# A STUDY OF EVALUATION OF SERUM C-PEPTIDE LEVELS AND ITS CORRELATION WITH GLYCEMIC CONTROL IN TYPE 2 DIABETIC MELLITUS

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## ABSTRACT

**Background:** Type 2 Diabetes Mellitus (T2DM) is characterized by insulin resistance and relative insulin deficiency. Serum C-peptide, a marker of endogenous insulin secretion, has emerged as a potential indicator of β-cell function and glycemic control. This study aims to evaluate serum C-peptide levels and their correlation with glycemic control in T2DM patients.

**Methods:** A hospital-based observational cross-sectional study was conducted on 175 randomly selected T2DM patients aged over 18 years. Serum C-peptide levels, fasting blood sugar (FBS), postprandial blood sugar (PPBS), and glycated hemoglobin (HbA1c) were measured. Patients were grouped based on their C-peptide levels: <0.5 ng/mL, 0.5–3.2 ng/mL, and >3.2 ng/mL. Statistical analysis was performed using chi-square and Pearson's correlation tests.

**Results:** The mean age of patients was 54.05±9.99 years, with a male predominance (57.71%). The majority had a duration of diabetes >5 years (44.57%). A significant positive correlation was found between C-peptide levels and HbA1c ($r=0.79$, $p<0.0001$) and PPBS ($r=0.24$, $p=0.001$). No significant correlation was observed with FBS ($r=-0.12$, $p=0.113$). Patients with higher C-peptide levels (>3.2 ng/mL) had significantly higher HbA1c levels (mean 12.15±1.43) compared to those with lower C-peptide levels.

**Conclusion:** Elevated serum C-peptide levels correlate positively with poor glycemic control in T2DM patients, as indicated by higher HbA1c and PPBS levels. Monitoring C-peptide levels can provide valuable insights into β-cell function and aid in the management of T2DM.

**Keywords:** Type 2 Diabetes Mellitus, C-peptide, Glycemic Control, HbA1c, Insulin Secretion

## INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from insulin resistance and relative insulin deficiency [1]. According to the International Diabetes Federation, approximately 425 million people worldwide were living with diabetes in 2017, with a significant increase in incidence observed in India [1,2].

T2DM is prevalent in 2.4% of the rural population and 11.6% of the urban population in India [2].

Proinsulin, synthesized by pancreatic β-cells, is cleaved into insulin and C-peptide before secretion [3]. While insulin regulates glucose uptake, C-peptide has been traditionally considered biologically inert. However, recent studies suggest that C-peptide binds to cell surface receptors, activating G-protein coupled receptors and increasing intracellular calcium levels [4]. It has been implicated in improving glomerular filtration, enhancing nitric oxide production, and modulating proinflammatory markers like interleukin-6 and TNF-α [4,5].

C-peptide measurement offers an advantage over insulin in assessing endogenous insulin secretion, as it is not significantly extracted by the liver and has a longer half-life [6]. Additionally, C-peptide levels are not influenced by exogenous insulin administration, making it a reliable marker in insulin-treated patients [7].

The relationship between C-peptide levels and diabetic complications has been explored, with some studies indicating a protective effect of residual β-cell function on microvascular complications in T1DM [8,9]. However, the role of C-peptide in T2DM remains less clear, with conflicting evidence regarding its association with glycemic control and complications [10,11].

This study aims to evaluate serum C-peptide levels in T2DM patients and investigate their correlation with glycemic control, as assessed by HbA1c, FBS, and PPBS levels.

## MATERIALS AND METHODS

### Study Design and Population

A hospital-based observational cross-sectional study was conducted at SMS Hospital and its attached group of hospitals from June 2021 until the desired sample size was achieved. A total

of 175 randomly selected T2DM patients aged over 18 years, willing to provide informed written consent, were included.

**Inclusion Criteria**

- Patients diagnosed with T2DM aged >18 years.
- Willingness to provide informed consent.

**Exclusion Criteria**

- Chronic liver or renal disease.
- Anemic patients or those with hemoglobinopathies (e.g., thalassemia, sickle cell anemia).
- Patients taking drugs affecting HbA1c (e.g., aspirin, vitamins E and C).
- Pregnant women with diabetes.
- Patients with acute or chronic pancreatitis, pancreatic carcinoma.
- Patients on insulin therapy.

**Data Collection**

Detailed medical history and clinical examination were performed. Anthropometric measurements (height, weight, BMI) were recorded. Laboratory investigations included FBS, PPBS, HbA1c, and serum C-peptide levels.

