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Research Article

Correlation of Vitamin D with HbA1c and Ejection Fraction in CAD Diabetic and Non CAD Diabetic Patients in Northern India

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Abstract

Aim: To find out the correlation of Vitamin D levels with HbA1c in diabetic patients and with HbA1c and Ejection Fraction in CAD diabetic patients in Northern India.

Methodology: Study included 80 type 2 diabetic patients with age 50 years and above. These patients were equally divided into two arms, CAD diabetic and Non CAD diabetic based on clinical features, assessment and medical history. Group 1 was having T2DM + CAD positive patients (N = 40) and Group 2 was having T2DM patients (N = 40). Clinical and biochemical parameters including blood sugar, lipid profile were done in all patients. CAD was diagnosed on the basis of history and with criteria of low Ejection Fraction on 2D Echo. Vitamin D levels and HbA1c in all these patients were measured and were correlated with Ejection Fraction.

Results: Vitamin D levels were on the lower side in CAD diabetic (15.4 ± 4.95) group than in Non CAD diabetic group (20.88 ± 9.98). Out of the 80 patients investigated Vitamin D deficiency was observed in 36 patients in the CAD diabetic group (N = 40) and the same was only 18 in the Non CAD diabetic group (N = 40). Mean HbA1c (8.61 ± 1.55) was on the higher side in the CAD diabetic group when it was compared to Non CAD diabetic (8.01 ± 1.02) group. The value of correlation in between Vitamin D and HbA1c in CAD diabetic group was -0.076. In a CAD diabetic group mean Ejection Fraction was 38.6 ± 5.85. The r value of correlation between Ejection Fraction with HbA1c and Vitamin D was -0.013 and 0.25 respectively.

Conclusion: Vitamin D levels and Ejection Fraction show inverse correlation with HbA1c levels in CAD diabetic group. Also, Ejection Fraction was directly proportional to Vitamin D levels in CAD diabetic patients.

Keywords: *Vitamin D; CAD; T2DM; Ejection Fraction*

Introduction

Vitamin D deficiency is a major concern all over the world. With the changing trends in dietary habits, change in day to day lifestyle and environmental factors decrease in Vitamin D levels has been observed worldwide [1]. Vitamin D which is derived from cholesterol, can be given as supplements to avoid its deficiency. Vitamin D deficiency is related to various lifestyle disorders like diabetes, hypertension, cardiovascular, cancers and various other immunological problems. It has been evidenced by various studies that people having diabetes are generally deficient in Vitamin D and that HbA1c is inversely proportional to Vitamin D levels [2]. Vitamin D has been linked to an increased risk of cardiovascular disease also [3]. It has also been observed that Vitamin D supplement can improve the condition of diabetes [4]. Vitamin D is recognized as an important factor for cardiovascular health and its deficiency may lead to significant risk factor for several cardiovascular diseases [5]. Reason for these associations are by in large not known.

The early detection and remedy of insufficient Vitamin D in man or woman with diabetes or those at risk for diabetes may be an easy and cost effective therapy which could improve their long term health outcomes.

In our study, we assessed the Vitamin D levels in CAD diabetic and non CAD diabetic patients from northern India and tried to find out a correlation between Vitamin D levels and HbA1c and Ejection Fraction in these two groups as Vitamin D has not been correlated with Ejection Fraction in any of the studies.

Materials and Methods

Methodology

The proposed study was conducted in the Department of Medicine and Department of Biochemistry, Maulana Azad Medical College, New Delhi. Patients were recruited from the Diabetes Clinic and Medical OPD of Lok Nayak Hospital, New Delhi and included 80 Type 2 Diabetes Mellitus patients of age 50 years and above who have a history of diabetes for more than five years.

Both male and female patients are taken into this study. Patients who were having thyroid disorders, renal and hepatic dysfunction, terminal diseases, malabsorption, tuberculosis, pregnant women and who was taking Vitamin D supplements were excluded from this study. Patients were divided into two groups.

- Group 1 (G1) - T2DM + CAD (based on Ejection Fraction).
- Group 2 (G2) - T2DM.

