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The Relationship Between Quantitative C-Reactive Protein (CRP) Levels and Leukocyte Count in Patients with Pulmonary Tuberculosis Infection at Arifin Achmad Regional General Hospital

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Abstract

Background: Pulmonary tuberculosis is a chronic infectious disease caused by Mycobacterium tuberculosis. C-Reactive Protein (CRP) and leukocyte count are indicators that can reflect the severity of infection in pulmonary TB patients. This study aims to analyze the correlation between quantitative CRP levels and leukocyte count in pulmonary tuberculosis patients. **Methods:** This was an observational analytic study with a cross-sectional approach conducted on 30 pulmonary TB patients at Arifin Achmad Hospital, Pekanbaru, who met the inclusion and exclusion criteria. CRP levels and leukocyte counts were obtained through laboratory tests, while demographic data were collected from patient medical records. Normality and linearity tests were conducted before the correlation analysis using linear regression tests. **Results:** The mean CRP level of patients was 84.14 ± 91.59 mg/L, with the lowest level being 0.71 mg/L and the highest being 316.7 mg/L. The mean leukocyte count was 10,481 ± 4,625.53 mm^3, with the lowest count being 3,190 mm^3 and the highest being 21,310 mm^3. Bivariate analysis showed no significant correlation between CRP levels and leukocyte count in pulmonary TB patients ($p = 0.378$). **Conclusion:** There is no significant correlation between quantitative CRP levels and leukocyte count in pulmonary tuberculosis patients at Arifin Achmad Hospital, Pekanbaru. Further studies with larger sample sizes and longitudinal designs are needed to explore the relationship between these variables and their implications in pulmonary TB management.

Keywords: Pulmonary tuberculosis, C-Reactive Protein, Leukocytes.

Introduction

Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis and remains a leading cause of morbidity and mortality worldwide. According to the World Health Organization (WHO), in 2021, there were approximately 10.6 million TB cases globally, with the majority occurring in Southeast Asia, Africa, and the Western Pacific. Indonesia is a country with a high TB burden, making controlling this disease a priority for national health programs.

TB diagnosis and monitoring require accurate clinical and laboratory examinations. One of the body's responses to M. tuberculosis infection is inflammation, characterized by an increase in various inflammatory biomarkers, including C-Reactive Protein (CRP) and the leukocyte count. CRP is an acute-phase protein produced by the liver in response to the release of pro-inflammatory cytokines, particularly interleukin-6 (IL-6), while leukocytes play a crucial role in the body's defense system against infection. Elevated CRP levels and leukocyte counts are frequently found in active TB patients and may reflect the degree of inflammation.

Several studies have shown that changes in hematological parameters, including the leukocyte count, are associated with TB disease activity. Similarly, CRP levels have been reported to correlate with infection severity and response to antituberculosis therapy. Therefore, evaluating the relationship between CRP levels and leukocyte counts has the potential to provide additional information in monitoring the condition of TB patients.

Arifin Achmad Regional Hospital, Pekanbaru, is one of the main referral hospitals for TB treatment in Riau Province. This study aims to analyze the relationship between quantitative C-Reactive Protein (CRP) levels and leukocyte counts in pulmonary tuberculosis patients at Arifin Achmad Regional Hospital, Pekanbaru.

Method

This is an observational analytical study with a cross-sectional design. The aim was to analyze the relationship between quantitative C-Reactive Protein (CRP) levels and leukocyte counts in pulmonary tuberculosis patients at Arifin Achmad Regional General Hospital, Pekanbaru. The study was conducted at the Clinical Pathology Laboratory of Arifin Achmad Regional General Hospital from February to June 2024.

The study population consisted of all pulmonary tuberculosis patients undergoing follow-up and treatment at Arifin Achmad Regional General Hospital from May to June 2024. A total of 30 patients were selected using a total sampling technique. Inclusion criteria included active TB patients aged 15–65 years who agreed to participate. Patients with comorbidities such as cancer or autoimmune disorders that can cause chronic inflammation were excluded.

Venous blood sampling was performed according to standard procedures. Quantitative CRP levels were determined using the immunoturbidimetric method on an Abbott Architect Plus C4000 instrument with Multigent CRP Vario reagent. Leukocyte counts were examined using a Sysmex XN-1000 Hematology Analyzer using flow cytometry. The normal CRP reference value is 0–5 mg/dL, while the normal leukocyte count ranges from 4,000–10,000/mm³.

Primary data were obtained from laboratory CRP and leukocyte count results, while secondary data were obtained from patient medical records. All data were processed using the Statistical Package for Social Sciences (SPSS) program through editing, coding, entry, cleaning, and saving. The analysis was conducted to assess the relationship between quantitative CRP levels and leukocyte counts in patients with pulmonary tuberculosis.