**Laboratory Methods**

- **FBS and PPBS:** Measured using the glucose oxidase-peroxidase method.
- **HbA1c:** Assessed via high-performance liquid chromatography.
- **Serum C-peptide:** Quantified using an enzyme-linked immunosorbent assay (ELISA).

**Statistical Analysis**

Data were analyzed using SPSS software version 22.0. Qualitative data were expressed as percentages and proportions, analyzed using the chi-square test. Quantitative data were expressed as mean ± standard deviation (SD), analyzed using t-test or ANOVA. Pearson's correlation was used to assess the relationship between C-peptide levels and glycemic parameters. A p-value $<0.05$ was considered statistically significant.

## RESULTS

### Patient Demographics

The study included 175 T2DM patients with a mean age of 54.05±9.99 years. The majority were male (57.71%), and 53.71% were aged between 51–70 years (Table 1).

### Duration of Diabetes and Family History

Most patients had a duration of diabetes >5 years (44.57%) or between 2–5 years (44.00%), with a mean duration of 6.45±5.24 years. A positive family history of diabetes was reported in 45.71% of patients.

### Anthropometric Measurements

The mean weight and height were 59.38±9.60 kg and 157.02±8.14 cm, respectively. The mean BMI was 24.18±4.95 kg/m², with 48% of patients having a BMI between 18.5–24.9 kg/m² (Table 2).

### Glycemic Parameters

- **FBS:** The mean FBS was 169.38±33.1 mg/dL, with 88.57% of patients having FBS >125 mg/dL.
- **PPBS:** The mean PPBS was 220.9±49.02 mg/dL, with 98.29% of patients having PPBS >140 mg/dL.
- **HbA1c:** The mean HbA1c was 7.78±2.08%, with 65.71% of patients having HbA1c >6.4%.

### Serum C-Peptide Levels

Patients were categorized based on C-peptide levels:

- <0.5 ng/mL: 9.71%
- 0.5–3.2 ng/mL: 84.57%
- 3.2 ng/mL: 5.71%

**Correlation with Glycemic Control**

- **HbA1c:** A significant positive correlation was found between C-peptide levels and HbA1c ($r=0.79$, $p<0.0001$). Patients with C-peptide >3.2 ng/mL had significantly higher HbA1c levels (mean 12.15±1.43%) compared to those with lower C-peptide levels (Table 3).
- **PPBS:** A positive correlation was observed between C-peptide levels and PPBS ($r=0.24$, $p=0.001$). Patients with higher C-peptide levels had elevated PPBS values.
- **FBS:** No significant correlation was found between C-peptide levels and FBS ($r=-0.12$, $p=0.113$).

**Tables and Figures**

***TABLE 1: AGE AND GENDER DISTRIBUTION OF PATIENTS***

| Age Group (years) | Male (%) | Female (%) | Total (%) |
|---|---|---|---|
| 30–50 | 22.29 | 16.00 | 38.29 |
| 51–70 | 30.29 | 23.43 | 53.71 |
| >70 | 5.14 | 2.86 | 8.00 |
| **Total** | **57.71** | **42.29** | **100.00** |

***TABLE 2: BMI DISTRIBUTION***

| BMI (kg/m²) | Number of Patients | Percentage (%) |
|---|---|---|
| <18.5 | 13 | 7.43 |
| 18.5–24.9 | 84 | 48.00 |
| 25–29.9 | 67 | 38.29 |
| >29.9 | 11 | 6.29 |
| **Total** | **175** | **100.00** |

***TABLE 3: CORRELATION OF C-PEPTIDE LEVELS WITH HBA1C***

| C-Peptide Levels (ng/mL) | Number of Patients | Mean HbA1c (%) | SD | p-value |
|---|---|---|---|---|
| <0.5 | 17 | 7.01 | 0.57 | |
| 0.5–3.2 | 148 | 7.57 | 1.89 | <0.0001 |
| >3.2 | 10 | 12.15 | 1.43 | |
| **Total** | **175** | | | |

