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Original Research Article

To Study the C - reactive protein Levels in Type 2 Diabetic Patients and Its Relation with the Glycemic Control

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Abstract

Objectives: To study C-reactive protein levels in type 2 diabetics, to assess the relationship between CRP levels and glycemic control. Also to evaluate the correlation between CRP levels and specific diabetic complications (microvascular and macrovascular).

Methods: A cross-sectional observation study conducted to assess CRP levels in patients with Type 2 diabetes mellitus**.** The study included 50 subjects diagnosed with Type 2 diabetes mellitus as per WHO guidelines. Venous blood samples will be collected after an overnight fast for Fasting plasma glucose, 2-hour post-prandial blood glucose, lipid profile and C-reactive protein (CRP) levels.

Results: Among patients with controlled glycemic status, the majority 72.7% had normal CRP levels while only 27.3% showed high CRP. Whereas in uncontrolled glycemic status 69.2%had high CRP and only 30.8% had normal CRP with a P value of 0.012 which is statistically significant. CRP is raised in patients with high HBA1C levels compared to low HBA1C levels with p value of 0.015. A statistically significant association was observed between dyslipidaemia and high CRP levels (p=0.047).

Conclusion: Type 2 diabetes with poor glycemic control is associated with high CRP levels indicating that it is a significant inflammatory marker in diabetes.

Keywords: Type 2 diabetes, C-Reactive Protein Levels, Glycemic Control.

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Introduction

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance, progressive dysfunction of pancreatic β-cells, and persistent hyperglycemia. It represents one of the most significant non-communicable diseases affecting populations worldwide.

India, in particular, bears a disproportionately high burden of diabetes and is often referred to as the "diabetes capital of the world". The high prevalence in India is influenced by genetic susceptibility, urban migration, reduced physical activity, dietary transitions, and increasing rates of obesity. Traditionally, diabetes has been viewed primarily as a disorder of the carbohydrate metabolism, however, emerging evidence suggests that Type 2 Diabetes Mellitus is not merely a metabolic condition but also a state of chronic low-grade systemic inflammation. Chronic hyperglycaemia leads to the activation of multiple biochemical pathways, including increased production of reactive oxygen species, advanced glycation end products, and activation of inflammatory signalling pathways. These mechanisms collectively contribute to endothelial dysfunction, vascular inflammation, and tissue injury resulting in diabetic complications. Inflammation has emerged as a key link between insulin resistance, obesity, and Type 2 Diabetes Mellitus. Adipose tissue, particularly visceral fat, act as an active endocrine organ that secretes several pro-inflammatory cytokines, including tumour necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6). These cytokines interfere with insulin signalling and promote a chronic inflammatory state. Persistent low-grade inflammation further exacerbates insulin resistance and contribute to metabolic dysregulation. C-Reactive protein level is the most commonly and widely used inflammatory marker.

Materials and Methods

A cross-sectional observation study was conducted to assess CRP levels in patients with type 2 diabetes mellitus and its association with diabetic complications in the outpatient and inpatient wards of the department of general medicine, King George hospital, Visakhapatnam. Duration of study was from October 2025 to December 2025. Ethical approval was obtained from the institutional scientific committee and ethics committee before commencing the study.

Sample Size: A convenient sample of 50 subjects diagnosed with Type 2 diabetes mellitus as per WHO guidelines were included in the study.

Sampling Technique: simple random method.

Inclusion Criteria: Type 2 diabetic patients aged above 30 years, both men and women are included in the study.

Exclusion Criteria:: Smokers, Alcoholics, Patients with acute infections or inflammatory diseases within the past 4 weeks, Patients with autoimmune disorders, chronic inflammatory diseases, or malignancies, Pregnant or lactating women. Terminally ill patients.

Method of Data Collection: A pre-designed semi-structured and pre-tested questionnaire was used as primary data collection tool. The questionnaire consists of Socio-demographic information.

Anthropometry data- Height and weight will be measured, and BMI calculated using the formula: BMI = weight (kg)/height (m^2)**,** Sphygmomanometer for measuring blood pressure.

Lab investigations- Venous blood samples will be collected after an overnight fast to determine: Fasting plasma glucose, 2-hour post-prandial blood glucose, Lipid profile, C-reactive protein (CRP) levels.

Plasma glucose will be measured using the glucose oxidase method. Serum cholesterol and triglycerides will be measured using commercially available enzymatic kits on the CHEM 7 semi-auto analyser. CBC and CRP levels will be measured from the same sample.

Implications: C-reactive protein (CRP) is one of the most extensively studied inflammatory markers in diabetes. Numerous epidemiological and clinical studies have demonstrated elevated CRP levels have been associated with poor glycemic control, increased resistance, obesity, and dyslipidaemia. High CRP levels have been consistently linked with the presence and severity of diabetic complications, particularly cardiovascular disease.

Assessing CRP levels in patients with type 2 diabetics can help early identification of high-risk patients and allows timely intervention, better monitoring, and more individualized management strategies.

