

Research Article

## THE CORRELATION BETWEEN C-REACTIVE PROTEIN (CRP) AND BLOOD PRESSURE IN ADULTS

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### ABSTRACT

C-reactive protein (CRP) is a systemic inflammatory marker associated with endothelial dysfunction and hypertension risk. This study aimed to examine the correlation between serum CRP levels and blood pressure in adults. A cross-sectional study was conducted involving 30 respondents. CRP levels were measured using the latex agglutination method, and blood pressure was assessed using a digital sphygmomanometer. The mean CRP level was  $21 \pm 25$  mg/L. Statistical analysis showed a significant positive correlation between CRP and systolic blood pressure ( $r = 0.386$ ;  $p = 0.007$ ), but no significant correlation with diastolic blood pressure ( $r = -0.048$ ;  $p = 0.736$ ). Individuals with elevated CRP levels ( $>6$  mg/L) tended to have higher blood pressure. In conclusion, CRP levels are significantly associated with systolic blood pressure and may serve as an early indicator of hypertension risk. CRP may be considered an additional biomarker in cardiovascular risk assessment.

### ABSTRAK

Protein C-Reaktif (CRP) merupakan penanda inflamasi sistemik yang meningkat pada kondisi inflamasi kronis. Penelitian ini bertujuan untuk mengetahui korelasi antara kadar CRP serum dengan tekanan darah pada dewasa. Penelitian ini menggunakan desain potong lintang dengan jumlah sampel 30 responden. Kadar CRP diperiksa menggunakan metode Aglutinasi Lateks, sedangkan tekanan darah diukur menggunakan sfigmomanometer digital. Rata-rata kadar CRP pada responden adalah  $21 \pm 25$  mg/L. Analisis statistik menunjukkan korelasi positif yang signifikan antara kadar CRP dan tekanan darah sistolik ( $r = 0,386$ ;  $p = 0,007 < 0,05$ ) dan tekanan darah diastolik ( $r = -0,048$ ;  $p = 0,736 > 0,05$ ). Responden dengan kadar CRP tinggi ( $>6$  mg/L) cenderung memiliki tekanan darah lebih tinggi dibandingkan kelompok dengan kadar CRP normal. Terdapat korelasi positif yang signifikan antara kadar CRP dan tekanan darah sistolik pada orang dewasa, tetapi tidak ada korelasi yang signifikan antara kadar CRP dan tekanan darah diastolik pada orang dewasa. Hasil ini menunjukkan bahwa peningkatan kadar CRP dapat menjadi indikator risiko dini untuk peningkatan tekanan darah dan potensi hipertensi. Pemeriksaan CRP dapat dianggap sebagai biomarker tambahan dalam evaluasi risiko kardiovaskular.

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## INTRODUCTION

Hypertension is a global health problem that significantly contributes to morbidity and mortality from cardiovascular disease (Berek, 2021). World Health Organization (WHO) data shows that approximately 1.28 billion adults worldwide have hypertension, and more than two-thirds of these are in low- and middle-income countries (WHO, 2025). In Indonesia, the prevalence of hypertension in adults also shows an increasing trend

year after year. This condition indicates that hypertension remains a serious challenge to the public health system (Risksedas, 2018).

One factor suspected to play a role in the mechanism of hypertension is low-grade chronic inflammation (Fatima, 2025). Systemic inflammation can cause endothelial dysfunction, increased peripheral vascular resistance, and changes in blood vessel structure, leading to increased blood pressure (Chen, 2022). One of the most frequently used biomarkers to assess systemic inflammation is C-Reactive Protein (CRP).

CRP is an acute-phase protein produced by the liver in response to the release of pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) (Kirgoz, 2023). High CRP levels are often found in individuals with obesity, insulin resistance, dyslipidemia, and cardiovascular disease (Gallo, 2022). Several studies have suggested that elevated CRP levels are associated with an increased risk of hypertension and atherosclerosis, but these results are not consistent across populations (Chen, 2022). Given the important role of inflammation in the pathogenesis of hypertension, analyzing the relationship between CRP levels and blood pressure in the adult population is relevant. This study aims to determine whether there is a correlation between CRP levels and blood pressure in adults, thereby providing an initial overview of the potential use of CRP as a biomarker for hypertension risk.

## MATERIALS AND METHODS

### Instruments, Materials, and Samples

This study used an analytical observational design with a cross-sectional approach, which aimed to determine the relationship between C-Reactive Protein (CRP) levels and blood pressure in adult individuals. The research sample consisted of 30 individuals. This number was determined based on the feasibility of access and population availability at the research location during the study period. This is recognized as a limitation of the study, as the relatively small sample size has the potential to reduce the study's statistical power.

