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Comparison of Vitamin D Levels in Obese and Normal-BMI Individuals

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ABSTRACT

Introduction: Deficiency of Vitamin D is found to be associated with many chronic diseases. Some studies reported inverse relationship between levels of vitamin D and obesity. **Aims & Objectives:** To compare vitamin D levels in obese and normal-BMI individuals and also to find out the relationship between levels of vitamin D and body mass index. **Place and duration of study:** This study was conducted in Shaikh Zayed hospital, Lahore for a duration of eight months. **Material & Methods:** In this cross-sectional comparative study, thirty obese individuals (BMI ≥ 30 kg/m^2) aged 20 to 45 years were recruited. Control group comprised of thirty age and gender matched normal-BMI individuals (BMI 18.5-24.9 kg/m^2). Levels of vitamin D were compared in the two groups and the relationship between levels of vitamin D and BMI was evaluated. **Results:** Vitamin D levels were found to be lower in obese than in normal-BMI group (14.29±9.14 ng/ml in obese and 20.07±7.32 ng/ml in normal-BMI group, p-value=0.002). Levels of vitamin D were found to be inversely correlated with BMI in the obese (r = -0.533, p-value= 0.004). After adjusting for gender, age, and sun exposure, every 1 kg/m^2 increase in body mass index was associated with 0.98 ng/ml decrease in 25-hydroxyvitamin D (p-value = .004). **Conclusion:** Levels of vitamin D were lower in obese individuals as compared to normal-BMI individuals and were correlated with body mass index in the obese group.

Key words: Vitamin D, Obesity, Vitamin D deficiency

INTRODUCTION

Vitamin D is stored in the body fat as it is a fat soluble vitamin. About 90% of the vitamin D in body comes from sunlight exposure. When skin is exposed to sun light, 7-dehydrocholestrol absorbs UVB radiation and is converted into previtamin D which within the membrane lipid bilayers undergoes rearrangement of its bonds and forms vitamin D.[1] In the liver, cholecalciferol is hydroxylated into 25-hydroxyvitamin D and in the kidney, it undergoes its 2nd hydroxylation to form the active vitamin D, 1,25-dihydroxyvitamin D.[2]

The discovered fact that receptors of vitamin D and the needed enzymes for activation of vitamin D are present in many tissues of the body, including pancreatic cells, cardiac muscles, bone cells, skeletal muscles and many other cells, has provided insight into the many non-skeletal functions of vitamin D. There is association between deficiency of vitamin D and many diseases including hypertension, cancers, infectious diseases, and autoimmune diseases.[3,4]

According to the Endocrine society, 25-hydroxyvitamin D levels of< 20 ng/ml is vitamin D deficiency and levels between 20-30 ng/ml is vitamin D insufficiency.[5] The deficiency of vitamin D is a world-wide problem and is considered as the new pandemic of this era[6,7] with an estimated prevalence of 20-80% in US, Europe, Canada.[8,9,10] In Pakistan, prevalence of the vitamin D deficiency was reported by Riaz et al (2016) to be 53.5%, insufficiency to be 31.2%, and normal levels were found in only 15.3% of the population.[11]

Studies in US have shown Vitamin D deficiency to be widespread in obese and Kumaratne et al (2017) found vitamin D level to be negatively correlated with BMI in adolescents.[12] Similarly in China, Cheng et al (2017) has shown BMI ≥26.06 kg/$m^2$to be risk factor for vitamin D deficiency.[13]
Our study aimed at comparing vitamin D levels in obese and normal-BMI individuals and finding out the correlation between the levels of vitamin D and BMI.

MATERIAL AND METHODS

This was a cross-sectional comparative study which was conducted for eight months in Shaikh Zayed hospital, Lahore after approval by the institutional ethical review board. Sixty individuals from patients' attendants aged 20-45 years of both genders were included. Thirty individuals were obese (BMI≥ 30 kg/m^2) and thirty were age and gender matched normal-BMI individuals (BMI 18.5-24.9 kg/m^2). Individuals with chronic illnesses, malabsorption diseases, osteomalacia, patients taking medications which affect metabolism of vitamin D, and pregnant and lactating women were excluded.
After informed consent was taken, history, demographic data and duration of sun exposure were recorded in a Proforma. Height and weight were taken using the mechanical weight and height scale TZ-160 and body mass index was calculated as equal to weight in kilograms divided by height squared in meters. Blood was drawn for serum 25-hydroxyvitamin D levels which was measured by immunesorbent assay (IDS, UK). Individuals with 25-hydroxyvitamin D of <20 ng/ml were labelled as vitamin D deficient, with 21-30 ng/ml were labelled as insufficient, and those with levels higher than 30 ng/ml were considered as having normal levels.

