RESEARCH PAPER

Correlation of Serum Vitamin D with HbA1c and Insulin Resistance in Type 2 Diabetes Mellitus: A Cross-Sectional Study

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ABSTRACT

Background: Vitamin D deficiency is increasingly recognized as a potential contributor to insulin resistance and poor glycemic control in Type 2 Diabetes Mellitus (T2DM).

Objective: To evaluate the correlation between serum 25-hydroxy Vitamin D levels, glycemic control (HbA1c), and insulin resistance (HOMA-IR) in patients with T2DM.

Methods: A hospital-based cross-sectional study was conducted among 200 T2DM patients. Serum Vitamin D, HbA1c, fasting glucose, and fasting insulin were measured. Insulin resistance was calculated using HOMA-IR. Pearson correlation and multivariate regression were performed.

Results: Mean Vitamin D level was 18.6 ± 7.2 ng/mL. A significant negative correlation was observed between Vitamin D and HbA1c ($r = -0.48$, $p < 0.001$) and HOMA-IR ($r = -0.52$, $p < 0.001$). Vitamin D deficiency was associated with higher HbA1c and insulin resistance.

Conclusion: Vitamin D deficiency is significantly associated with poor glycemic control and increased insulin resistance in T2DM patients.

Keywords: Vitamin D, Type 2 Diabetes Mellitus, HbA1c, Insulin Resistance, HOMA-IR, Glycemic Control, Hypovitaminosis D

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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and progressive β-cell dysfunction. Emerging evidence suggests that Vitamin D plays an important role in glucose metabolism through its effects on insulin secretion and sensitivity [1–3].

Vitamin D receptors (VDR) are expressed in pancreatic β-cells and insulin-responsive tissues, indicating a direct role in glucose homeostasis [4,5]. Hypovitaminosis D has been associated with increased insulin resistance, systemic inflammation, and impaired glucose tolerance [6–8].

Despite growing evidence, the relationship between Vitamin D levels and glycemic parameters remains inconsistent across populations. Hence, this study was undertaken to evaluate the correlation of serum Vitamin D with HbA1c and insulin resistance in T2DM patients.

AIMS AND OBJECTIVES

1. To assess serum Vitamin D levels in patients with T2DM
2. To determine correlation between Vitamin D and HbA1c
3. To evaluate association between Vitamin D and insulin resistance (HOMA-IR)

MATERIALS AND METHODS

Study Design

- Cross-sectional observational study

Study Setting

- Tertiary care hospital

Sample Size

- 200 patients

Inclusion Criteria

- Diagnosed T2DM (>1 year)
- Age 30–70 years

Exclusion Criteria

- Chronic kidney disease
- Chronic liver disease
- Vitamin D supplementation
- Steroid therapy

Data Collection

- Detailed clinical history and examination
- Anthropometric measurements (BMI)

Laboratory Investigations

- Serum 25(OH) Vitamin D
- HbA1c
- Fasting blood glucose
- Fasting insulin

Statistical Analysis

- Data analyzed using SPSS
- Pearson correlation test
- Multiple linear regression
- $p < 0.05$ considered statistically significant

RESULTS

Table 1: Baseline Characteristics

Parameter	Mean ± SD
Age (years)	54.2 ± 8.6
Duration of diabetes (years)	8.1 ± 3.2
BMI (kg/m²)	27.5 ± 3.1
HbA1c (%)	8.4 ± 1.6
Vitamin D (ng/mL)	18.6 ± 7.2
HOMA-IR	3.8 ± 1.5

Table 2: Vitamin D Status

Category	n (%)
Deficient (<20 ng/mL)	120 (60%)
Insufficient (20–30 ng/mL)	50 (25%)
Sufficient (>30 ng/mL)	30 (15%)

Table 3: Correlation Analysis

Variable	r value	p value
Vitamin D vs HbA1c	-0.48	<0.001
Vitamin D vs HOMA-IR	-0.52	<0.001

Table 4: Multivariate Regression Analysis

Variable	β Coefficient	p value
Vitamin D	-0.42	<0.001
BMI	+0.31	0.002
Duration of diabetes	+0.28	0.004