Statistical Analysis: All data was entered into a secure database (Microsoft Excel) with periodic verification for accuracy and data will be analysed using SPSS software version 16.0. Students t-test will be used to compare continuous variables. Chi-square test will be applied to assess association between CRP levels and diabetic complications. And a p-value < 0.05 was considered statistically significant.

Observations and Results

In this study, out of total 50 patients, 30 were Females which is of 60% and 20 were males which were of 40%. The study population shows that majority are females.

Table 1: Age

Age	Frequency	Percentage (%)
30 – 40 years	**7**	**14%**
40 – 50 years	**9**	**18%**
50 – 60 years	**12**	**24%**
60-70 years	**16**	**32%**
70- 80 years	**6**	**12%**

The age of the study participants ranged from 31 to 75 years, with a mean age of 54.9±11.7 years. The median age was 55 years, indicating that half of the participants were older than 55 years. This study shows that majority of patients belonged to 60-70 years age (32%) indicating prevalence of type 2 diabetes increases with advancing age.

Poor Glycemic Control:

Table 2: CRP Grading in relation to Glycemic Control among study subjects (n = 50)

Glycemic Status	CRP Grading				Total	
	Normal		High			
	N	%	N	%	N	%
Controlled	08	72.2	03	27.3	11	100.0
Uncontrolled	12	30.8	27	69.2	39	100.0
Total	20	40.0	30	80.0	50	100.0

This table shows the association between glycemic control and CRP grading.

Among patients with controlled glycemic status n =11, the majority had normal CRP levels 72.7% while only 27.3% showed high CRP. In contrast among uncontrolled 69.2%had high CRP and only 30.8% had normal CRP. The chi square value = 6.294 with a P value of 0.012 which is statistically significant P less than 0.05. It shows that uncontrolled glycemic status is associated with high CRP levels.

HbA1C:

Table 3: HbA1c in relation to CRP Grading among study subjects (n= 50)

CRP GRADING	HbA1C LEVEL	
	MEAN	SD
NORMAL (N=20)	6.55	0.7
HIGH (N=30)	7.06	0.7

HbA1C showed a significant association with CRP suggesting that chronic hyperglycaemia, rather than short term glucose fluctuations, is more strongly linked to elevated CRP. P value is 0.015 which is a statistically significant.

Table 4: CRP Grading in relation with lipid profile among study subjects (n= 50)

	CRP		
Lipid Profile	Normal	Elevated	Total
Normal	12	8	20
Dyslipidemia	10	20	30
Total	22	28	50

Chi-square value: 3.94. p-value: 0.047

A statistically significant association was observed between lipid profile and CRP levels. Elevated CRP was more frequently seen among participants with dyslipidemia (20/30) compared to those with a normal lipid profile (8/20). This finding suggests that dyslipidemia is associated with increased systemic inflammation, as reflected by higher CRP levels. The observed relationship supports the role of inflammatory mechanisms in lipid abnormalities and their contribution to cardiovascular risk.

Table 5: CRP Grading in relation to overall diabetic complications among study subjects (n=50)

Complications	CRP grading					
	Normal		High		Total	%
Present	06	26.1	17	73.9	23	100
Absent	14	51.9	13	48.1	27	100
Total	20	40.0	30	60.0	50	100

Among patients with diabetic complications 73.9% had elevated CRP levels were 48.1% of patient without complication shows higher CRP although a higher proportion of complications was observed in high CRP group.

Discussion

Type 2 diabetes mellitus is increasingly recognized as a metabolic disorder associated with chronic low-grade systemic inflammation. C-reactive protein, an acute phase reactant, reflects this inflammatory burden and has been linked to poor glycaemic control, insulin resistance, dyslipidaemia, and diabetic complications. The present study evaluated CRP levels in patients with type 2 diabetes mellitus and assessed their association with glycemic status, lipid profile, and organ specific complications, with findings compared to previous studies. In present study, a statistically significant association was observed between CRP levels and glycaemic control. Among patients with uncontrolled diabetes, 69.2% had elevated CRP levels, whereas only 27.3% of controlled diabetics showed elevated CRP values (p= 0.012). This finding indicates that poor glycemic control is associated with increased systemic inflammation. Comparable results have been reported in earlier studies. King et al.[10] observed approximately 1.8-2fold higher CRP levels in patients with Hb1AC values greater than 7%, while Doraickannu et al.[7] reported elevated hs-CRP levels in 64% of poorly controlled diabetic patients study. The slightly higher proportion observed in this study may reflect a tertiary-care hospital population with higher prevalence of uncontrolled diabetes. Although insulin resistance was not measured directly in the present study, the observed association between elevated CRP levels, higher HbA1C values, and uncontrolled diabetes indirectly supports a link between systemic inflammation and insulin resistance. Sharma and pandit demonstrated a significant positive correlation between hs-CRP levels and insulin resistance indices in patients with type 2 diabetes mellitus [6].

In the present study, HbA1c showed a statistically significant association with CRP levels (p=0.015), whereas fasting and post-prandial blood glucose levels did not show statistically significant associations. This suggests that long-term glycemic burden is more closely related to systemic inflammation that short-term glucose fluctuations.

