



Correlation Between HbA1C Levels And C-Reactive Protein Levels In Diabetes Mellitus Patients

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ABSTRACT

Diabetes mellitus (DM) is a chronic disease characterised by elevated blood glucose levels ≥ 200 mg/dl due to metabolic disorders. Insulin resistance triggers a blood glucose imbalance, resulting in no energy supply needed by the body's cells. The condition of DM is destructive to the body and, therefore, needs to be measured with stable parameters for the long term. HbA1c is a standard clinical examination used as a determinant of glycaemic status in DM disease. C-reactive protein (CRP) level is an effective parameter in determining the index of damage or inflammation that occurs in the body due to DM. This study aims to determine the relationship between HbA1c levels and CRP levels in patients with diabetes mellitus at Dr. Sardjito Hospital. Twenty patients with type 2 diabetes mellitus were included in this study using the purposive sampling technique. HbA1c data and CRP levels were analysed with the Spearman correlation test. The Pearson correlation test results showed a p-value = 0.001 and an r-value = 0.705. There is a relationship between HbA1c levels and CRP levels in DM patients at RSUD Dr. Soedirman Kebumen.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia due to abnormalities in insulin secretion, insulin action, or both, causing metabolic function disorders and multi-organ failure, especially in the kidneys, eyes, nerves, heart, and blood vessels (Tandjungbulu et al., 2022). The Ministry of Health of the Republic of Indonesia reported in 2018 that the prevalence of DM mainly aged 55–64 years at 6.29% and females at 1.78% (Kemenkes RI, 2019). The prevalence of DM in Central Java in 2021 was 10.7% (DinkesProv Jateng, 2021). During 2022, there were 647 thousand cases of diabetes in Central Java, and in Kebumen Regency, two types of diabetes were identified, namely type I DM with 980 cases and type 2 DM (T2DM) with 10,482 cases. The results of data collection at RSUD Kebumen found 739 cases of diabetes, with 137 cases of type 1 DM (T1DM), 491 cases of type II diabetes, 23 cases of diabetes during pregnancy, and 88 cases of other types of diabetes.

DM disease can thus be diagnosed through blood glucose measurement (Bistara, et al., 2022). The application of DM disease management cannot be applied to general blood glucose measurements because the results are less specific (Bistara et al., 2022). HbA1c is one of the components that determines the glycemic status of DM patients. This component has been standardized and is effective for long-term use. HbA1c in DM patients will increase based on the presence or absence of binding between hemoglobin and blood glucose, not on the rise and fall of glucose levels in the body. The binding between

the two is stable, so the value is not easily influenced by external factors such as the amount of food intake (Widiyanti et al., 2020).

Metabolic disorders in patients with DM will affect the body's tissue regeneration cycle, resulting in tissue damage or inflammation very quickly. C-reactive protein (CRP) is used as an inflammatory marker with high sensitivity. Even high-sensitivity C-reactive protein (Hs-CRP) can detect CRP levels as low as 0.3 mg/L to as high as 300 mg/L quantitatively (Blinc et al., 2020). Omer and Ali reported that there were significant differences in fasting blood glucose, HbA1C, Hs CRP, IL-6, and TNF- α levels between the control group and the case group in patients with T2DM in Sudan. Still, there were no significant differences in all these parameters between male and female patients (Omer & Ali, 2019).

Bhaskar et al. reported that there is a correlation between CRP levels and HbA1C levels in patients with T2DM at Nalanda Medical College and Hospital in Patna, Bihar, India (Bhaskar et al., 2021). There was a difference in HbA1C levels between DM and non-DM groups at Kütahya Private Hospital in Kutahya province, western Turkey. HbA1C levels correlate with CRP levels in T2DM patients (Son, 2019). This study aims to determine the correlation between HbA1C levels and CRP levels in T2DM patients at RSUD Dr. Soedirman Kebumen, Kebumen Regency.

METHOD

This study used a cross-sectional design and was conducted in July 2023 at RSUD Dr. Soedirman Kebumen after obtaining ethical clearance from the Health Research Ethics Commission of Universitas Muhammadiyah Purwokerto number KEPK/UMP/49/VII/2023. Twenty T2DM patients were involved in this study using the purposive sampling technique.

Inclusion criteria: 1) DM patients who were registered at RSUD Dr. Soedirman Kebumen for the last year, according to medical records; 2) Patients willing to sign informed consent; 3) Chronic type 2 DM patients obtained through medical record results. Exclusion Criteria: 1) No history of metabolic syndrome, hypertension, viral or bacterial infections, or other comorbidities; 2) DM patients with anemia based on medical records. Measurement of HbA1C levels used the VIVaDiag POCT Analysis Vim 1000, while measurement of CRP levels used the BiOLiS 30i. The data were analysed using the Spearman correlation test.