***FIGURE 1: SCATTER PLOT SHOWING CORRELATION BETWEEN C-PEPTIDE LEVELS AND HBA1C***

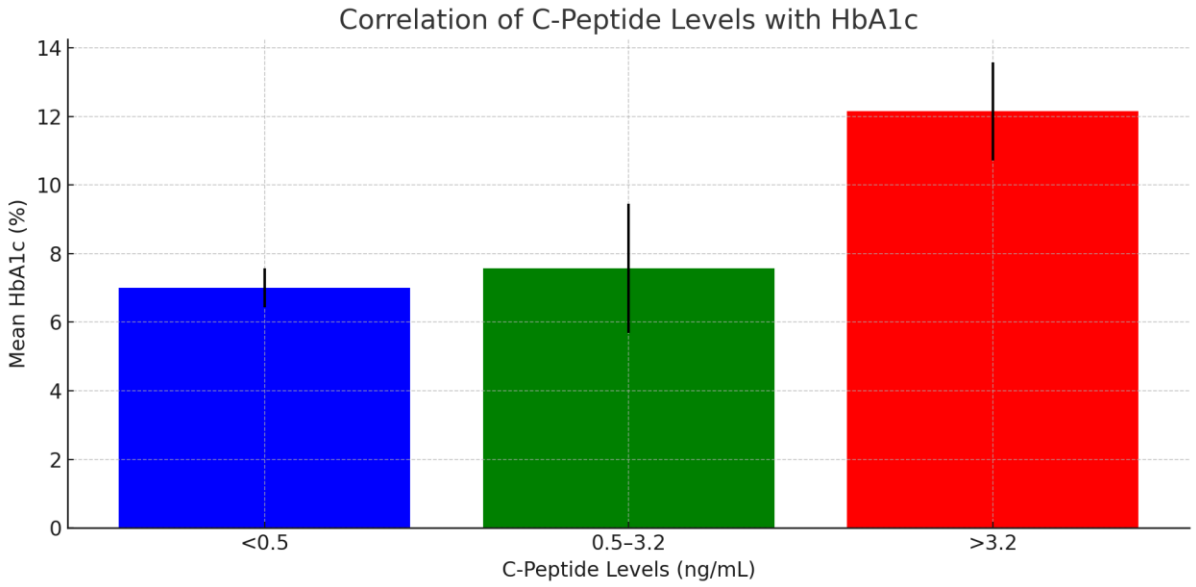
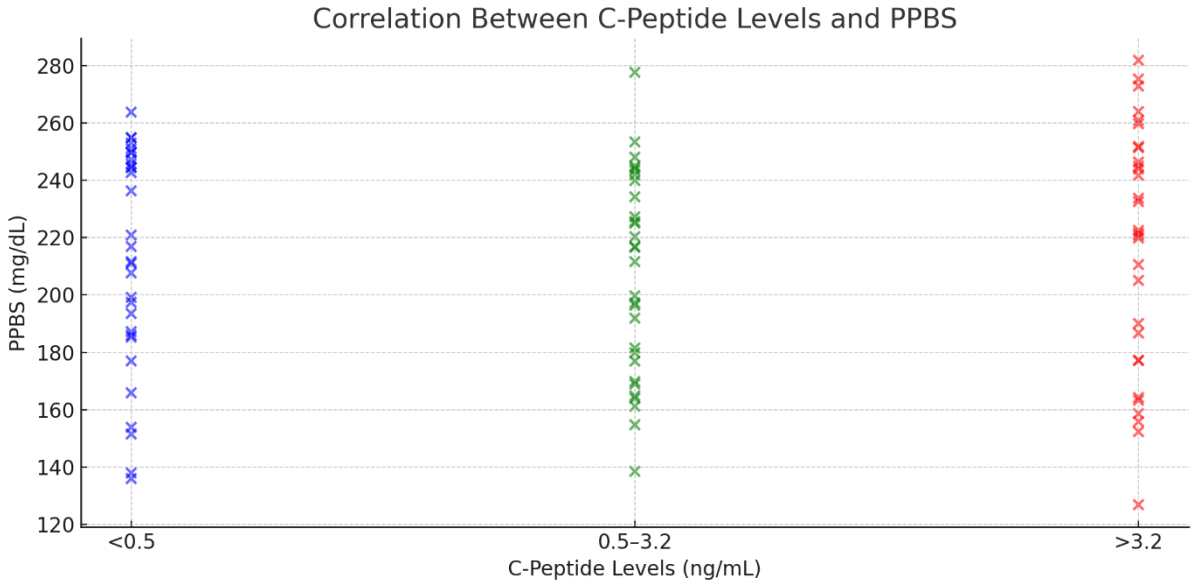


***FIGURE 2: SCATTER PLOT SHOWING CORRELATION BETWEEN C-PEPTIDE LEVELS AND PPBS***



## DISCUSSION

This study investigated the correlation between serum C-peptide levels and glycemic control in patients with T2DM. The findings demonstrate a significant positive correlation between C-peptide levels and both HbA1c and PPBS, indicating that higher C-peptide levels are associated with poorer glycemic control.

The mean age of participants was consistent with other studies highlighting the prevalence of T2DM in middle-aged individuals [12]. The male predominance aligns with previous research suggesting higher susceptibility among males due to lifestyle factors [13].

