Study of Serum Vitamin D3 in Diabetes Mellitus

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Absract:
The purpose of this study To study serum magnesium levels in acute gastroenteritis.
2.Correlation of severity of diarrhea with serum magnesium level.
3.Correlationofserummagnesiumlevelindiarrheawithserum
potassium and calcium levels.
4.To correlate the severity of hypomagnesemia if present with its
clinical and ECG manifestations
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Introduction: *Association of Obesity with Type2 Diabetes Mellitus is well recognized. It shows that Vitamin D gets deposited in body fat stores after which it is no longer bioavailable. This may explain why a significant amount of diabetic individuals have vitamin D deficiency.*
Method:*This is an observational study that was conducted in the Medicine Department in tertiary care hospital over 1 year, which included 70 adults, 35 with confirmed type2 Diabetes Mellitus and 35 not having Type2Diabetes Mellitus.*
Result:*There was a significant association between Vitamin D3 levels and diabetes (p value <0.05*
Keywords:*Diabetes Mellitus, Vitamin D3*

I. Introduction

The current worldwide epidemic of Diabetes Mellitus is a serious health problem because of the high toll of vascular complications associated with the condition. Deficiency of vitamin D may have a role in the pathogenesis and development of type 2 diabetes by modulating insulin secretion and insulin action. A number of large epidemiological studies suggest a link between both the conditions.[1]Association of Obesity with Type2 Diabetes Mellitus is well recognized. It shows that Vitamin D gets deposited in body fat stores after which it is no longer bioavailable. This may explain why a significant amount of diabetic individuals have vitamin D deficiency.[2]Vitamin D replenishment improves control of blood sugar and insulin secretion in patients with Type 2 Diabetes Mellitus with established hypovitaminosis D, thereby suggesting a role for vitamin D in pathogenesis of diabetes mellitus.

II. Aims And Objectives

To determine the association, if any, between Vitamin D status and Type 2 Diabetes Mellitus.

III. Materials & Methods

► This is anobservational study that was conducted in the Medicine Department in tertiary care hospitalover 1 year, which included 70 adults, 35 with confirmed type2 Diabetes Mellitus and 35 not having Type2Diabetes Mellitus during 2014-2015.
► Both Outdoor and Indoor patients were recruited in the study
► Informed written consent for allowing the clinical data of the patients to be used for study purpose was obtained from all the patients.

- ► Detailed clinical evaluation, as per the annexed proforma, was performed in all the study subjects
- ► Laboratory investigations, as per the proforma and as dictated by the patient's condition were conducted.
- ► Patients were advised for vitamin D replacement and/or titration of antidiabetic treatment as required under the supervision of the consultants of the treating unit.

Inclusion Criteria (for case):
- ► OPD / Indoor patient of a tertiary care hospital.
- ► Known case of type 2 diabetes mellitus on drug therapy &/or life style modifications.
- ► Newly diagnosed cases of type 2 diabetes mellitus as per ADA guidelines.

Inclusion Criteria (for controls):
- ▪ OPD / Indoor patient of TERTIARY CARE HOSPITAL.
- ▪ No past history of diabetes mellitus.
- ▪ Blood sugar and HBA1C levels in normal range.
  (FBS <110 mg/dl, HBA1C< 6.5)

Exclusion Criteria (for case&controls):
- ▪ Age less than 18 years.
- ▪ History of hypertension, chronic heart disease or any other chronic illness
- ▪ Patients with Nephropathy or renal failure
- ▪ History of calcium supplementation in last three months.
- ▪ History of vitamin D supplementation in last three months.

Analysis:
- ► The serum 25-hydroxy Vitamin D3 levels were then compared with the fasting blood sugars and post prandial sugar levels and HBA1C in both the cases and controls
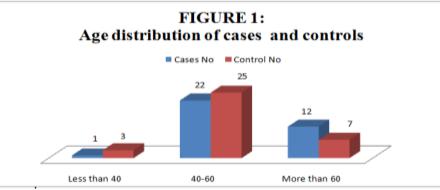
Classification according to Vitamin D3 (ng/ml)	
Vitamin D3 level	**Interpretation**
<20	Deficiency
20-29	Insufficiency
>29	Normal

IV. Observations And Results:

1) Age Distribution:

Cases and controls were divided in different age group and compared with each other (Table1 & Figure1)

TABLE 1: Age Distribution		
Age in Years	**Cases No (%)**	**Controls No (%)**
< 40	1 (3%)	3 (9%)
40-60	22 (63%)	25 (71%)
> 60	12 (34%)	7 (20%)
Total	35 (100%)	35 (100%)

