

## THE RELATIONSHIP BETWEEN LEUKOCYTE COUNT WITH TUBERCULOSIS (TB) LESION AREA IN CHEST X-RAY EXAMINATION

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### ABSTRAK

Jumlah leukosit merupakan salah satu parameter hematologi yang diketahui dapat membantu mendiagnosis kerusakan organ dan berfungsi sebagai indikator sistem imun tubuh. Jumlah leukosit berhubungan dengan luas lesi di lapang paru pasien tuberculosis pada pemeriksaan Foto Rontgen Dada (CXR). Penelitian ini bertujuan untuk mengevaluasi apakah jumlah leukosit dapat digunakan sebagai indikator alternatif untuk deteksi dini dan penilaian keparahan tuberculosis tanpa mengandalkan hasil CXR. Oleh karena itu, penelitian ini dilakukan dengan tujuan untuk mengetahui hubungan antara jumlah leukosit dengan luas lesi TB dari pemeriksaan Foto Rontgen Dada (CXR). Penelitian ini merupakan penelitian kuantitatif jenis observasional analisis dengan desain cross sectional study yang dilakukan terhadap 60 subjek penelitian yang berasal dari data rekam medis pasien TB di RSUD Saiful Anwar Malang, pada bulan Januari 2022 sampai dengan Desember 2023. Data yang diperoleh dianalisis dengan metode Chi-Square yang menunjukkan tidak terdapat hubungan yang signifikan antara jumlah leukosit dengan luas lesi TB dari pemeriksaan CXR (Chi-Square,  $p=0,706$ ). Kesimpulan dari penelitian ini adalah jumlah leukosit tidak berhubungan dengan deskripsi luas lesi pada penderita TB.

### ABSTRACT

**The Relationship Between Leukocyte Count with Tuberculosis (TB) Lesion Area in Chest X-Ray Examination.** Leukocyte count is one of the hematological parameters known to help diagnose organ damage and serve as an indicator of the body's immune system. Leukocyte counts are associated with the extent of lesions in the lung fields of tuberculosis patients on Chest X-ray (CXR) examination. This study aims to evaluate whether the leukocyte count can be used as an alternative indicator for early detection and severity assessment of tuberculosis without relying on CXR results. Therefore, this study was conducted with the aim to determine the relationship between leukocyte count and TB lesion area from Chest X-ray (CXR) examination. This study is a quantitative research type of observational analysis with a cross sectional study design conducted on 60 research subjects derived from medical record data of TB patients at Saiful Anwar Hospital, Malang, from January 2022 to December 2023. The data obtained were analyzed using the Chi-Square method, which showed that there was no significant relationship between leukocyte count and the extent of TB lesions from the CXR examination (Chi-Square,  $p=0.706$ ). The conclusion of this study is that leukocyte count is not associated with the description of the lesion area of TB patients.

## INTRODUCTION

Tuberculosis (TB) is a contagious infectious disease that affects the upper respiratory tract and is caused by bacteria classified as Acid-Fast Bacilli (AFB).<sup>1</sup> TB remains one of the major factors in health problems and a leading cause of death worldwide.<sup>2</sup> According to the 2022 Global Tuberculosis Report by the World Health Organization (WHO), it is estimated that globally in 2021, there were 10.6 million TB cases with a mortality rate of 1.6 million.<sup>3</sup> In the same year, Indonesia ranked second after India for the highest number of TB cases in the world, with 969,000 cases and 93,000 deaths annually, which is equivalent to 11 deaths per hour.<sup>4</sup> The root cause of the difficulty in controlling TB is the lack of commitment from service providers, policymakers, operational funding, infrastructure supplies, and inadequate TB management.<sup>5</sup>

Leukocytes are known as blood components with an important role as the body's defense agents by detecting foreign invaders or infections caused by microorganisms such as bacteria and viruses.<sup>6</sup> The leukocyte count can help diagnose organ damage and serve as an indicator of the body's immune system condition.<sup>7</sup> The normal leukocyte count ranges from 5,000 to 10,000 cells/ $\mu$ L of blood. Homeostatic disturbances, such as infections, can trigger an increase (leukocytosis) or decrease (leukopenia) in the number of leukocytes.<sup>2</sup>