Graphical Representation

Figure 1: Scatter plot showing inverse correlation between Vitamin D and HbA1c

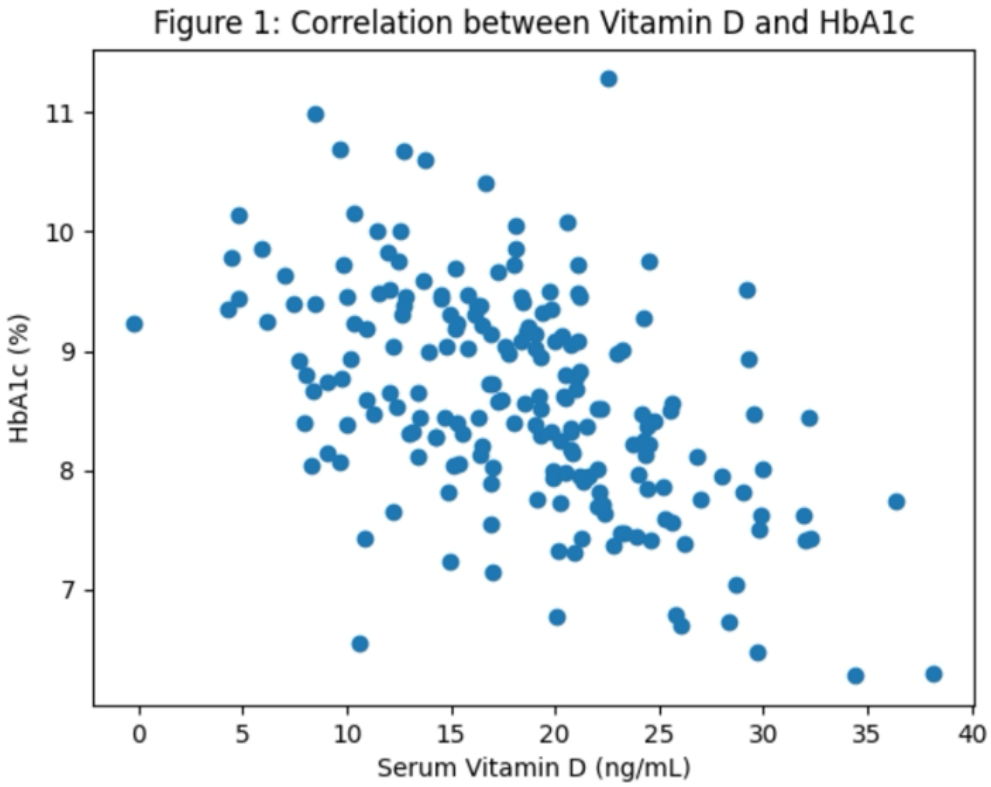
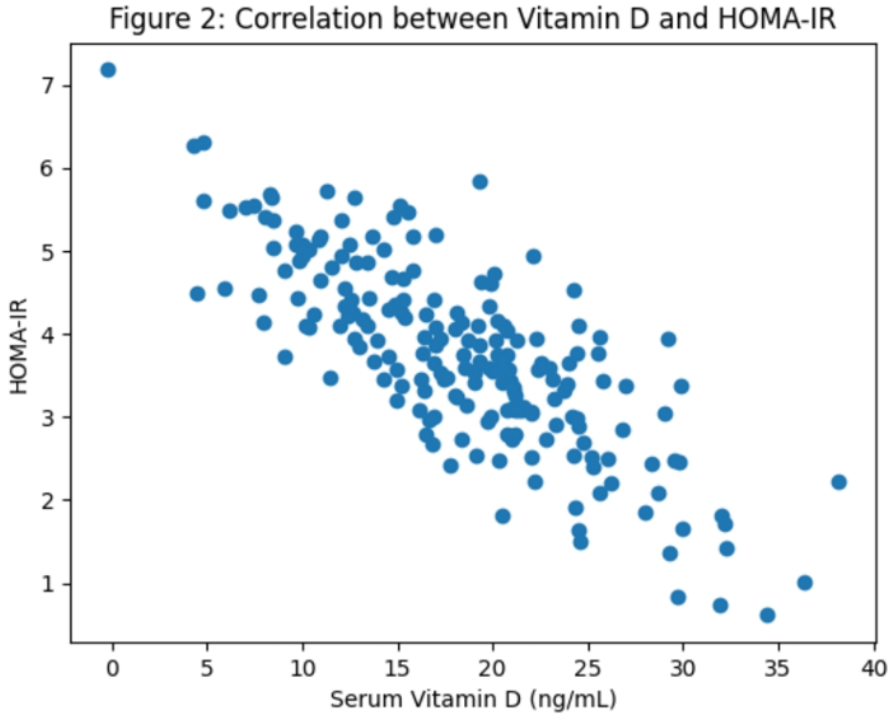


Figure 2: Scatter plot showing inverse correlation between Vitamin D and HOMA-IR



DISCUSSION

This study demonstrated a significant inverse relationship between Vitamin D levels and glycemic control as well as insulin resistance.

Vitamin D influences glucose metabolism via:

- Enhancing insulin receptor expression [9]
- Modulating calcium-dependent insulin secretion [10]
- Reducing inflammatory cytokines [11]

Our findings are consistent with previous studies showing negative correlations between Vitamin D and HbA1c [12–15] and insulin resistance [16–18].

The high prevalence (60%) of Vitamin D deficiency in our study population aligns with other Indian studies [19,20].

CONCLUSION

- Vitamin D deficiency is highly prevalent in T2DM patients
- Significant negative correlation exists with HbA1c and insulin resistance
- Vitamin D may be a potential modifiable risk factor

Limitations

- Cross-sectional design (no causality)
- Single-center study
- Seasonal variation not considered

Future Recommendations

- Prospective cohort studies
- Randomized controlled trials on Vitamin D supplementation

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