Out of 80 patients, 26 were males and 54 were females. Height, weight, BMI and waist circumference were measured in all. The diagnosis of diabetes was based on medical history, clinical features and on laboratory investigations such as fasting blood sugar, post prandial sugar, HbA1c values as per ADA 2018 criteria. Duration of diabetes was also based on the medical records and history of the patient. Coronary Artery Disease was diagnosed on the basis of medical history and Ejection Fraction as per 2D Echo.

Result

In Group 1 the mean age was 62.63 ± 5.62 years, BMI 29.52 ± 3.15 kg/m^2, waist circumference 102.9 ± 4.95 cm and duration of diabetes was found 10.73 ± 3.57 years. In Group 2, mean age was 59.6 ± 6.32, BMI 28.56 ± 2.49 kg/m^2, waist circumference 100.73 ± 6.19 cm and duration of diabetes was 10.33 ± 3.52 years. At 95% Class Interval unpaired T test was applied and the mean age was found to be statistically significant in both these groups (Table 1).

S. No.	Parameters	Group 1 (N = 40) T2DM + CAD Mean ± SD	Group 2 (N = 40) T2DM Mean ± SD	P Value
1	Age (years)	62.63 ± 5.62	59.6 ± 6.32	0.0262
2	BMI (kg/m^2)	29.52 ± 3.15	28.56 ± 2.49	0.1345
3	Waist Circumference (cm)	102.9 ± 4.95	100.73 ± 6.19	0.0873
4	Duration of Diabetes (years)	10.73 ± 3.57	10.33 ± 3.52	0.4000

Table 1: *Comparison of parameters in group 1 and group 2 in diabetic patients.*
** P-value ≤ 0.05 is considered statistically significant.*
** P -value is calculated by 2 tailed T test.*

Mean HbA1c, FPG, PP, Cholesterol and triglycerides in the CAD positive group was 8.61 ± 1.53%, 149.4 ± 29.12 mg/dl, 196.42 ± 49.95 mg/dl, 182.47 ± 24.34 mg%, 190.25 ± 71.63 respectively. The above parameters in the Non CAD diabetic group were 8.01 ± 1.02%, 139.9 ± 27.25 mg/dl, 191.15 ± 38.73 mg/dl, 180.87 ± 42.04 mg/dl and 178.8 ± 92.6 mg/dl respectively. The p value for HbA1c levels in both these groups was 0.0391 which was statistically significant (Table 2).

S. No.	Parameters	Group 1 (N = 40) T2DM + CAD Mean ± SD	Group 2 (N = 40) T2DM Mean ± SD	P value
1	HbA1c (%)	8.61 ± 1.53	8.01 ± 1.02	0.0391
2	FPG (mg/dl)	149.4 ± 29.12	139.9 ± 27.25	0.1360
3	PP (mg/dl)	196.42 ± 49.95	191.15 ± 38.73	0.5995
4	Cholesterol (mg/dl)	182.47 ± 24.34	180.87 ± 42.04	0.8355
5	Triglycerides (mg/dl)	190.25 ± 71.63	178.16 ± 92.6	0.5156

Table 2: *Comparison of parameters in group 1 and group 2 diabetic patients.*
** P-value ≤ 0.05 is considered statistically significant.*
** P -value is calculated by 2 tailed T test.*

The plasma concentration of 25 hydroxy Vitamin D (25OHD) was measured using a direct radioimmunoassay. As defined by the Endocrine Society's Clinical Practice Guidelines [2]. Vitamin D deficiency can be defined as a plasma 25OHD levels less than 20 ng/ml, insufficiency as plasma 25OHD levels 21 - 29 ng/ml and sufficiency having plasma 25OHD levels above 30 ng/ml.

The mean Vitamin D levels in G1 were found to be 15.4 ± 4.95 and it was 20.88 ± 9.98 in G2. At 95% Confidence Interval, the two tailed P value equals. 0002. This difference is considered to be extremely statistically significant.

