ORIGINAL ARTICLE

OBESITY AND DIABETES AS DETERMINANTS OF VITAMIN D DEFICIENCY

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Background: Vitamin D has been the focus of attention in the recent past owing to its multitude of effects on various organ systems including immune system, endocrine, cardiovascular etc. Diabetes mellitus and obesity are widely prevalent in our region. The present study was designed with an objective to determine the vitamin D status in relation to diabetes mellitus and obesity in our area. **Methods:** This cross-sectional study was conducted at the Medical C Unit of Department of Medicine, Ayub Teaching Hospital from January to December 2017. Approval of ethical committee was taken. A total of 117 patients were enrolled in this study of which 109 were finalized for analysis owing to incomplete data in 8 cases. Patients' characteristics were recorded on a structured proforma. Type 2 diabetes was confirmed using HbA1C Levels. Using ADA 2016 criteria. Vitamin D status was assessed using 25-OH-Vit D levels from the same laboratory. Height and weight of the patients were recorded to obtain BMI. Data was entered and analysed using SPSS version 20. **Results:** Of the total sample, 69 (63.3%) were females and 40 (36.7%) were males. Mean age of the participants was 44.13±15.777. Mean vitamin D levels were 26.35±18.72. A total of 83 (76.14%) patients were either vitamin D deficient 66 (60.6%) or insufficient 17 (15.6%) while 26 (23.9%) were sufficient in vitamin D. There was statistically significant difference in vitamin D status in diabetic versus non diabetic patients (p=0.015). As regards BMI and vitamin D status, the difference was also statistically significant (p=0.018). **Conclusion:** Vitamin D deficiency is widely prevalent in our region. There is also a high prevalence of obesity and diabetes mellitus and they are inversely related to low vitamin D levels.

Keywords: Vitamin D deficiency; Obesity; Diabetes

Citation: Gilani SYH, Bibi S, Siddiqui A, Shah SRA, Akram F, Rehman M. Obesity and diabetes as determinants of vitamin d deficiency. J Ayub Med Coll Abbottabad 2019;31(3):432–5.

INTRODUCTION

Vitamin D, the sunshine vitamin, has recently gained enormous attention in relation to considerable physiological functions in addition to its previously defined classical role in maintaining bone health. Deficiency of vitamin D has been implicated in a number of disease processes including cancers, cardiovascular diseases and infectious disorders.[1,2]

The non-skeletal functions of vitamin D has been the focus of interest in the past few years.[3] 1,25-dihydroxyvitamin D (3) (1,25(OH)(2)D(3)), the active form of vitamin D, acts as an immunomodulator apart from its well established role of regulation of bone mineral metabolism. It targets various immune cells including monocytes, macrophages, dendritic cells (DCs), as well as T-lymphocytes and B-lymphocytes.[4]

Presently a multitude of studies point to a significant role of Vit D in a variety of disorders like malignancies, metabolic syndrome and certain autoimmune diseases.[5] Furthermore studies have demonstrated the presence of Vit D receptors in pancreatic tissue suggesting role of vitamin D in pancreatic function.[6]

Low levels of vitamin D are associated with impaired insulin production and release and is thought to be an underlying factor for glucose intolerance in patients with type 2 diabetes. The role of vitamin D in diabetes is further enhanced by the fact that good glycaemic control is obtained following Vit D replacement therapy in diabetic patients who have documented vitamin D deficiency.[7]

Several studies show an inverse relationship between vitamin D concentration and obesity. Vitamin D levels are reported to decrease with rising adiposity.[8,9]

An indirect relationship between obesity and vitamin D deficiency can be attributed to less outdoor physical activities in obese people ultimately leading to decreased amounts of sunlight received and hence low vitamin D levels.[10]

However, other studies directly link the low levels of vitamin D to its low bioavailability from dietary intake or skin as it is sequestered in body's adipose tissue.[11]

The presence of a huge number of patients with diabetes mellitus and obesity in our region raises concern about their vitamin D status. Presently

information about vitamin D status in relation to diabetes and obesity in adult population of our area is meagre. Therefore, the present study was designed to determine vit d status in relation to obesity and type 2 DM in our setups.