FIGURE 1: Age distribution of cases and controls

In study, 1 (3%) case was less than 40 years, 22 (63%) were between the age of 40-60 years, 12 (34%) cases more than 60 years and. In controls,3 (9%) were less than 40 years, 25 (71%) were between the age of 40-

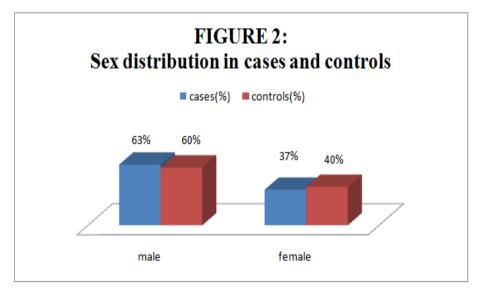60 years, 7 (20%) were more than 60 years.Mean Age for both case and control groups is shown in Table 1A below.

TABLE 1 A:				
Variables	**Groups**		**Independent t-test applied**	
	Cases	**Controls**	**p- value**	**Difference is**
	Mean ± SD	**Mean ± SD**		
Age (years)	56 ± 7.54	53 ± 9.46	0.147	Not significant

Age group distribution was almost equal in both groups. Differences of age between two groups were not significant. (P value > 0.05)

2) Sex distribution:

Cases and controls were divided in male and female groups and compared with each other. (Table 2 & Figure 2)

TABLE 2: Sex distribution		
Sex	**Cases No (%)**	**Cases No (%)**
Male	22 (63%)	21 (60%)
Female	13 (37%)	14 (40%)

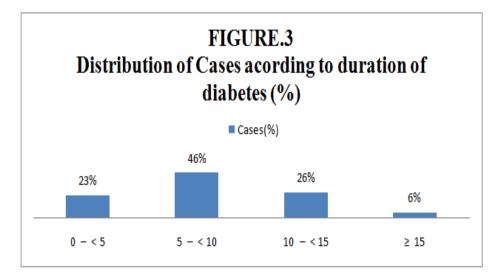FIGURE 2: Sex distribution in cases and controls

Out of 35 cases, 22 (63%) were male and 13 (37%) were female. Among the controls out of 35, 21 (60%) were male and 14 (40%) were female. Sex distributions in both groups were comparable.

3)DistributionOf Cases According To Duration Of Diabetes:

In study 23% had Type 2 diabetes mellitusfor5 to 10years , followed by 46% had for 10 to 15 yearsand 26% had for 10 to 15 years. (Table 3 & Figure 3)

TABLE 3: Distribution of cases according to duration of diabetes:	
Duration of Diabetes in years	**Cases No (%)**
0 – < 5	8 (23%)
5 – < 10	16 (46%)
10 – < 15	9 (26%)
≥ 15	2 (6%)

FIGURE.3
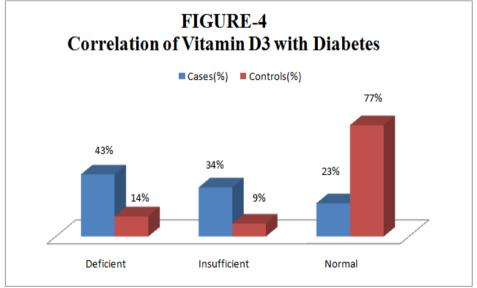Distribution of Cases acording to duration of diabetes (%)

4) Correlation of Vitamin D3 with Diabetes:

Among cases 15 (43%) had level of Vitamin D3 less than 20 ng/ml (Deficient*), 12(34%) cases had level between 20 to 29 ng/ml (Insufficient*)and 8 (23%) cases had more than 29 ng/ml (Normal*), while 5(14%) controls had level of Vitamin D3 less than 20 ng/ml, 3 (9%) had level between 20 to 29 ng/ml, and 27 (77%) had had more than 29 ng/ml. (Table 11 & Figure 11)

TABLE 4:Correlation of Vitamin D3 with Diabetes among cases & controls :		
Vitamin D3 (ng/ml)	**Cases (%)**	**Controls (%)**
<20	15 (43%)	5 (14%)
20-29	12 (34%)	3 (9%)
>29	8 (23%)	27 (77%)

* As per Criteria mentioned on Page no.60 in materials and methods

FIGURE-4
Correlation of Vitamin D3 with Diabetes

From Figure 4 we can see more no of diabetic patients had Vitamin D3 deficiency than non diabetic.