S. No.	Parameters	Group 1 (N = 40) T2DM + CAD Mean ± SD	Group 2 (N = 40) T2DM Mean ± SD	P value
1	Vitamin D	15.4 ± 4.95	20.88 ± 9.98	.0002

Table 3: *Comparison of parameters in group 1 and group.*
** P-value ≤ 0.05 is considered statistically significant.*
** P -value is calculated by 2 tailed T test.*

In CAD diabetic group (N = 40) Vitamin D deficiency was found in 36 patients, insufficiency was found in 03 patients and sufficiency was observed only in 01 patients. In Non CAD diabetic group (N = 40) Vitamin D deficiency was found in 18 patients, insufficiency was found in 30 patients and Vitamin D sufficient number was 02 (Figure 1). The mean Vitamin D deficiency in G1 was found to be 14.28 ± 3.39 and the same was 52.37 ± 22.81 in G2. At 95% confidence interval, the two tailed P value equals .0001. This difference is considered to be extremely statistically significant. In addition, Vitamin D insufficiency was also measured in both groups. The mean Vitamin D insufficiency in G1 and G2 was 24.15 ± 4.15 and 24.09 ± 2.26 respectively (Table 4).

The correlation coefficient was also calculated in both groups with respect to Vitamin D, HbA1c and Ejection fraction. An inverse relation has been observed in G1 when HbA1c was compared with Vitamin D (r value -0.076) and EF (r value -0.013). In G2 correlation coefficient (r value) was found to be 0.089 when HbA1c was compared with Vitamin D. The correlation coefficient was also calculated in G1 with respect to EF and Vitamin D and it was found to be positive as r value equals to 0.25 (Table 5).

Discussion

In this study, we have shown that Vitamin D deficiency is associated with increased risk of diabetes and CAD. This study population only represents the population of northern India and this is the first study in north India to report the correlation of Vitamin D deficiency with HbA1c and Ejection Fraction in diabetic CAD patients.

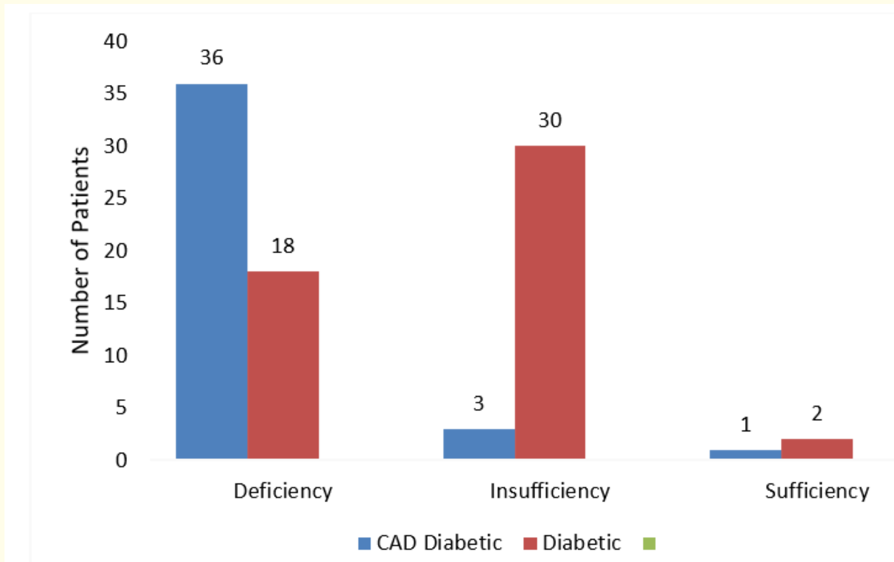

Figure 1: *Vitamin D levels in CAD diabetics and Non CAD diabetics.*

S. No.	Vitamin D Levels	Group 1 T2DM with CAD (Mean ± SD)	Group 2 T2DM (Mean ± SD)	P value
1	Deficiency	14.28 ± 3.39	52.37 ± 22.81	.0001
2	Insufficiency	24.15 ± 4.15	24.09 ± 2.26	.9695

Table 4: *Comparison of vitamin D levels in group 1 and group 2.*
** P-value ≤ 0.05 is considered statistically significant.*
** P-value is calculated by 2 tailed T test.*

S. No.	Groups (N = 40)	Parameters		R value
1	G1 (T2DM with CAD)	Vitamin D	HbA1c	-0.076
2	G2 (T2DM)	Vitamin D	HbA1c	0.089
3	G1 (T2DM with CAD)	Ejection Fraction	Vitamin D	0.25
4	G1 (T2DM with CAD)	Ejection Fraction	HbA1c	-0.013

Table 5: *Comparison of parameters in group 1 and group 2.*

There could be a possible link between low level of Vitamin D and diseases such as diabetes, cardiovascular diseases, kidney diseases etc. According to Pekkanen., *et al.* persons having Vitamin D deficiency in their body are more prone to cardiovascular disease, including systolic and diastolic dysfunction but further studies are required to know the exact mechanism to better clarify the role of Vitamin D supplementation in improving public health [6]. Suzzane., *et al.* demonstrated that Vitamin D deficiency increases the risk for cardiovascular disease [7].