Limitations in diagnostic methods and inefficiencies in testing often result in delays in diagnosing and treating TB patients, leading to the use of imaging modalities to support diagnosis. Chest X-ray (CXR) is a practical method for detecting TB lesions, although it is more costly compared to AFB sputum tests.<sup>9</sup> CXR is often used as an initial test to evaluate the disease in patients with unexplained cough symptoms.<sup>10</sup>

Leukocytes, which function as part of the immune system, are closely related to chronic infections such as tuberculosis (TB). This is stated in the research by Lewar et al (2018), which indicates that an increase in leukocyte count is significantly associated with TB infection. TB is known to affect human hematological components as it impacts the hematopoiesis process, making it an important marker for diagnostic purposes and for detecting persistent acid-fast bacilli.<sup>11</sup> Various hematological parameters correlate with the severity of clinical findings in TB patients, which can be observed in chest X-ray (CXR) examinations.<sup>12</sup>

This makes it interesting to investigate the involvement of leukocyte count in influencing the extent of TB lesions. The use of Chest X-ray as a non-invasive early detection modality is believed to be appropriate and can be used to establish a TB diagnosis. Therefore, the researcher is interested in conducting a study on the "The Relationship Between Leukocyte Count with Tuberculosis (TB) Lesions Area in Chest X-ray Examination."

## METHODS

This study is a quantitative research with a cross-sectional design in the form of observational analysis. The data used in this study is secondary data obtained from the medical records of TB patients at Saiful Anwar Hospital, Malang, from January 2022 to December 2023. The subjects were selected based on inclusion criteria, namely a positive TB diagnosis, age over 18 years, complete, legible, and valid medical record data (CXR and CBC), and newly diagnosed TB patients. The exclusion criteria were patients with comorbid diseases, patients with other bacterial or viral infections, and patients with hematologic malignancies. Additionally, it is necessary to control for confounding variables, such as secondary infections, to improve the validity of the research results.

The data obtained from the research subjects, including laboratory results (CBC) and CXR, were compiled into a spreadsheet, which will then be processed and analyzed using the Chi-Square method to find the relationship between leukocyte count and the extent of TB lesions from CXR examination. The Chi-Square method was chosen because this study examines the relationship between two groups of data with a categorical-nominal scale (leukocyte count) and a categorical-ordinal scale (extent of TB lesions).

## RESULTS

The research data successfully collected consists of medical records from 60 subjects who met the inclusion and exclusion criteria for data analysis.

### Characteristics of the Study Subjects

The study identified general characteristics including gender and age of the research subjects, with the distribution outlined in the table below:

Table 1. Characteristics of the Study Subjects

Characteristics	Frequency (n)	Percentage (%)
Gender		
Woman	21	35
Man	39	65
Age (year)		
<21	3	5
21-30	10	16,6
31-40	14	23,3
41-50	16	26,6
>50	17	28,3

Based on Table 1, it is known that the majority of the study subjects are male, with a total of 39 individuals (65%), and most are over 50 years old (28.3%).

### Research Data

The data consists of independent variables, which are the grouping of leukocyte counts obtained from the laboratory results in the medical records of the study subjects. Meanwhile, the dependent variable consists of the severity of TB lesion extent, which was obtained from the Chest X-ray (CXR) examination.

Table 2. Research Data

Variable	Frequency (n)	Percentage(%)
Leukocyte Count		
Leukopenia	3	5
Normal	28	46,6
Leukocytosis	29	48,3
TB Lesion Area		
Minimal	5	8,3
Moderate	10	16,6
Far Advance	45	75

Based on Table 2, it is known that the study subjects have the highest leukocyte count distribution in the leukocytosis group, with 29 individuals (48.3%), while the majority of the study subjects have a far advance TB lesion area, with 45 individuals (75%).

### Data Analysis

The data in this study were analyzed using the SPSS Statistics 25 program with the Chi-Square analysis method.

Table 3. Cross Tabulation Research Data

		TB Lesion Area			Total
		Minimal	Moderate	Far Advance	
Leukosit Count	Leukopenia	0	1	2	3
	Normal	2	6	20	28
	Leukocytosis	3	3	23	29
Total		5	10	45	60

Based on Table 3, it is known that all three groups of study subjects have the highest distribution in the large lesion picture, with details as follows: 2 individuals (66.6%) in the leukopenia group, 20 individuals (71.4%) in the normal group, and 23 individuals (79.3%) in the leukocytosis group.