Elevated C-peptide levels in T2DM patients may reflect hyperinsulinemia secondary to insulin resistance. As β-cells compensate for insulin resistance, increased proinsulin and C-peptide are secreted [14]. This compensatory mechanism may eventually lead to β-cell exhaustion, contributing to poor glycemic control.

The strong positive correlation between C-peptide levels and HbA1c ($r=0.79$) suggests that C-peptide can serve as a marker for long-term glycemic control. Similar findings were reported by Li et al., who found that higher C-peptide levels were associated with increased HbA1c in T2DM patients [15].

The lack of significant correlation between C-peptide levels and FBS contrasts with the findings related to PPBS. Postprandial hyperglycemia is a significant contributor to elevated HbA1c levels and may be more sensitive to changes in insulin secretion and action [16].

Previous studies have shown conflicting results regarding the role of C-peptide in T2DM. While some have suggested protective effects of residual insulin secretion on microvascular complications, others have not found such associations [17,18]. Our study supports the notion

that elevated C-peptide levels, indicative of insulin resistance and β-cell overactivity, correlate with poor glycemic control.

The clinical implications of these findings emphasize the importance of monitoring C-peptide levels as part of the comprehensive management of T2DM. It may aid in identifying patients at risk of poor glycemic control and guiding therapeutic interventions targeting insulin resistance.

**Limitations**

This study has certain limitations, including its cross-sectional design, which precludes establishing causality. The sample was hospital-based, which may limit the generalizability of the findings. Further longitudinal studies with larger populations are needed to validate these results.

## CONCLUSION

Elevated serum C-peptide levels are significantly associated with poor glycemic control in T2DM patients, as evidenced by higher HbA1c and PPBS levels. Monitoring C-peptide levels can provide valuable insights into endogenous insulin secretion and β-cell function. Incorporating C-peptide assessment in routine clinical practice may enhance the management and therapeutic strategies for patients with T2DM.

## REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas, 8th edn. Brussels, Belgium: 2017.
2. Indian Council of Medical Research. Guidelines for Management of Type 2 Diabetes 2018.
3. Marx N, et al. Proatherogenic effects of C-peptide: inhibition of endothelial apoptosis and activation of nuclear factor-κB. Diabetologia. 2004;47(3):532-536.
4. Forst T, et al. Biological activity of C-peptide on the vascular endothelium: effects on nitric oxide production. Diabetes. 2000;49(5):755-761.
5. Wahren J, et al. C-peptide is a bioactive peptide. Diabetologia. 2000;43(7):687-703.
6. Polonsky KS, et al. C-peptide as a measure of the secretion of insulin. N Engl J Med. 1986;314(4):200-205.
7. Rigler R, et al. Specific binding of proinsulin C-peptide to human cell membranes. Proc Natl Acad Sci U S A. 1999;96(23):13318-13323.
8. Johansson BL, et al. Beneficial effects of C-peptide on myocardial blood flow and function in type 1 diabetic patients. Diabetes. 1996;45(7):933-939.
9. Ekberg K, et al. C-peptide replacement therapy and sensory nerve function in type 1 diabetic neuropathy. Diabetes Care. 2007;30(1):71-76.
10. Steffes MW, et al. Beta-cell function and the development of diabetes-related complications in the diabetes control and complications trial. Diabetes Care. 2003;26(3):832-836.

11. Davis TM, et al. The relationship between residual beta-cell function and diabetic complications. Diabetes Res Clin Pract. 1998;39(3):165-172.

12. Wild S, et al. Global prevalence of diabetes: estimates for 2000 and projections for 2030. Diabetes Care. 2004;27(5):1047-1053.

13. Ali O. Genetics of type 2 diabetes. World J Diabetes. 2013;4(4):114-123.

14. Kahn SE. The relative contributions of insulin resistance and beta-cell dysfunction to the pathophysiology of Type 2 diabetes. Diabetologia. 2003;46(1):3-19.

15. Li Y, et al. Association of fasting serum C-peptide levels with metabolic risk factors and chronic complications in type 2 diabetes. Med Sci Monit. 2015;21:3550-3557.

16. Monnier L, et al. Contributions of fasting and postprandial plasma glucose increments to the overall diurnal hyperglycemia of type 2 diabetic patients. Diabetes Care. 2003;26(3):881-885.

17. Panero F, et al. C-peptide and microvascular complications in type 2 diabetic patients. Diabetes Metab Res Rev. 2009;25(1):41-49.

18. Saisho Y. Importance of beta-cell function for the treatment of type 2 diabetes. J Clin Med. 2014;3(3):923-943.