In our study, we found that Vitamin D deficiency was more prevalent in the CAD diabetic group when it was compared with the Non CAD diabetic group. A study conducted by Daniel Mauss., *et al.* found that Vitamin D deficiency is associated with chronic diseases like diabetes mellitus. It was also evidenced by other studies that patients having Vitamin D deficiency have high fasting sugar values and HbA1c levels [8]. We also found that lower HbA1c patients had higher Vitamin D levels in CAD diabetic and Non CAD diabetic group. Laway., *et al.* demonstrated that Vitamin D levels shows negative correlation with HbA1c and fasting plasma glucose levels [9]. Our results were in line with the findings of Laway., *et al.* as we also found an inverse relationship with Vitamin D and HbA1c in CAD diabetic group.

A study conducted by Eshaghian., *et al.* shows that there is an inverse correlation with HbA1c and Ejection Fraction. It was found that higher HbA1c increases the chance of heart failure in CAD diabetic patients [10]. Our results with regard to EF are in synchronicity with the above mentioned studies as in the CAD diabetic group, HbA1c shows an inverse relationship with Vitamin D and Ejection Fraction.

Study conducted by Jun Gu., *et al.* shows that higher HbA1c is a predictor of progression of heart failure in type 2 diabetic patients [11]. Wenhui., *et al.* reported that at each 1% increase in baseline HbA1c there are chances of 6% increased risk of Heart Failure in African Americans and 8% in whites [12]. A study conducted by Katharina Kienreich shown that cardiovascular diseases, including Coronary Artery Disease have accounted for many deaths all over the world and especially in developed countries. Although the exact function and mechanism of Vitamin D is not widely recognized but maintaining optimum levels of Vitamin D in the body might also reduce the chance of progressing and developing diseases like CAD and diabetes after middle age [13]. Study conducted by Dalbeni., *et al.* demonstrated that Vitamin D supplementation over a period of six months significantly improves Ejection Fraction in elderly patients with Heart Failure [14]. Boxer., *et al.* reported that high dose of Vitamin D supplementation did not improve 6-min walk distance over a period of one year, but was related to significant improvement in cardiac function [15].

With the growing western lifestyle and dietary habits Vitamin D deficiency is a major concern for all of us. Vitamin D primarily acts in bone metabolism, but at the same time it also influences body's mechanism and help in developing diabetes and cardiovascular disease when its quantity is not sufficient in the body [16].

A study conducted by Adham I. Ahmed in Palestine depicts that Vitamin D deficiency is related to positive C-reactive protein in CAD patients. He found that C reactive proteins act as a marker and it is found in higher concentration in patient with coronary artery disease. CAD was more commonly found in patients above the age of 45 years [17]. Further studies are required on a large scale to determine whether Vitamin D supplementation would help in preventing the heart disease [18].

There are few limitations in this study like we studied the Vitamin D levels in only 80 patients and it does not represent the whole Indian population, but there might be a possible link between cardiovascular disease and diabetes with Vitamin D deficiency. Further studies are required to reach to a final conclusion whether low levels of Vitamin D are the primary cause for developing CAD and diabetes in Indian population.

In our study, we tried to correlate all three parameters as Vitamin D, HbA1c and Ejection Fraction in CAD Diabetic patients.

Conclusion

We reported severe Vitamin D deficiency in CAD diabetic patients when it was compared with the Non CAD diabetic group. Vitamin D levels and Ejection Fraction show inverse correlation with HbA1c levels in CAD diabetic group. Also, Ejection Fraction was directly proportional to the Vitamin D levels in CAD diabetic patients. Further studies are needed with large sample size to confirm our results.

Conflict of Interest

None.

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