RESULT

The majority of T2DM patients at RSUD, Dr. Soedirman Kebumen, were aged ≥ 56 years old. There were 16 patients (80%). The mean age of the patients was 60.10 ± 11.323 years old. The majority of T2DM patients were male: 12 patients (60%), experienced excessive thirst and hunger: 13 patients (65%), severe weight loss: 11 patients (55%), often urinated at night: 14 patients (70%), and regularly exercised:

13 patients (65%). The mean HbA1C level was $7.87 \pm 2.499\%$, while the mean CRP level was $4.96 \pm 2.103\%$. The details of the subject characteristics are illustrated in Table 1, while the correlation between HbA1C levels and CRP levels is illustrated in Table 2.

Table 1. Subject Characteristics

Characteristics	Frequency (n)	Percentages (%)	Mean $\pm$ SD	Median (Min-Max)
Age (y.o)				
25-40	2	10	$60,10 \pm 11,323$	62,50 (27-82)
41-55	2	10		
≥ 56	16	80		
Gender				
Male	12	60		
Female	8	40		
The patient feels excessive hunger and thirst.				
Yes	13	65		
No	7	35		
Severe weight loss in patients				
Yes	11	55		
No	9	45		
The patient urinates frequently at night.				
Yes	14	70		
No	6	30		
The patient is taking anti-diabetic drugs.				
Yes	20	100		
No	-	-		
The patient exercises regularly.				
Yes	13	65		
No	7	35		
Frequency of exercise rhythm within 1 week				
1-2 times	20	100		
3-4 times	-	-		
HbA1C levels (%)			$7,87 \pm 2,499$	7,17 (5,17 - 13,46)
CRP levels (mg/L)			$4,96 \pm 2,103$	4,82 (1,01 - 11,32)

Table 2. Correlation between HbA1C levels and CRP levels in T2DM patients

	Kadar CRP
Kadar HbA1c	$r = 0,705$
	$p = 0,001$

Based on Table 2, it is known that there is a correlation between HbA1C levels and CRP levels in T2DM patients at RSUD Dr. Soedirman Kebumen.

DISCUSSION

HbA1C levels and CRP levels are two components that are related to each other. HbA1C is a biomarker of glycemic status, while CRP levels are a biomarker of inflammation that occurs in a person's body (Aini

et al., 2020). Because HbA1C can be a marker of conditions leading to acute and chronic organ damage occurring due to DM, checking CRP levels is effective in confirming the presence or absence of inflammation or infection (Oktavia et al., 2021).

Most T2DM patients in this study were aged ≥ 56 years. Elderly conditions affect physiological changes in the body. When the aging process occurs, the body experiences a slow decline in ability, and even body tissues cannot regenerate completely or experience a decrease in ability. This condition causes a loss of immunity, resulting in susceptibility to diseases such as DM (Yusrita & Novela, 2018).

Gender affects the condition of DM. Women are more susceptible to DM due to a lack of physical activity and exercise and an uncontrolled lifestyle (Khairinisa et al., 2022). DM patients feel excessive hunger and thirst due to difficulties in processing energy through glucose synthesis obtained from carbohydrates, resulting in insulin resistance as the body's homeostatic response by sending hunger signals (Driva et al., 2021).

Severe weight loss occurs in people with DM because glucose and energy cannot be processed correctly, leading the body to break down energy reserves such as fat and muscle during the metabolic process. Frequent urination at night was caused by hyper concentration in the kidney organs (Permatasari et al., 2020). These kidneys will naturally maintain a normal state and automatically try to remove excess glucose. This process occurs more often at night when the body is resting while metabolic processes continue. The body is aided by physical activity during the day through the release of sweat and is, therefore, fluidly balanced, not only in the kidneys (Kusumawardhani, 2021).

The results of this study are in line with the research of Elimam et al., which showed that there is a relationship between HbA1C levels and CRP levels in T2DM patients ($p = 0.001$, $r = 0.761$) (Elimam, Abdulla, and Taha, 2019). It is also supported by the research of Seo and Shin, which shows that there is a positive correlation between HbA1C and hs-CRP in South Korea. Hs-CRP levels affected HbA1c levels. HbA1c increased significantly as hs-CRP increased (Seo & Shin, 2021). The study of Ramesh et al. also showed a positive correlation between HbA1C levels and hs-CRP levels in T2DM patients in Mysore, India (Ramesh et al., 2019). In contrast to the research of Permatasari et al., which showed there was no relationship between HbA1c levels and CRP levels in DM patients with obesity and non-obesity (Permatasari et al., 2020).

The HbA1C level test includes the hemoglobin component that binds blood glucose. This test is used in the assessment of blood glucose control and is the most reliable because it can describe the average blood glucose level in the previous 3 months (Anggrina et al., 2022). In addition to being positively correlated with CRP levels, HbA1C levels are also known to have a positive correlation with several other biomarkers, including serum ferritin, insulin levels, blood glucose levels, and triglyceride levels in T2DM patients (Son, 2019).

CONCLUSION

There is a correlation between HbA1C levels and CRP levels in patients with T2DM at RSUD Dr. Sardjito. It is necessary to conduct research related to the correlation of HbA1C levels with CRP levels in controlled T2DM patients. It is required to research other inflammatory markers such as IL-6, TNF- α , and procalcitonin, as well as examination of insulin levels and kidney function, in an effort to manage DM.

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