MATERIAL AND METHODS

This cross-sectional study was conducted in Department of Medicine Ayub Teaching Hospital Abbottabad Pakistan over a period of one year from January to December 2017. Sample size was calculated using the WHO Software with the assumptions: 95% confidence level, 43% anticipated prevalence[12] and 9% absolute precision. Sample size thus calculated was 117. The patients were recruited from medical OPD and ward. Their characteristics were recorded on a structured *pro forma*. Type 2 diabetes was confirmed using HbA1C Levels. Using ADA 2016 criteria, patients were classified as diabetics (HBA1C>6.5) and non-diabetics (HBA1C <6.5) Vitamin D status was assessed using 25-OH-Vit D levels from the same laboratory. It was categorized as sufficient (>30ng/ml), insufficient (20–30 ng/ml) and deficient (<20 ng/ml). Height and weight of the patients were recorded to obtain BMI. Based on BMI patients were classified as non-obese (<25), overweight (25–30) and obese (>30). Patients with disorders or drugs known to affect vitamin D status like chronic renal failure (CRF), chronic liver disease (CLD), malignancies, and systemic steroids therapy were excluded from the study. Patients who received vitamin D supplements in the past one month were also excluded from the study. Data was entered and analysed using SPSS version 20.

Mean and standard deviation were calculated for age and 25-hydroxyvitamin D levels. Categorical variables like gender, age groups, BMI groups, diabetes status groups and vitamin D status groups were described as frequencies and percentages. Significance testing in case of categorical variables was done using chi-square test with $p \leq 0.05$ was considered significant.

RESULTS

A total of 117 patients were recruited in the study, of which 109 were finalized for analysis owing to incompleteness of data in 8 cases. Of these, 40 (36.7%) were males. Mean age of the patients was 44.13±15.78 years. Mean vitamin D levels were 26.35±18.72. Vitamin D levels by gender, age groups, BMI and diabetic status are given in Table-1. Vitamin D status of the different categories of patients was assessed. Table 2 to 4 gives data about deficiency of vitamin D by different categories.

Table-1: Frequency of vitamin D deficient patients in different categories and their p value.

Variable	Total n (%)	% with vit d deficiency	*p*-value
Gender			
Male	40 (36.7)	28 (70)	0.162
Female	69 (63.3)	38 (55)	
Age groups			
18–40 years	45 (41.2)	21 (46.6)	0.062
41–65 years	53 (48.6)	35 (66)	
>65 years	11 (10.09)	10 (90.9)	
BMI groups			
Non obese	39 (35.77)	19 (51.2)	0.018
Overweight	46 (42.20)	26 (56.5)	
Obese	24 (22.01)	21 (87.5)	
Diabetes			
Diabetic	58 (53.21)	42 (72.4)	0.015
Non-Diabetic	51 (46.78)	24 (47.05)	

Table-2: Vitamin D status of participants in different age groups

Age groups	Vit D deficient	Vit D insufficient	Vit D sufficient	Total
18-40 Years	21 (46.6%)	9 (20%)	15 (33.3%)	45 (41.2%)
41-65Years	35 (66%)	7 (13.2%)	11 (20.7%)	53 (48.6%)
>65 Years	10 (90.09%)	1 (9.09%)	0 (0%)	11 (10.09%)
Total	66 (60.6%)	17 (15.6%)	26 (23.9%)	109 (100%)

Table-3: Vitamin D status of participants in different BMI groups

BMI groups	Vit D deficient	Vit D insufficient	Vit D sufficient	Total
Non obese	19 (51.2%)	6 (15.38%)	14 (35.89%)	39 (35.77%)
Overweight	26 (56.5%)	10 (21.7%)	10 (21.7%)	46 (42.20%)
Obese	21 (87.5%)	1 (4.16%)	2 (8.3%)	24 (22.01%)
Total	66 (60.6%)	17 (15.6%)	26 (23.9%)	100 (100%)

Table-4: Vitamin D status in relation to diabetes.