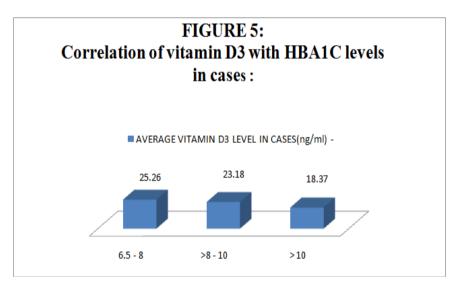| TABLE 4A:				
Variables	**Groups**		**Independent t-test applied**	
	Cases	**Controls**	**p- value**	**Difference is**
	Mean ± SD	**Mean ± SD**		
Vitamin D3 (ng/ml)	23.37±7.53	35.4±7.91	**<0.0000001**	**Highly Significant**

Above data were analyzed statistically by t-test and difference was found to be statistically highly significant meaning thereby that diabetic patients had significantly lower levels of Vitamin D3 amounting to Vitamin D3 deficiency / insufficiency as compared to non-diabetic individuals.

5)Correlation of Vitamin D3 with HBA1C levels in cases &controls:

Among cases average Vitamin D3 level was 25.26 ± 7.78(SD) ng/ml in patient having value of HBA1C between 6.5 - 8, it was 23.18 ± 7.52(SD) ng/ml in cases having HBA1C value of >8 - 10 whereas it was 18.37 ± 6.69 (SD) ng/ml with HBA1C value of more than 10, so Vitamin D3 levels were lower among cases with higher HBA1C levels; same in controls, Vitamin D3 level was 31.10 ±8.03 (SD) ng/ml with HBA1C value between 5 to 6 and it was 33.07 ±7.20 (SD) ng/ml with HBA1C of less than 5.Shown in (Cases-Table 5 & Figure 5,Controls-Table 5A & Figure 5A).
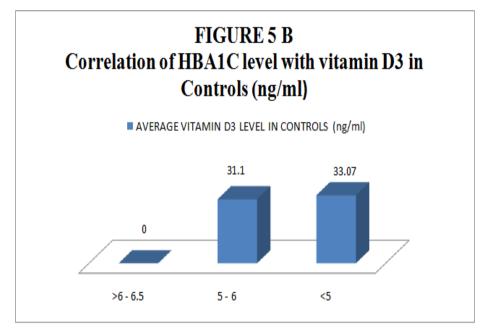
TABLE 5: Correlation of Vitamin D3 with HBA1C levels in cases	
HBA1C (%)	Average Vitamin D3 level in Cases(ng/ml)
< 6.5	-
6.5 – 8	25.26
>8 – 10	23.18
> 10	18.37

TABLE 5 A:		
TEST	P VALUE	SIGNIFICANCE
ANOVA TEST	0.19	NON SIGNIFICANT

FIGURE 5:
Correlation of vitamin D3 with HBA1C levels in cases :

TABLE 5B:Correlation of HBA1C level with Vitamin D3 in Controls (ng/ml)		
HBA1C (%)		Average Vitamin D3 in Controls (ng/ml)
> 6 - 6.5		0
5 – 6		31..10
<5		33.07

From above table we can see that Vitamin D3 level is lower in patient having higher HBA1C value as compared to in patient with lower HBA1C value. The difference of Vitamin D3 levels with different levels of HBA 1C was statistically analyzed by ANOVA test. The p value thus obtained was 0.19 (>0.05) so that the difference was not statistically significant meaning thereby that Vitamin D3 level does not correlate with changing value of HBA1C in a significant manner.

FIGURE 5 B
Correlation of HBA1C level with vitamin D3 in Controls (ng/ml)

In controls difference of Vitamin D3 levels in two groups with values of different HBA1C was analyzed by applying t- test and it was not statistically significant meaning that there is no correlation between Vitamin D3 values with HBA1C value in controls.