Result

Characteristics of Research Subjects

Table 1: Characteristics of Research Subjects

Variable	f (%)	Mean	SD	Median (Min-Max)
Sex				
Male	21 (70)			
Female	9 (30)			
Age (Year)		42,4	16,75	44,5 (15-65)
Male		45,2	16,30	49 (18-68)
Female		35,8	16,88	29 (15-65)

Based on Table 1, the majority of respondents were male (21 people) (70%), while 9 respondents were female (30%). The age characteristics of the study subjects were: the youngest was 15 years old, female, and the oldest was 65 years old, female.

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Univariate Analysis

The Mean CRP Levels

Table 2: CRP Levels

Variable	f (%)	Mean	SD	Median (Min-Max)
CRP Levels (mg/L)		84,14	91,59	57,77 (0,71-316,7)

Characteristics of Quantitative CRP levels in the research subjects obtained a mean Quantitative CRP level of 84.14 ± 91.59 mg/L. The lowest Quantitative CRP level was 0.71 mg/L in a 49-year-old female respondent, while the highest Quantitative CRP level was 316.7 mg/L in a 49-year-old male respondent.

The Mean Leukocyte Count

Table 2: Leukocyte Count

Variable	f (%)	Mean	SD	Median (Min-Max)
Leukocyte Count (mm^3)		10.481	4.625,53	10.450 (3.190 -21.310)

The mean leukocyte count among the study subjects was 10,481 ± 4,625.53 mm^3. The lowest leukocyte count was 3,190 mm^3 in a 23-year-old male respondent, while the highest leukocyte count was 21,310 mm^3 in a 38-year-old male respondent.

Bivariate Analysis

The Relationship Between C-Reactive Protein Levels and Leukocyte Count in Pulmonary Tuberculosis Patients

Table 3: Results of the Normality Test of CRP Variables

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Result CRP	.200	30	.004	.833	30	.000

a. Lilliefors Significance Correction

The results of the normality test for the CRP outcome variable were not normally distributed because the significance value of Shapiro-Wilk was 0.878, greater than alpha 5% or 0.05.

Figure 1: Linearity Test Results of CRP Result Variables

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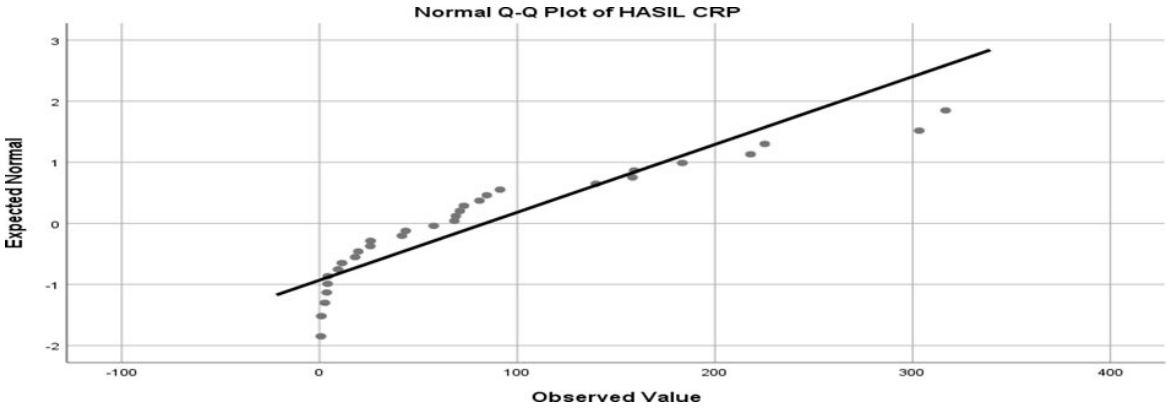


The results of the linearity test of the CRP outcome variable are non-linear because the plot does not follow a linear line in the graph.

Table 4: Results of the Normality Test of Leukocyte Variables

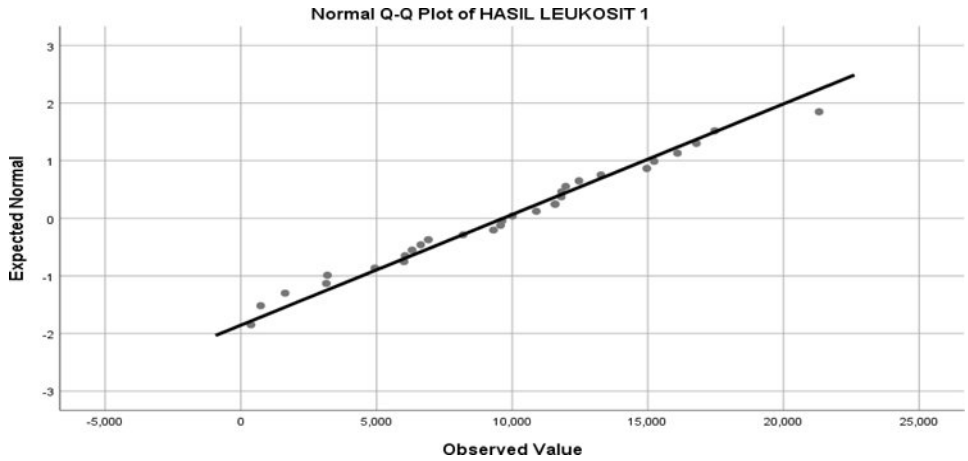
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Result Leukocyte 1	.077	30	.200*	.982	30	.878

*This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The results of the normality test for the leukocyte count variable are normally distributed, as the Shapiro-Wilk significance value is 0.878, greater than the 5% alpha value, or 0.05.

