

Does hypovitaminosis D have a role in lipid profile alteration among non-obese diabetics?

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Abstract

Objective: The prevalence of hypovitaminosis D among diabetics is very high with it being an adjuvant causative factor. It has been shown in few studies that hypovitaminosis D has an impact on lipid profile of diabetic patients but most of the studies haven't excluded the confounding factor viz. obesity. It is a known fact that obesity has a major role in development of hypovitaminosis D. So in our study, we try to find out whether the association between hypovitaminosis D and lipid profile exists even after excluding obesity in diabetics. **Materials and Methods:** It is a cross section study conducted in 55 Non-obese diabetics. We had measured serum FBS, vitamin-D, urea, creatinine, lipid profile and urinary microalbumin. **Results:** We found a negative correlation between vitamin-D with that of TGL (r: -0.337; p<0.012) and VLDL (r: -0.190; p<0.011). There was no association found between hypovitaminosis D with that of cholesterol, HDL and LDL. **Conclusion:** From our study it's clear that hypovitaminosis D is associated with TGL and VLDL even after excluding obesity.

Keywords: Diabetic Mellitus, Vitamin D, lipid profile.

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INTRODUCTION

Diabetes Mellitus has become a pandemic disease. Though extensive research is being conducted, yet prevalence of it grows tremendously every year. The results of the 2014 International diabetic federation are alarming, which state that every twelfth person in the world is a diabetic patient and a person dies every seven seconds. India has a major contribution in this global burden with a prevalence of 8.6% and its prevalence in Tamil Nadu is 10.4%.^{1,2} Type 2 diabetes mellitus is the most common form of diabetes with a complex pathophysiology and has been the subject of much study over the years. As a result of these studies, a significant proportion of the riddle of causation of T2DM has been

unravelling. One such is the role of vitamin D in reducing the blood glucose concentration by increasing the serum calcium concentration which in turn increases the first phase of insulin secretion.³ So hypovitaminosis D in diabetic patients can worsen the glycemic status.⁴⁻⁶ The prevalence of hypovitaminosis D in diabetics in Indians is 66.4%.⁷ Studies have shown that vitamin D might also have a role in regulating lipid profile in diabetics there by reducing the cardiovascular events.⁸⁻¹⁰ And it is also a known fact that obesity is one of the causative factors of hypovitaminosis D.^{11,12} But most of the previous studies tried to correlate vitamin D levels with lipid profile in diabetics without excluding obesity from their study population, though usually obesity, diabetes and hypertension coexist together.^{13,14} So this study was done to find the association between vitamin D and lipid profile exists even after excluding this confounding factor-obesity.

MATERIALS AND METHODS

Study design

It was a hospital based cross sectional study which consisted of 55 non-obese type-2 diabetes mellitus patients and the duration of study was 3 months from February 2015 to April 2015. The study population was

determined using $n = 4pq/L^2$ with a relative precision and prevalence of hypovitaminosis is obtained from Maaji SU.⁷ Since nutritional supplementation and renal impairment can alter the serum vitamin D levels both of these factors were applied as exclusion criteria. After getting a written informed consent from the study group 3ml of clotted blood and urine was collected for the estimation of fasting blood glucose, vitamin D, fasting lipid profile, urea and creatinine in serum. To rule out renal impairment, we had estimated urinary microalbumin. Urinary Microalbumin was estimated by immunoturbidimetry method using Microlab 300 semi-automatic analyzers. The serum vitamin D level was analyzed by ELISA using miasmini ELISA reader and the rest of the analyst were estimated by Chem-Well fully auto-analyzer.

Statistical analysis

Analysis was done using SPSS version 16 for windows. All values were expressed in mean \pm SD. The correlation between vitamin D with that of fasting blood glucose and fasting lipid profile was done using Pearson’s correlation. The difference in mean vitamin D in subgroups was analyzed using ANOVA. A value of $p < 0.05$ was considered statistically significant.