TABLE 5C:				
Variables	**Groups**		**Independent t - test applied**	
	HBA1C (5-6)	**HBA1C (<5)**	**p- value**	**Difference is**
	Mean ± SD	**Mean ± SD**		
Vitamin D3 (ng/ml)	**31.10±8.03**	**33.07±7.20**	**0.6988**	**Not Significant**

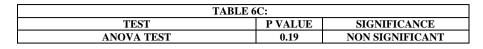**Correlation of obesity with Vitamin D3levels among cases&controls:**

In study cases with BMI of <18.5 had Average level of Vitamin D3 was 33.99 ng/ml, cases with BMI between 18.5 to 24.9 had average level of vitaminD3 24.88ng/ml, cases with BMI between 25 to 29.9 had average Vitamin D3 level of 21.54ng/ml and cases with BMI more than 30 had Vitamin D3 was 20.20ng/ml. In controls, person with BMI <18.5 had average Vitamin D3 level of 31 ng/ml, person with BMI between 18.5 to 24.9 had 32.68 ng/ml, with BMI between 25 to 29.9 had average Vitamin D3 level of 32.85 ng/ml and BMI more than 30 had 30.43 ng/ml. (Table 6,6 A,6 B,6 C& Figure 6).
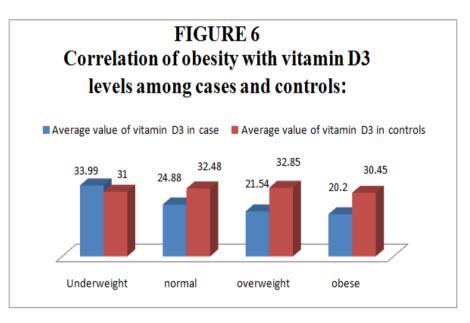
TABLE 6:Correlation of obesity with Vitamin D3 levels among cases		
BMI	**Average Vitamin D3 Level in cases (ng/dl)**	**Standard deviation**
<18.5	33.99	7.64
18.5-24.9	24.88	7.52
25-29.9	21.54	7.41
> 30	20.20	6.11

TABLE 6 A:		
Test	**P Value**	**Significance**
Anova Test	**0.19**	**Non Significant**

TABLE 6B:Correlation of obesity with Vitamin D3 levels among controls:		
BMI	**Average Vitamin D3 Level in controls**	**Standard deviation**
<18.5	31	7.83
18.5-24.9	32.48	7.91
25-29.9	32.85	9.11

> 30	30.45	6.11

TABLE 6C:		
TEST	**P VALUE**	**SIGNIFICANCE**
ANOVA TEST	**0.19**	**NON SIGNIFICANT**

FIGURE 6
Correlation of obesity with vitamin D3 levels among cases and controls:

We calculated p value by Anova test to find out the correlation between obesity and Vitamin D3 level in cases and controls. In both the p value was more than 0.05(i.e. not significant),meaning thereby that Vitamin D3 level did not correlate with changing value of BMI in a significant manner in either cases or controls.

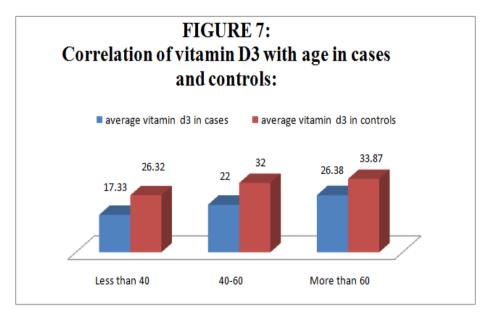**7)Correlation of Vitamin D3 with age in cases &controls:**
In study Average level of Vitamin D3 in cases is 17.33 ng/ml among age group of less than 40 years, whereas it was 22 ng/ ml and 26.37 ng/ml in age group of 40-60 years and more than 60 years respectively. In control group also it was 26.32 ng/mlin less than 40 years of age group and it was 32 and 33.87 ng/ml in age group of 40-60 years and more than 60 years. (Table 7, 7A, 7B, 7C&Figure 7)

TABLE 7:Correlation of Vitamin D3 with age in cases		
Age in Years	**Average level of Vitamin D3 in cases (ng/ml)**	**Standard Deviation**
<40	17.33	6.68
40-60	22	7.41
>60	26.38	7.52
TABLE 7 A:		
TEST	**P VALUE**	**SIGNIFICANCE**
ANOVA TEST	**0.38**	**NON SIGNIFICANT**

TABLE 7B:Correlation of Vitamin D3 with age among controls:		
Age in Years	**Average level of Vitamin D3 in controls (ng/ml)**	**Standard deviation**
<40	26.32	8.02
40-60	32	7.91
>60	33.87	7.69

TABLE 7C:		
TEST	**P VALUE**	**SIGNIFICANCE**
ANOVA TEST	**0.20**	**NON SIGNIFICANT**

P value obtained from above tables by applying ANOVA test was more than 0.05 in both the cases and controls, meaning thereby that the age did not correlate with levels of Vitamin D3 levels in a significant manner.

