental and personal factors. These include the fact that Istanbul's working environment is usually indoor; such as offices and factory, and population consume less vitamin D-rich nutrients such as fish and milk, as the industry has developed. In a study conducted to observe geographical and climatic characteristics in Turkish immigrants living in Western countries revealed that 25 (OH) vitamin D deficiency was extremely high. This is explained by the fact that obesity indoor dressing, low exposure to sunlight and dark skinnedness were high in this group [3]. In studies conducted in relation to indoor clothing in Turkish women, 25 (OH) vitamin D deficiency was found to be prominent especially in women dressed in such a way as to cover their arms [4]. In our study, 25 (OH) vitamin D levels were significantly lower in patients with high BMI than those with normal BMI, and negative correlation between BMI and vitamin D was found. The negative association between BMI and 25 (OH) vitamin D level has been previously reported in many studies [5-11]. Several arguments have been put forward to explain the reason for the low vitamin D in obese people. These obese people are less mobile and are exposed to less ultraviolet (UV) light as they go out less, consume less vitamin D-containing foods, have vitamin D spread in fat tissue, and increase the efficiency of 1-α hydroxylase enzyme in the kidney sortable [9]. Four studies in recent years have suggested that 1,25 $(OH)_2$ vitamin D, which is increased in obesity, promotes lipogenesis and prevents 25 (OH) vitamin D formation by negative feedback [12-15].

However, the number of samples of these four studies is very low (between 10 and 16); the vitamin D assay (protein binding assay) used in these studies is less sensitive and is not currently used.

In non-obese, the effects of vitamin D were also wondered and a study was conducted on 180 non-obese female and 201 male Lebanese university students. Although the participants had normal body weight, 25 (OH) vitamin D was found to be negatively associated with BMI [16]. In our study, there was no significant relationship between BMI and 25 (OH) vitamin D in the group with normal BMI.

In a study of two hundred obese patients, a more significant decrease in PTH levels was observed in the group given vitamin D [17]. In our study, there was no significant correlation between 25 (OH) vitamin D and PTH levels.

In a study of 3262 cases, vitamin D deficiency was found in 69.2% of cases [18]. In our study, vitamin D deficiency was found to be 60% in all cases, 62.9% in the obese group and 55.8% in the control group. However, our study was not designed to observe the rate of vitamin D deficiency in general population.

In a study of 248 obese patients in which the relationship between body fat ratio and vitamin D was studied, a significant relationship was found between D low vitamin D and body fat mass [19]. In our study, the body fat percentage measured by bioelectrical impedance method was significantly higher in the case group than the control group. However, there was no significant correlation between body fat percentage and vitamin D in the whole population.

In a study of 528 obese patients with metabolic syndrome in which the relationship between waist circumference and 25 (OH) vitamin D levels was examined, a significant negative correlation was found between waist circumference and 25 (OH) vitamin D. At the same time, there was an independent negative correlation between obesity and waist circumference and 25 (OH) vitamin D [19]. In a study of women with 102 metabolic syndrome and 18 women with premenopausal age, the waist circumference was higher in the group with vitamin D deficiency [20]. In our study, waist circumference was significantly higher in the study group than in the control group. Overall, there was a significant negative correlation between 25 (OH) vitamin D and waist circumference. However, there was no significant correlation between 25 (OH) vitamin D and the hip circumference in present study.

In a study of a type 2 diabetic, 60 control cases, 25 (OH) vitamin D, significantly elevated HbA1c, waist circumference and hip circumference were detected in patients in the study. In this study, a significant negative correlation was detected in the correlation analysis with 25 (OH) vitamin D and HbA1c [21]. Another study in a 50-DM patient did not find a significant relationship between vitamin D levels and HbA1c [22]. In our study, no significant relationship was found between HbA1c and 25 (OH) vitamin D in relation to each other. In addition, there was no significant correlation between glucose and 25 (OH) vitamin D in our study. Other studies are diabetic studies. Our patients did not have diabetes. In a study evaluating 110 patients in 2012, no correlation was found between alkaline phosphatase and 25 (OH) vitamin D in the correlation analysis performed in all patients [23]. In our study, there was a negative correlation between alkaline phosphatase (ALP) and 25 (OH) vitamin D when analyzed by Pearson's correlation test, and this relationship was statistically significant.

As a result, there was a negative correlation between BMI, body weight, ALP, waist circumference and 25 (OH) Vitamin-D in our study. No significant correlation was found between 25 (OH) vitamin D and age, body fat ratio, HbA1c and hip circumference. 25 (OH) vitamin D levels are lower in obese patients than in patients with normal VKI, suggesting that obesity may play a role in the pathogenesis of vitamin D deficiency. In addition to adjusting the balance of caloric intake and physical activity, obesity should be emphasized as well as the importance of using sunlight to prevent obesity.

In conclusion, we believe that measuring vitamin D levels in obese patients would be beneficial. There is a need for long-term prospective observational studies with larger population in this regard supporting our results are needed.

Compliance with ethical statements

Conflicts of Interest: None.

Financial disclosure: None

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