The study was conducted at the Clinical Laboratory and Public Health Post during the period of June–September 2024. The study population was adult individuals aged 27–64 years. The study sample consisted of 30 respondents, selected using a purposive sampling technique based on the following inclusion and exclusion criteria: Inclusion criteria: healthy individuals without a history of severe chronic disease, not currently taking anti-inflammatory drugs, and willing to participate in the study. Exclusion criteria: individuals with acute infections, autoimmune diseases, kidney disorders, or heart failure. Independent variable: serum CRP levels. Dependent variables: systolic and diastolic blood pressure. Confounding variables: age, body mass index (BMI), smoking habits, and physical activity.

The research procedure consisted of: a. Data Collection: Identity and risk factor data were collected through interviews using a structured questionnaire, b. Blood Pressure Measurement: Blood pressure was measured using a digital sphygmomanometer after the respondents had rested for at least 10 minutes in a sitting position. Measurements were taken twice with a five-minute interval, and the average value was used as the final result, and c. Blood Sampling and Examination: A total of 3 mL of venous blood was drawn from the cubital vein using a sterile needle. The sample was then centrifuged to separate the serum. CRP levels were determined using the latex agglutination method with a commercial kit according to the manufacturer's instructions. Results are expressed in mg/L.

Data were analyzed using SPSS software version 27.0. Normality was tested using the Shapiro–Wilk test. Since the data were not normally distributed, the Spearman's Rho correlation test was used to assess the relationship between CRP levels and systolic and diastolic blood pressure. A systolic p-value (0.007)  $<0.05$  was considered statistically significant with a very low correlation (0.386) while a diastolic p-value (0.736)  $>0.05$  was not statistically significant. Research ethics were obtained from Etik commission Prima Indonesia University number 035/KEPK/UNPRI/VI/2025

## RESULT AND DISCUSSION

This study involved 30 adult respondents aged 27–64 years, consisting of 14 men (46,7%) and 16 women (53,3%). The average age of respondents was  $49.0 \pm 10$  years. Based on blood pressure measurements, 76,7% of respondents were classified as having high blood pressure ( $\geq 140/90$  mmHg), while the remainder were in the normal and pre-hypertension categories. The average serum CRP level for all respondents was  $21 \pm 25$  mg/L, with a range of 6 to 96 mg/L. CRP is said to be positive if the level exceeds 6 mg/L.

**Table 1** Frequency Distribution of Gender to CRP

Variabel	C-Reactive Protein (CRP)		
	Positive	Negative	Total
Age			
Adults (n, %)	22 (73,4)	8 (26,7)	30 (100)
Gender			
Male (n, %)	10 (33,3)	4 (13,3)	14 (46,7)
Female (n, %)	12 (40)	4 (13,3)	16 (53,3)

**Table 2.** Frequency Distribution of Gender to Systolic Blood Pressure

Variable	Systolic			Total
	Normal	Pre-Hypertension	Hypertension	
Men (n, %)	2 (6,7)	8 (26,7)	4 (13,3)	14 (46,7)
Woman (n, %)	1 (3,3)	1 (3,3)	14 (46,7)	16 (53,3)

**Table 3.** Frequency Distribution of Gender to Diastolic Blood Pressure

Variable	Diastolic			Total
	Normal	Pre-Hypertension	Hypertension	
Men (n, %)	6 (20)	5 (16,7)	3 (10,0)	14 (46,7)
Woman (n, %)	3 (10)	3 (10)	10 (33,3)	16 (53,3)

Tables 2 and 3 show that high systolic and diastolic blood pressure/hypertension are most common in women. Several studies have shown that women have higher average CRP levels than men, even after adjusting for cardiovascular risk factors. In women, Body Mass Index (BMI) is the strongest predictor of CRP, while in men, waist circumference is a stronger predictor. This suggests that the inflammatory response mediated by body fat operates differently in each gender (Ebong, 2016).

**Table 4.** Crosstabulation of CRP and Blood Pressure

Variable Blood Pressure	CRP		Total
	Positive	Negative	
<b>Systolic</b>			
Normal	0 (0)	3 (10)	3 (10)
Pre-Hypertension	7 (23,3)	2 (6,7)	9 (30,0)
Hypertension	15 (50)	3 (10)	18 (60)
<b>Diastolic</b>			
Normal	6 (20)	3 (10)	9 (30)
Pre-Hypertension	4 (13,3)	4 (13,3)	8 (26,7)
Hypertension	12 (40,0)	1 (3,3)	13 (43,3)

Table 4 shows that systolic and diastolic blood pressure in hypertension indicate a positive CRP compared to normal blood pressure or pre-hypertension. A positive CRP in hypertensive patients indicates chronic systemic inflammation in the body, which can worsen hypertension and increase the risk of cardiovascular complications such as atherosclerosis (Ebong, 2016). CRP is a marker of inflammation, and this inflammation can cause damage to blood vessels (endothelial dysfunction) and the heart, thereby increasing blood vessel stiffness and triggering increased blood pressure (Chen, 2022). Hypertension can trigger chronic inflammation in blood vessel walls, and CRP is one of the inflammatory markers produced in response. Inflammation characterized by increased CRP can damage the endothelial lining of blood vessels, which plays a role in regulating blood vessel stiffness and thickness (Fatima, 2025). CRP is also involved in the remodeling process (structural changes) of blood vessels and the heart in response to excess pressure and injury caused by hypertension (Kirkagoz, 2023).

