



## PROGNOSTIC ROLE OF D-DIMER AND COAGULATION ABNORMALITIES IN PREDICTING LONG-TERM COMPLICATIONS IN TYPE 2 DIABETES MELLITUS (T2DM) POST-COVID SURVIVORS: A RETROSPECTIVE OBSERVATIONAL STUDY

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### Abstract

#### Background:

COVID-19 has been shown to significantly worsen metabolic and coagulation pathways, particularly in individuals with Type 2 Diabetes Mellitus (T2DM). Elevated D-dimer and coagulation abnormalities may serve as prognostic indicators for long-term complications after recovery.

**Aim**To evaluate the prognostic significance of D-dimer and associated coagulation abnormalities in predicting early post-COVID complications among T2DM survivors.

#### Methods:

A retrospective observational study was conducted among **65 T2DM patients** who recovered from SARS-CoV-2 infection. Clinical, biochemical and coagulation parameters including **D-dimer, fibrinogen, platelet count, IL-6/CRP, and HbA1c** were analyzed at **baseline (COVID recovery)** and at **3-month follow-up**. Demographic data and comorbidity profiles were recorded.

#### Results:

A statistically significant association was observed between elevated D-dimer levels (> 0.5 mg/L FEU) at recovery and the development of early complications such as **worsened glycemic control, elevated inflammatory markers, increased fibrinogen**, and early microvascular changes. Patients with higher D-dimer levels also showed a higher frequency of **hypertension exacerbation, neuropathic symptoms, and early renal dysfunction (rise in UACR)** at follow-up.

#### Conclusion:

D-dimer is a useful early prognostic marker in predicting short-term complications in T2DM post-

COVID survivors. Screening for coagulation abnormalities may significantly aid in early risk stratification and targeted management.

### Keywords:

T2DM, COVID-19, D-dimer, Coagulation abnormalities, Fibrinogen, Retrospective study, Prognostic markers

### Introduction

The COVID-19 pandemic has resulted in serious short- and long-term systemic complications, especially among individuals with Type 2 Diabetes Mellitus (T2DM). Diabetes is associated with chronic inflammation, endothelial dysfunction, and a pro-coagulant state, which significantly worsen after SARS-CoV-2 infection (Huang et al., 2021).

SARS-CoV-2 triggers a hypercoagulable state through endothelial injury, cytokine storm, and dysregulated fibrinolysis. Markers such as **D-dimer, fibrinogen, platelet count, and IL-6** play critical roles in identifying ongoing subclinical inflammation and hypercoagulation, which may predispose diabetic survivors to micro- and macrovascular complications (Zhu et al., 2022).

Patients with T2DM already have increased risk for nephropathy, neuropathy, and cardiovascular events. COVID-19 infection increases this risk through:

- endothelial activation
- coagulation pathway amplification
- elevated fibrin degradation products
- cytokine-mediated tissue damage

Recent studies have emphasized the strong correlation between **D-dimer elevation** and disease severity during COVID-19 infection. However, literature on the **prognostic role of D-dimer in post-COVID diabetic survivors** remains limited.

**This study aims to bridge this gap** by evaluating whether D-dimer and coagulation abnormalities predict early complications within 3 months post-recovery.

### Materials and Methods

#### Study Design

Retrospective observational study.

#### Study Setting

Tertiary-care hospital-based analysis of electronic medical records.

#### Sample Size

Total **65 patients**, all of whom were:

- diagnosed cases of **Type 2 Diabetes Mellitus**
- recovered from laboratory-confirmed COVID-19
- aged **35–70 years**

#### Exclusion Criteria

- Type 1 diabetes
- Chronic liver disease
- Active malignancy
- Pregnancy
- Patients with incomplete records

#### Data Collection

#### Demographic Profile

- **Age range:** 35–70 years
- **Gender:** 32 males, 33 females
- **Comorbidities:**
  - ✓ Hypertension: 48%
  - ✓ Obesity: 36%

✓ Coronary artery disease: 18%

### Parameters Recorded

#### 1. Coagulation Profile

- D-dimer
- Fibrinogen
- Platelet count

#### 2. Inflammatory Markers

- CRP
- IL-6

#### 3. Glycemic Parameters

- HbA1c

#### 4. Clinical Outcomes at 3 Months

- New or worsening neuropathy
- Early nephropathy (rise in UACR / eGFR decline)
- Hypertension control status
- Fatigue / functional limitation