Table 4. The Relationship Between Leukocyte Count and TB Lesions Area Using the Chi-Square Analysis Method

	Value	df	p sig.
Pearson Square	Chi-2.162	4	0,706

The Chi-Square test results in a p-value of 0.706 ( $p > 0.05$ ), indicating that there is no significant relationship between the leukocyte count and TB lesions area. This suggests that the leukocyte count does not significantly influence the severity of TB lesions as observed in the Chest X-ray (CXR) examination.

## DISCUSSION

Based on the Chi-Square test in Table 5.4, a p-value of 0.706 ( $p > 0.05$ ) was obtained, indicating that there is no statistically significant relationship between leukocyte count and TB lesions area.<sup>2</sup> The results of this study contradict findings from previous research by Lewar (2018) regarding the relationship between leukocyte count differences and TB lesion size, which showed that an increase in leukocyte count was significantly related to the large lesion size ( $p=0.017$ ) compared to the group with minimal lesions ( $p=0.001$ ). Additionally, other studies have mentioned that the overall leukocyte count increases, especially in patients who have not received anti-TB treatment (OAT).<sup>13</sup> An increase in leukocyte count (leukocytosis) in TB patients before starting OAT occurs as a response to microorganisms or foreign substances in the body, serving as a cellular and humoral defense mechanism.<sup>14</sup> TB infection triggers the body's immune response, activating leukocytes and stimulating the production of more leukocytes to combat TB infection through bacterial phagocytosis.<sup>15</sup> Conversely, the leukocyte count in individuals who have received OAT tends to decrease, as the OAT reaction suppresses bacterial growth and phagocytosis, reducing the bone marrow's ability to perform hematopoiesis.<sup>16</sup> Administering OAT to TB patients can reduce leukocyte count, which had previously been elevated due to infection. Leukocyte counts return to normal after several months of regular and proper OAT treatment.<sup>17</sup>

The inconsistency of this study's results regarding the relationship between leukocyte count and TB lesion size can be attributed to several factors. This study examined the leukocyte variable as a whole, with neutrophils (50-70%) dominating the leukocyte types, making the results more inclined to represent the innate response of neutrophils. Akhigbe et al. (2018) stated that there was no significant relationship between hematological parameters, except for monocytes, and CXR findings in TB patients.<sup>18</sup> This aligns with Pratiwi's (2019) research, which mentioned that the increase in leukocytes, particularly monocytes and lymphocytes, is a cellular response to chronic TB infection, while neutrophils are part of the innate immune response that increases during acute infections. During acute infection, TB lesions are not yet formed or visible on chest X-ray images.<sup>19</sup>

Moreover, the limited number of research subjects (60 participants) in this study may have impacted the variation of results. In contrast, Akhigbe et al. (2018) used a larger sample size, which indirectly provided more variation, influencing the significance of their findings. Furthermore, the limitations in subject selection criteria at the data collection stage resulted in less specificity, particularly in controlling for potential confounding variables such as secondary infections and comorbid conditions.<sup>18</sup>

This research contributes to the medical field by providing insights into the relationship between leukocyte count and TB lesions. For chronic TB patients, monocytes are more accurate in representing the extent of TB lesions in the lungs. This study can be applied in the medical field to assist with earlier diagnosis of TB lesions by examining the hematological parameter of monocyte count, without relying solely on the interpretation of chest X-ray images. Additionally, the findings can serve as a reference for the academic community at Brawijaya University and other researchers who wish to conduct further studies on the relationship between leukocyte count and TB lesions.

The limitation of this study is the limited sample size, which affects the level of variation and restricts the generalizability of the research results. Additionally, the development of the subject criteria established during data collection yielded less specific results, including in controlling potential confounding variables such as secondary infections and comorbid diseases. Therefore, a larger sample size with more diverse variation is needed.

## CONCLUSION

This study's findings suggest that leukocyte count cannot be used as an alternative indicator for determining the extent of TB lesions in CXR-based diagnosis.

Based on the research conducted, the researcher proposes several recommendations for future studies, including increasing the sample size and expanding the scope of the research sample. This would help obtain a greater variety of samples and allow for a more generalizable population conclusion.

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