**Table 5.** Correlation CRP and Blood Pressure

Variable	P-value	Correlation
Blood Pressure		
Systolic (mmHg)	0.007	0.386
Diastolic (mmHg)	0.736	-0.048

Table 5 show that analysis using the Spearman correlation test showed: Correlation between CRP and systolic blood pressure:  $r = 0.386$ ;  $p=0.007 < 0.05$ ; and No Correlation between CRP and diastolic blood pressure:  $r = -0.048$ ;  $p = 0.736 > 0.05$ . These results indicate a significant positive relationship between CRP levels and systolic blood pressure in adult respondents. This means that the higher the CRP level, the higher the individual's systolic blood pressure.

These study results strengthen evidence that systemic inflammation plays a role in elevated blood pressure in the adult population. CRP, an acute-phase protein, is produced by the liver in response to pro-inflammatory cytokines such as IL-6 and TNF- $\alpha$ . Elevated CRP levels reflect low-grade chronic inflammation that can affect vascular endothelial function (Yeo, 2024). Endothelial dysfunction due to inflammation leads to decreased availability of nitric oxide (NO), which plays a key role in vasodilation. Decreased NO and increased oxidative stress contribute to increased vascular tone and peripheral resistance, ultimately increasing blood pressure (Richardson, 2015). These findings align with studies by Sesso et al. (2003) and Lakoski et al. (2005) which reported that high CRP levels were significantly associated with an increased risk of hypertension in young and middle-aged adults. Other studies have also shown that individuals with CRP levels  $>3$  mg/L have twice the risk of developing hypertension compared to individuals with low CRP levels (Ebong, 2016). However, it should be noted that this relationship is associative, not causal. Other factors such as obesity, insulin resistance, smoking habits, and diet may also contribute to increased CRP levels and blood pressure. Therefore, further studies with longitudinal or interventional designs are needed to confirm the causal role of CRP in the development of hypertension.

Analysis using the Spearman correlation test showed no Correlation between CRP and diastolic blood pressure:  $r = -0.048$ ;  $p=0.738 > 0.05$ . This means that higher CRP levels tend to lower diastolic blood pressure. The difference in correlation between systolic and diastolic blood pressure may be related to the different physiological mechanisms underlying the two types of blood pressure: Systolic blood pressure reflects the peak pressure when the heart contracts and pumps blood (Yeo, 2024). Elevated CRP, a marker of systemic inflammation, is often associated with arterial stiffness (atherosclerosis). Arterial stiffness has a greater impact on increased systolic blood pressure. Diastolic blood pressure reflects the pressure when the heart rests between beats. Although inflammation (CRP) is correlated with blood vessel damage, its specific relationship with diastolic blood pressure may be more complex and influenced by other factors, such as peripheral vascular elasticity and cardiac function during relaxation (Gallo, 2022).

Overall, these findings suggest that inflammation plays a role in the development of hypertension, but its influence may be more pronounced in the systolic component than in the diastolic component, possibly due to mechanisms related to vascular stiffness resulting from chronic inflammation.

Clinically, the results of this study indicate that CRP testing can be used as an additional biomarker in screening for hypertension and cardiovascular disease risk, particularly in adults with metabolic risk factors. Early detection of elevated CRP levels allows for earlier lifestyle interventions and hypertension prevention. This study has several methodological limitations that should be considered when interpreting the results. First, the use of a cross-sectional design limits the study's ability to establish causality between variables, as exposure and effect data were measured at a single point in time. Second, the relatively small sample size (e.g.,  $n=30$ ) potentially reduces statistical power and increases the risk of sampling bias, making the findings less representative of the broader population. Finally, data collected at a single point in time cannot accurately reflect the course of disease or behavioral changes over time. Therefore, future longitudinal studies are needed to validate the causal relationships found in this study.

## CONCLUSION

The study results showed a significant positive correlation between C-Reactive Protein (CRP) levels and Systolic but no dyastolic blood pressure in adults and . The higher the serum CRP levels, the higher the systolic blood pressure values and the higher the serum CRP levels, the lower the diastolic blood pressure values. This finding supports the hypothesis that systemic inflammation plays a role in the pathogenesis of

hypertension, through mechanisms such as endothelial dysfunction and increased peripheral vascular resistance.

Thus, CRP can be used as an additional biomarker to assess the risk of hypertension and cardiovascular disease in the adult population. CRP testing, especially with sensitive methods such as high-sensitivity CRP (hs-CRP), can provide predictive value for an individual's vascular health status.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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