Statistical Analysis:
The data was analyzed by SPSS 17.0. After checking for normality of distribution, Mann Whitney-U test was applied for comparing serum levels of vitamin D in the obese and normal-BMI individuals as well as in males and females. Correlation between vitamin D levels and age, vitamin D levels and BMI, and vitamin D levels and hours of sun exposure were studied in both groups. Significant correlation was evaluated after assessing for modification and confounding by cofactors. A significant p-value was ≤ 0.05.

RESULTS

In our study, 60 individuals were enrolled, 30 obese and were age and gender matched with 30 normal-BMI individuals. Gender distribution was 40% males and 60% females in each group. No significant difference in sun exposure was seen between the obese and the normal-BMI groups (p-value = 0.145).
Deficiency of vitamin D was seen in 80% of the obese individuals and in 66.7% of the normal-BMI individuals and its levels were found to be lower in obese than in normal-BMI individuals (Table-1).Vitamin D levels were not significantly different in males and females (Table-2).
An inverse correlation was seen between levels of vitamin D and body mass index in the obese after controlling for cofactors (r= -0.533, p-value=0.004), however, no significant relationship was found in the normal-BMI individuals (r= -0.207, p-value=0.301).A significant positive correlation was seen between levels of vitamin D and sun exposure in normal-BMI individuals after controlling for cofactors (r = 0.591, p-value= 0.001), however, no significant correlation was found in the obese group (r = .119, p-value= 0.553).No significant correlation was seen between levels of vitamin D and age in both groups (r = -.098 with p-value= 0.608)
Multivariate regression analysis was done and BMI was found to significantly predict vitamin D levels in obese(p-value = .004) after adjusting for age, gender, and sun exposure; every 1 kg/m^2 increase in body mass index was associated with 0.98 ng/ml decrease in 25-hydroxyvitamin D levels. In the normal-BMI group, only sun exposure significantly predicted vitamin D levels (p-value=.001) and every one hour increase in sun exposure was associated with 1.127 increase in serum vitamin D levels (Table-3).

Group	Mean Ranks	Sum of Ranks	Mann-Whitney U	p-value
Obese (n=30)	23.68	710.50	245.5	0.002
Normal-BMI (n=30)	37.32	1119.50		

Table-1: Serum vitamin D levels (ng/ml) in obese group versus normal-BMI group

Group		Mean Rank	Sum of Ranks	Mann-Whitney U	p-value
Obese	Males (n=12)	14.04	168.50	90.500	0.458
	Females (n=18)	16.47	296.50		
Normal	Males (n=12)	17.33	208.00	86.000	0.350
	Females (n=18)	14.28	257.00		

Table-2: Serum vitamin D levels (ng/ml) in males versus females

Group	Variable	B Coefficient	p-value
Obese (n=30)	Age	0.150	0.548
	BMI	-0.984	0.004
	Sun exposure	0.230	0.553
	Gender	1.323	0.681
Normal-BMI (n=30)	Age	0.345	0.070
	BMI	-0.837	0.301
	Sun exposure	1.127	0.001
	Gender	3.653	0.151

Table-3: Multiple regression analysis for variables predicting vitamin D

DISCUSSION

In our study, levels of vitamin D were seen to be lower in obese than in normal-BMI individuals. It is believed that vitamin D is sequestered in the adipose tissues and therefore levels are decreased. Our results corresponded to the previous studies in other parts of the world.[12,13]

Vitamin D levels were found to be inversely correlated with BMI in the obese group and this is similar to what Kumaratne et al (2017) have shown in their results.[12] However, there was no significant association in normal-BMI individuals.

Levels of vitamin D were not significantly different in males and females in our study. Cheng et al (2017) found vitamin D levels to be lower in women as compared to men[13], however, the age group taken in their study was 65-95 years whereas in our study the age group was 20-45 years. The difference in results could be due to older women staying more at homes with less sun exposure as compared to older men. However, in a study by Jadoon et al (2018), their results corresponded to ours and there was no significant difference between levels of vitamin D in males and females.[14]

No significant correlation was seen between age and vitamin D levels and the same was shown by Cheng et al (2017) in their study[13], however, the age group taken by both the studies was specific and did not include wide range of years. In a study by Dix et al (2017), age was found to be a significant predicting factor for vitamin D levels.[15]

We found vitamin D levels to be significantly correlated with hours of sun exposure in normal-BMI individuals but no significant correlation was found in obese individuals. Our results corresponded with the result of Dix et al (2017) who also found no correlation in the obese individuals.[15]

CONCLUSIONS

Levels of Vitamin D were seen to be lower in obese than in normal-BMI individuals and levels were found to be correlated with BMI in the obese group. Screening for deficiency of vitamin D in obese patients with bone and muscle aches is recommended.

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