Figure 2: Linearity Test Results of Leukocyte Result Variables



The results of the linearity test of the leukocyte results variable are linear because the plot follows the linear line in the graph.

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Table 5: Homogeneity Test Results

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4552.115	784.784		5.800	.000
	CRP Result	-6.552	6.442	-.189	-1.017	.318
a. Dependent Variable: ABS_RES						

The results of the heteroscedasticity test using the Glejser Test show that the significance value is 0.318, greater than 0.05, so there are no symptoms of Heteroscedasticity in the data, or the data is homogeneous.

Table 6: Linear Regression Analysis Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8853.160	1312.649		6.744	.000
	CRP Result	9.659	10.775	.167	.896	.378

a. Dependent Variable: Leukocyte Result 1

Hypothesis Ho: There is no relationship between Leukocyte Levels and CRP. Based on the results of the multiple linear regression in Table 6, quantitative CRP levels and leukocyte counts in patients with pulmonary tuberculosis infection obtained a significance value of 0.378, greater than 5% alpha or 0.05, indicating no relationship between quantitative CRP levels and leukocyte counts in patients with pulmonary tuberculosis infection.

Discussion

Univariate Analysis

The study results showed that the majority of pulmonary tuberculosis (TB) patients were male (70%), while 30% were female. This finding aligns with several previous studies that reported a higher prevalence of pulmonary TB in men than in women. The high incidence of TB in men is thought to be related to risk factors such as smoking, alcohol consumption, and higher social activity, which increase the chance of exposure to Mycobacterium tuberculosis.

The mean C-Reactive Protein (CRP) level in the study subjects was 84.14 ± 91.59 mg/L,

with a lowest value of 0.71 mg/L and a highest of 316.7 mg/L. Elevated CRP levels in TB patients indicate an inflammatory response due to M. tuberculosis infection. CRP is an acute-phase protein produced by the liver in response to pro-inflammatory cytokines, particularly IL-6 and TNF-α. High CRP levels can also be influenced by disease severity, the presence of comorbidities, and lifestyle factors such as smoking. In this study, the highest CRP levels were found in patients with complications of diabetes mellitus, HIV, and a history of smoking, which can exacerbate the inflammatory process.

The mean leukocyte count in pulmonary TB patients was 10,481 ± 4,625.54 mm^3, with a range of 3,190–21,310 mm^3. An increase in the leukocyte count reflects the body's immune response to bacterial infection through phagocytosis. However, lower leukocyte counts can be found in patients who have undergone effective antituberculosis drug therapy or Obat Anti Tuberkulosis (OAT). The variation in leukocyte counts in this study suggests that the hematological response of TB patients is influenced by the activity of the infection and the success of therapy. In general, CRP levels and leukocyte counts can be used as indicators of inflammation, aiding in monitoring the clinical condition of pulmonary tuberculosis patients.

Bivariate Analysis

The analysis showed no significant correlation between quantitative C-Reactive Protein (CRP) levels and leukocyte counts in pulmonary tuberculosis patients ($p = 0.378$; $p > 0.05$). This finding suggests that elevated CRP levels are not always accompanied by elevated leukocyte counts in pulmonary TB patients. These results align with previous research that reported no significant correlation between CRP levels and leukocyte counts in tuberculosis patients.

CRP is an acute-phase protein that increases in response to inflammation and tissue damage caused by Mycobacterium tuberculosis infection. CRP levels can be influenced by disease severity, the inflammatory response, and the effectiveness of antituberculosis therapy. Meanwhile, leukocyte counts reflect the body's immune response to bacterial infection and can change depending on the activity of the infection and the success of treatment.

The lack of a correlation between CRP levels and leukocyte counts in this study is likely because the two parameters are influenced by different biological mechanisms. CRP levels are more related to the systemic inflammatory process and response to therapy, while leukocyte

counts reflect the body's defense activity against infection. Therefore, changes in these two parameters do not always occur simultaneously in pulmonary tuberculosis patients.

Conclusion

Based on the results of data processing and analysis, the researchers drew the following conclusions:

1. The average quantitative CRP level in tuberculosis patients at Arifin Achmad Regional Hospital was 84.14 mg/L.
2. The average leukocyte count in tuberculosis patients at Arifin Achmad Regional Hospital was 10,481 mm^3.
3. The multiple linear regression analysis of quantitative CRP levels and leukocyte counts in pulmonary tuberculosis patients yielded a significance value of 0.378, greater than 5% alpha or 0.05, indicating no effect or relationship between quantitative CRP levels and leukocyte counts in pulmonary tuberculosis patients at Arifin Achmad Regional Hospital.

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