RESULTS

The demographic data of the study population are shown in Table: 1. Out of 55 diabetics, 51 patients had vitamin D deficiency, three had insufficiency and only one patient had normal vitamin D concentration. We analyzed the correlation between vitamin D with fasting glucose level and lipid profile. We obtained negative correlation between serum vitamin D and fasting blood glucose and it was statistically significant [$r = -0.350$; $p = 0.009$]; Table: 2]. We also found an inverse correlation between vitamin D with TGL ($r = -0.337$; $p = 0.012$) and VLDL (r

$= -0.342$; $p = 0.011$). But in our study there was no correlation found between vitamin D with that of cholesterol ($r = -0.237$; $p = 0.081$), LDL ($r = -0.190$; $p = 0.165$) and HDL [$r = 0.216$; $p = 0.113$]; (Table: 2)].

Table 1: Demographic characteristics and laboratory findings of patients

| Parameter | Mean \pm SD (n = 55) | Minimum | Maximum |
|------------------------------|------------------------|---------|---------|
| Age (in years) | 49.35 \pm 7.61 | 35 | 60 |
| Male: Female | 32:23 | - | - |
| BMI (kg/m ²) | 22.64 \pm 1.77 | 18.5 | 24.9 |
| FBS (mg/dl) | 167.04 \pm 23.61 | 131 | 211 |
| Serum Urea (mg/dl) | 25.95 \pm 6.57 | 15 | 38 |
| Serum Creatinine (mg/dl) | 0.79 \pm 0.17 | 0.5 | 1 |
| Urinary microalbumin (mg/dl) | 18.79 \pm 5.40 | 10 | 28 |
| Cholesterol (mg/dl) | 189.16 \pm 41.17 | 118 | 327 |
| TGL (mg/dl) | 142.02 \pm 60.09 | 63 | 273 |
| HDL (mg/dl) | 43.35 \pm 7.32 | 25 | 69 |
| LDL (mg/dl) | 117.41 \pm 38.41 | 39 | 240 |
| VLDL (mg/dl) | 28.40 \pm 12.02 | 13 | 55 |
| Vitamin D (ng/ml) | 12.80 \pm 5 | 4.80 | 30 |

Table 2: Correlation between vitamin D with that of fasting blood glucose and lipid profile

| | Vitamin D | |
|-----------------------|--------------------------------|---------|
| | Pearson’s Correlation; r value | p value |
| Fasting blood glucose | -0.350 | 0.009* |
| S. Cholesterol | -0.237 | 0.081 |
| TGL | -0.337 | 0.012* |
| HDL | 0.216 | 0.113 |
| LDL | -0.190 | 0.165 |
| VLDL | -0.342 | 0.011* |

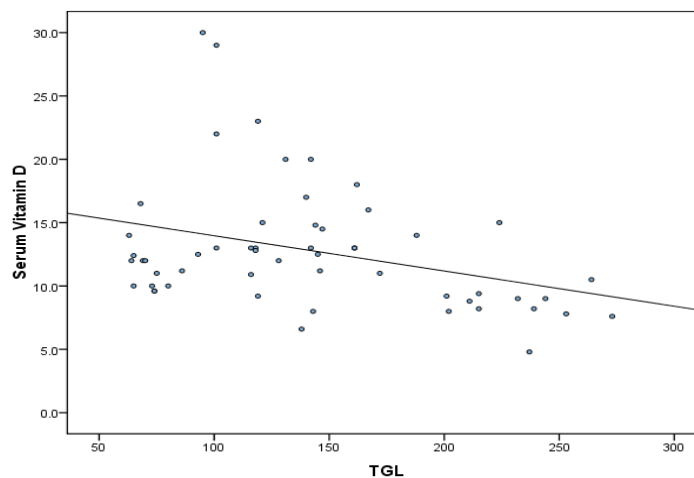


Figure 1: Scatter plot for correlation between serum vitamin D and TGL

Then we divided the study population into three subgroups based upon ATP III classification.¹⁵ Patients with normal TGL were classified as subgroup 1, borderline high TGL as subgroup 2 and high TGL as subgroup 3. To find the difference in mean vitamin D levels among these groups we performed ANOVA. The results revealed that there was significant difference seen in the mean vitamin D levels between subgroup 1 and 3. But there was no statistically significant difference between subgroup 2 to that of subgroup 1 and 3 (Table: 4 and 5).