FIGURE 7:
Correlation of vitamin D3 with age in cases and controls:

8)Correlation of Vitamin D3 with sex in cases and controls:

In study Average Vitamin D3 level in males among cases was 24.86 ng/ml and in controls 32.27 ng/ml,in females among cases it was 20.84 ng/ml and in controls it was 31.29 ng/ml,it was lower among females in both groups. (Table 8 & Figure 8)

TABLE 8: Correlation of Vitamin D3 with sex in cases and controls		
Sex	Average Vitamin D3 level in cases (ng/ml)	Average Vitamin D3 level in controls (ng/ml)
Male	24.86	32.27
Female	20.84	31.29

FIGURE 8
Correlation of vitamin D3 with sex in cases and controls

TABLE 8 A:				
Variables	**Groups**		**Independent t-test applied**	
	Male cases	Female cases	p- value	Difference is
	Mean +/- SD	Mean +/- SD		
Vitamin D3(ng/ml)	24.86+/- 7.58	20.84 +/- 7.58	0.94	Not significant

Vitamin D3 levels in male and female groups among cases were different, but the difference was not statistically significant meaning that sex group did not directly correlate with Vitamin D3 levels.

V. Discussion

➢ In our study, mean HBA1C value among cases was 8.42 which were similar to Odisha study in which it was 8.42.
➢ In our study, mean FBS was 142.33 which were also quite similar to Odisha study where it was 148 mg/dl.
➢ In our study, mean Vitamin D3 level among cases was 23.37 ng/ml, whereas it was 16.98 ng/ml in Odisha study

TABLE A2:Correlation of HBA1C and Vitamin D3 in Odisha and Present study				
Serum levels of HBA1C (%)	**No of cases in present study**	**No of cases in 'odisha' study**	**Average level of Vitamin D3 in present study ng/ml**	**Average level of Vitamin D3 in 'odisha' study ng/ml**
HBA1C< 7	10	46	23.40	22.44
HBA1C> 7	25	56	22.22	16.98

TABLE A3:Comparision of different studies with present study:				
Parameters (mean)	**Present study**	**Odisha study, 2014[329]**	**CIGOLINI, 2006 Italy[327]**	**Athens study 2012**
Age (YEARS)	56	52	60	56.8
Male (%)	63	54.98	57	-
Female (%)	37	45.02	43	-
BMI (kg/ m^2)	26.87	22.33	29.7	-
FBS (mg/dl)	142.33	148	-	`-
HBA1C (%)	8.42	8.42	7.04	7.26
Vitamin D3 (ng/ml)	23.37	16.98	19.7	19.26

➢ In our study, cases and controls were comparable according to age, sex and obesity which could be confounding factors and distribution was equal according to these parameters in both the groups. Vitamin D3 deficiency is strongly associated with Diabetes which was shown in our study by correlating various confounding factors with Vitamin D3 in non diabetic and in diabetic patients and there was association between them and Vitamin D3 in diabetics but there is no any independent association between them with Vitamin D3deficiency.

VI. Summary & Conclusion

➢ A total of 35 cases & 35 controls were studied.
➢ There were 22 males and 13 females in cases of Diabetes Mellitus. Maximum numbers of cases were between the ages of 40 to 60 years. The mean age was 56 years.
➢ In our study, 46 % cases had diabetes since last 5 to 10 years, 23% cases had diabetes for more than 10 years.
➢ In our study, 46 % cases had HBA1C less than 8% and 54% had HBA1C more than 8%.
➢ In our study, 43% cases had a deficiency of Vitamin D3, 34% had insufficiency and 23% had normal levels of Vitamin D3.
➢ In our study, 54% cases had BMI values between 18.5 -24.9 kg/m^2, 23% had a BMI of more than 30 kg/m^2.
➢ Among cases, 18 were on Oral Anti Diabetic drug, 14 cases were on insulin and 3 cases were on both.
➢ Among cases, average Vitamin D3 level decreases as the HBA1C value increases, i.e. it was 18.23 ng/ml with HBA1C more than 8 and it was 25.26 with HBA1C less than 8.
➢ From our study, we conclude that:
a. In our study, cases had more Vitamin D3 deficiency as compared to the controls.
b. There was a significant association between Vitamin D3 levels and diabetes (p value <0.05)
➢ On the basis of our study it can be recommended that Vitamin D3levels must be done on Diabetic patients, especially in situations of
a. Uncontrolled blood sugar level
b. Higher HBA1C values
➢ In above study Vitamin D3 deficiency was more among Diabetics so we can advise Vitamin D3 supplementation and can observe improvement in control of blood sugar level and HBA1C.

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