This observation is consistent with findings reported by festa et al. who demonstrated that CRP correlates strongly with chronic glycaemic exposure and insulin resistance than with isolated fasting or post prandial glucose values [11]. Pradhan et al. also emphasised that inflammatory markers better reflect sustained metabolic dysregulation rather than acute glycaemic variations [9]. A statistically significant association was observed between CRP levels and lipid profile abnormalities in the present study. Among patient with dyslipidemia, 66.7% had elevated CRP levels compared to 40% among those with normal lipid profile (p= 0.047). This finding highlights the close relationship between dyslipidemia and systemic inflammation in type 2 diabetes mellitus. Dyslipidaemia promotes endothelial dysfunction and atherosclerosis through inflammatory pathways, reinforcing the role of CRP as a marker linking metabolic abnormalities with cardiovascular risk. Similar associations between CRP and dyslipidaemia in cardiovascular risk have been reported in previous studies.

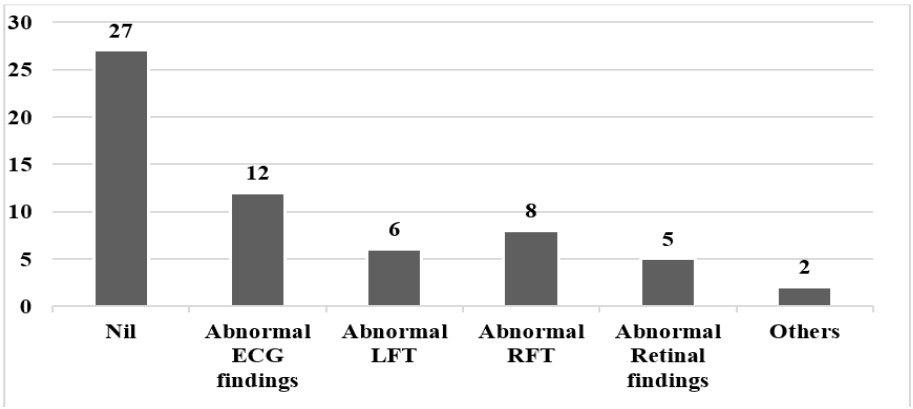


Figure 1: Various diabetic complications among study subjects (n=50)

In the present study, 73.9% of patients with diabetic complications had elevated CRP levels, compared to 48.1% among those without complications. This findings are consistent with the casalemonferrato study by Bruno et al. which demonstrated increased all causes and cardiovascular mortality among diabetic patients with elevated CRP levels [2]. Similarly tian et al. in a meta-analysis identified CRP as an independent predictor of cardiovascular and all-cause mortality in type 2 diabetes mellitus [4]. A notable trend was observed between elevated CRP levels and renal involvement. Among patients with abnormal renal function tests, 87.5% had elevated CRP levels, compared to 54.8% among those with normal renal parameters. This observation parallels the findings of Navarro et al., who reported significantly higher CRP levels in diabetic patients with nephropathy [14], supporting the role of inflammation in the progression of diabetic renal disease. In the present study, 75% of patients with abnormal ECG findings had elevated CRP levels, compared to 55.3% among those with normal ECGs. Ridker et al. demonstrated that CRP predicts cardiovascular events independently of lipid levels, highlighting its role in atherosclerosis and endothelial dysfunction [12]. The present findings are therefore contributory and consistent with existing evidence.

Among patients with abnormal liver function tests, 83.3% had elevated CRP levels, compared to 56.8% among those with normal LFT values. This finding may reflect underlying non-alcoholic fatty liver disease, which is frequently associated with insulin resistance and chronic inflammation in patients with type 2 diabetes mellitus. 60% of patients with retinal changes exhibited elevated CRP levels, suggesting that CRP reflects systemic inflammatory status rather than localised microvascular damage, particularly in early or mild retinopathy.

Limitations: Relatively Small sample size which may have limited the statistical power to detect significant associations, particularly for organ-specific complications.

Cross-sectional study design: as data were collected at a single point in time, causal relationship between CRP levels and glycemic control or diabetic complications cannot be established.

Potential confounding factors such as obesity, duration of diabetes, medication use (e.g., statins or anti-inflammatory drugs), were not fully controlled and may have influenced CRP levels.

Conclusion

The present study demonstrates that type 2 diabetes mellitus is closely associated with a state of chronic low-grade systemic inflammation, as reflected by elevated c-reactive protein levels. a statistically significant association was observed between elevated CRP levels and poor glycemic control, particularly higher hba1c values, indicating that sustained hyperglycaemia plays a key role in promoting inflammatory activity.

The significant associations were also observed between CRP levels and dyslipidemia, emphasizing the interplay between metabolic abnormalities and inflammation in type-2 diabetes mellitus. Elevated CRP levels were consistently more prevalent among patients with uncontrolled diabetes, lipid abnormalities, and diabetes complications, suggesting that CRP reflects overall disease severity and metabolic stress.

Overall, the results of this study support the role of CRP as a useful adjunct biomarker in the comprehensive evaluation of patients with type 2 diabetes mellitus. Incorporating CRP assessment alongside routine glycemic and lipid parameters may help in early identification of high-risk individuals and facilitate timely preventive and therapeutic interventions.

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