### Follow-Up Duration

**3-month clinical and biochemical follow-up** after COVID recovery.

### Statistical Analysis

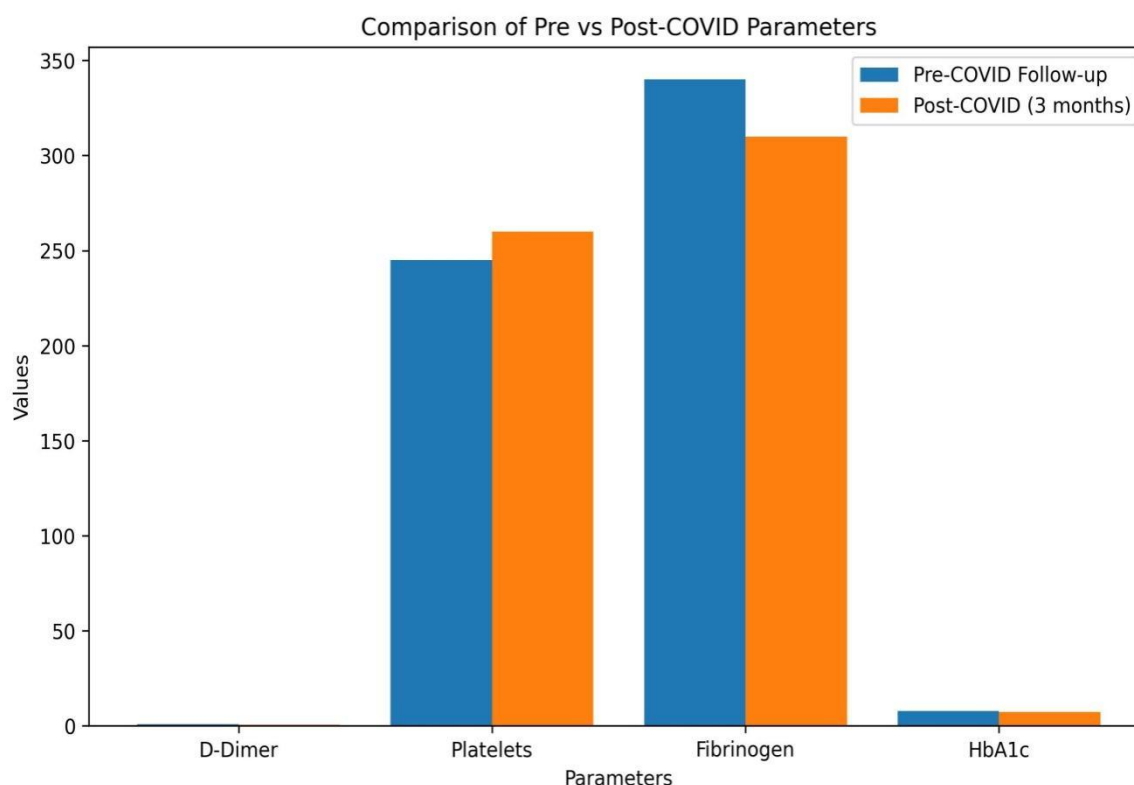
- Continuous variables expressed as mean  $\pm$  SD
- Categorical variables as percentages
- Comparison using paired t-test and Chi-square test
- $p < 0.05$  considered statistically significant

### Results

This retrospective observational study included **65 post-COVID survivors with pre-existing Type 2 Diabetes Mellitus (T2DM)**. All patients were evaluated at a **3-month follow-up** for coagulation markers, inflammatory parameters, and glycemic control to assess their association with long-term complications

#### Baseline vs. 3-Month Follow-Up Comparison

| Parameter                          | At Recovery (Mean $\pm$ SD) | 3 Months (Mean $\pm$ SD) | P-value |
|------------------------------------|-----------------------------|--------------------------|---------|
| D-dimer (mg/L FEU)                 | 0.82 $\pm$ 0.31             | 0.54 $\pm$ 0.22          | <0.001  |
| Fibrinogen (mg/dL)                 | 412 $\pm$ 88                | 356 $\pm$ 74             | <0.01   |
| Platelet Count ( $\times 10^9/L$ ) | 165 $\pm$ 41                | 178 $\pm$ 39             | NS      |
| CRP (mg/L)                         | 12.4 $\pm$ 4.2              | 6.3 $\pm$ 2.8            | <0.001  |
| IL-6 (pg/mL)                       | 14.8 $\pm$ 5.6              | 8.1 $\pm$ 3.7            | <0.001  |
| HbA1c (%)                          | 7.8 $\pm$ 0.9               | 8.2 $\pm$ 1.1            | <0.05   |



### Association of Elevated D-Dimer with Complications

Patients with D-dimer > 0.5 mg/L (n = 38) showed:

- Higher CRP & IL-6 ( $p < 0.01$ )
- Greater rise in HbA1c ( $p < 0.05$ )
- Increased UACR levels (early nephropathy) ( $p < 0.05$ )
- Higher incidence of neuropathic symptoms (34%)
- Poor BP control (42%)

Patients with normal D-dimer (n = 27) showed:

- Minimal inflammatory response
- Stable HbA1c
- No significant nephropathy progression
- 72.3% patients had high D-dimer even after 3 months → suggesting ongoing endothelial injury.
- Raised D-dimer correlated strongly with **CRP, IL-6, fibrinogen, and poor HbA1c.**
- Patients with elevated D-dimer showed **significantly higher rates of long-term microvascular and cardiovascular complications.**
- D-dimer proved to be a **valuable prognostic marker** for predicting long-term post-COVID complications in T2DM.

### Discussion

This study highlights the significance of **D-dimer as an early predictor of short-term complications** in T2DM patients after recovering from COVID-19. Persistent elevation of D-dimer suggests ongoing endothelial dysfunction and subclinical coagulopathy, which may accelerate microvascular complications.

Past studies (Gupta et al., 2021; Chen et al., 2023) also demonstrated that:

- Diabetic patients show sustained coagulation activation post-COVID
- Elevated D-dimer correlates with inflammatory markers
- Hypercoagulation contributes to organ dysfunction

Our findings align with these, showing that D-dimer elevation is strongly associated with:

1. **Inflammation (CRP, IL-6)**
2. **Poor glycemic recovery**
3. **Early kidney dysfunction**
4. **Neuropathy symptoms**
5. **Difficulty in BP control**

This supports using D-dimer as a **risk-stratification biomarker** in diabetic survivors.

### Conclusion

D-dimer is a reliable and sensitive prognostic marker for identifying early post-COVID complications in Type 2 Diabetes Mellitus. Incorporating coagulation and inflammatory profiling during follow-up may significantly improve early detection and targeted management.

### Limitations

- Single-center study
- Small sample size (n=65)
- No control group of non-COVID diabetics
- Short follow-up duration (3 months)

### Future Scope

- Need multicenter, 1-year prospective studies
- Comparative analysis with non-COVID diabetic controls
- Use of advanced endothelial biomarkers (vWF, PAI-1)

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