Table 3: ANOVA for Vitamin D and Subgroup for TGL

| Subgroups | n | Serum Vitamin D Mean ± SD | p value |
|------------------------------------|----|---------------------------|---------|
| Subgroup – 1 (normal TGL) | 36 | 13.98 ± 5.29 | < 0.001 |
| Subgroup – 2 (borderline high TGL) | 6 | 14.17 ± 2.48 | |
| Subgroup – 3 (high TGL) | 13 | 8.88 ± 2.27 | |

Table 5: Post-Hoc for Vitamin D and Subgroup for TGL

| Subgroups | Mean Difference | p value |
|---|-----------------|---------|
| Subgroup – 1 (Normal TGL) vs Subgroup – 2 (borderline high TGL) | -0.19 | 1.00 |
| Subgroup – 1 (Normal TGL) vs Subgroup – 3 (High TGL) | 5.10 | 0.003* |
| Subgroup – 2 (borderline high TGL) vs Subgroup – 1 (normal TGL) | 0.19 | 1.00 |
| Subgroup – 2 (borderline high TGL) vs Subgroup – 3 (High TGL) | 5.28 | 0.066 |
| Subgroup – 3 (High TGL) vs Subgroup – 1 (normal TGL) | -5.10 | 0.003* |
| Subgroup – 3 (High TGL) vs Subgroup – 2 (borderline high TGL) | -5.28 | 0.066 |

DISCUSSION

The main objective of this study is to find out the association between hypovitaminosis D and lipid profile in non-obese diabetics. Our study results reveal that hypovitaminosis D is common in diabetics even after excluding obesity and it is associated with an increase in fasting blood glucose. We also found an inverse correlation between low vitamin D to that of TGL and VLDL. The vitamin D concentration in patients with normal TGL is higher than that of patients with high TGL concentration. But it was also found that the concentration of vitamin D in patients with normal TGL is lower than that of patients with borderline high TGL, this can be explained due to the low size of this subgroup (borderline high TGL n = 6) and it is not statistically significant. Few studies have been done to find the association between vitamin D and lipid profile in non-obese individuals, but the results of those are not unified.

A study was done by Jorde R, *et al.* to find the association between lipid profile and vitamin D after adjusting for obesity and the study showed an inverse association between vitamin D and TGL.¹⁰ But the results of Saedisomeolia A *et al* was contradictory to the previous study, because though he had found an inverse association between vitamin D and lipid profile, this association was abolished after adjusting for BMI.¹⁶ Similarly a study was done by Ponda MP, *et al* to find the influence of vitamin D deficiency on lipid profile. They divided their study population into two groups based on vitamin D levels and found that cholesterol, TGL and LDL is high in vitamin D deficiency group then compared to another group in which vitamin D was normal.¹⁷ But obesity was not excluded from their study. Similar results were observed in research done by Martin D *et al.*¹³ The 25 (OH)D-1 α -hydroxylase enzyme which synthesis the active form of the vitamin D is present in β cell and its receptor is also found in it.¹⁸ Vitamin D increases the insulin secretion either by increasing the serum calcium concentration or by binding to its own receptor in β cell.¹⁹ Vitamin D enhances the insulin sensitivity by increasing the expression of insulin receptors as well as it increases the insulin response to glucose transport into the cell.²⁰ The role of vitamin D in reducing triglyceride can be explained by its interaction with calcium, parathyroid hormone, lipoprotein lipase and insulin. Vitamin D increase the serum calcium concentration and this elevated calcium will diminish the hepatic triglyceride synthesis and secretion. One of the functions of parathyroid hormone is to reduce the peripheral removal of triglyceride, since vitamin D suppress parathyroid hormone it indirectly increase the peripheral removal of triglyceride. Vitamin D deficiency is one of the adjuvant causative factors in the development of insulin resistance. In insulin resistance triglyceride and VLDL production are elevated.²¹ Finally, since vitamin D is required for lipoprotein lipase activity, its activity is reduced in the presence of vitamin D deficiency.²²

Limitation

We had excluded the obesity based on BMI and not based on abdominal obesity, which might be wiser one and we had used relative precision for sample size calculation, which is also a limitation of the study.

CONCLUSION

From our study, we conclude that vitamin D deficiency is common among non-obese type 2 diabetics and vitamin D is inversely associated with glycemic control, TGL and VLDL even after excluding obese individuals.

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