Diabetes status	Vit D deficient	Vit D insufficient	Vit D sufficient	Total
Diabetic	42 (72.4%)	8 (13.79%)	8 (13.79%)	58(53.2%)
Non-Diabetic	24 (47.05%)	9 (17.64%)	18 (35.29%)	51(46.8%)
Total	66 (60.6)	17 (15.6)	26 (23.9%)	109(100%)

DISCUSSION

A total of 109 patients were enrolled in our study comprising 69 (63.3%) female patients and 40 (36.7%) male patients. Of the male patients, 31 (77.5%) were either vitamin D deficient 28 (70%) or insufficient 3 (7.5%). Among the females, 52 (75.2%) were having inadequate vitamin D levels. There was no statistically significant difference in vitamin d status of both genders in our study (p=0.162). In another study conducted in Iran, 57.5% of the study population comprised female participants. This study also reported no significant difference in vitamin D status as regards the gender of the participants.[13] A recently published meta-analysis from Iran reported a prevalence of vitamin D deficiency in 45.64% males as compared to 61.90% females.[14]

A total of 83 (76.1%) of the patients in our study were either vit d deficient 66 (60.6%) or insufficient17 (15.6%). Similar results are reported in another study in UAE where the figures for vitamin D inadequacy are reported to be 74%.[15]Another study from Kuwait has also shown a high prevalence of vit d def 36.3%or inadequacy 46.6% in adult patients. In this study a total of 33.6% patients were overweight and 45% were obese.[16] our study population comprised 42.2% overweight and 22% obese patients while 35.8% were non obese.

A number of studies point to a potential association of diabetes with vitamin D deficiency. A study investigating the association of vitamin D intake in relation to type 2 diabetes mellitus points to a useful effect of vitamin D in decreasing risk of type 2 DM.[17] A total of 58 (53.2%) diabetic and 51 (46.8%) non diabetic patients participated in our study. Among the diabetic patients 42 (72.4%) were vitamin D deficient while among the non-diabetics, vitamin D deficiency was present in 24 (47.05%). A total of 8 (13.79%) diabetic patients were sufficient in vit d while in comparison 18 (35.29%) non diabetic patients were vit d sufficient. (p=0.015) Similar results were reported in another study on type 1 diabetic patients, that showed that less than 25% of patients had sufficient levels of vitamin D.[18] Another systematic review that analysed 8 observational cohort studies and 11 RCT concluded that patients with vitamin D status >25 ng/ml had a 43% reduced risk of having type 2 DM when compared to those with low <14 ng/ml vit D levels.[19]A study on diabetic patients reported 72.1% of type 2 diabetic patients to be vitamin D deficient. Also, patients with type2 DM were documented to have elevated values of BMI.[20] Another meta-analysis of observational studies on relationship of low vitamin D status with type 2 diabetes concluded that low levels are inversely related to type 2 diabetes. This relationship was proven to be statistically significant (p=0.000).[21]

In our study vitamin d deficiency was more prevalent in obese (87.5%) patients as compared to overweight (56.5%) and non-obese (51.2%) patients (p=0.018). Studies from other parts of the world report similar associations. A study from three different regions of Saudi Arabia, has also reported a high prevalence of vitamin D deficiency in obese participants as compared to those who were overweight and non-obese.[22] Another study from Lebanon reported an inverse relationship of vitamin D levels with BMI where low vitamin D levels were reported in patients with high BMI. (p<0.001).[23]

CONCLUSION

Vitamin D deficiency is quite prevalent in our setup. This deficiency has a significant inverse relationship with diabetes mellitus and obesity. The concomitant high prevalence of obesity and diabetes mellitus in our region warrants the need for early detection of vitamin D deficiency and its supplementation in deficient patients. Further studies are needed to recommend optimal doses and protocols of vitamin D supplements in such patients and to study their effects on glycaemic control and reducing BMI.

AUTHOR CONTRIBUTION

SYHG: Principle author, designed and conducted the whole study. SB, SRAS, MR: Data analysis, literature review. AS, FA: Discussion.

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Submitted: 19 March, 2019	*Revised: --*	*Accepted: 17 April, 2019*

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