

MONOCYTES AND NEUTROPHILS ANALYSIS IN PULMONARY TUBERCULOSIS PATIENTS AT PUSKESMAS WONOREJO SAMARINDA

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ABSTRACT

Tuberculosis (TB) remains a significant global health concern, with the immune response involving key roles for monocytes and neutrophils. Analysis of immune cells, such as monocytes and neutrophils, is crucial for understanding the host response to TB infection and for monitoring treatment effectiveness. This cross-sectional study analyzed the distribution of monocyte and neutrophil counts among 17 pulmonary TB patients in Puskesmas Wonorejo Samarinda from January-April 2024. The collected data were analyzed descriptively. Results showed that 64.70% of patients had elevated monocyte counts, while 35.30% had normal monocyte levels. For neutrophils, 41.20% of patients had normal counts, 17.60% had increased counts, and 41.20% had decreased counts. The predominance of monocyte elevation and the heterogeneous neutrophil response underscore the importance of these cells as potential biomarkers for TB monitoring and prognosis. Strengthening the use of these parameters may improve clinical management and outcomes for TB patients.

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INTRODUCTION

Tuberculosis (TB) continues to be a major public health burden worldwide. According to the World Health Organization (WHO), 10.8 million people developed TB and 1.25 million died from the disease in 2023 (WHO, 2024). Indonesia is the second highest contributor to global TB cases, with over 820,000 reported cases in 2023

and a significant burden among children (The Ministry of Health Republic of Indonesia, 2023). The urgency of TB control in Indonesia is underscored by national regulations and multi-sectoral strategies to improve case detection and treatment outcomes. The immune system, particularly the roles of monocytes and neutrophils, is central to the pathogenesis and progression of TB, providing valuable

information for diagnosis, prognosis, and monitoring treatment response (Scriba et al., 2017).

TB caused by *Mycobacterium tuberculosis* remains a leading cause of morbidity and mortality worldwide, especially in developing countries like Indonesia. The host immune response to TB is complex, involving innate immune cells such as monocytes and neutrophils that contribute to pathogen control and immunopathology (Hilda et al., 2020; Muefong & Sutherland, 2020). Monocytes serve as precursors to macrophages and dendritic cells, mediating phagocytosis, antigen presentation, and granuloma formation (Luo et al., 2023). Neutrophils act as first responders by phagocytosing bacteria, releasing neutrophil extracellular traps (NETs), and producing reactive oxygen species (Jeon et al., 2019; Kroon et al., 2023)

Recent studies have shown increased monocyte counts in active TB patients correlating with poor prognosis and delayed cavity closure (Luo et al., 2023; Suraidah et al., 2024). Conversely, neutrophil counts tend to decrease during effective treatment, indicating resolution of acute inflammation (Jeon et al., 2019). Ratios such as monocyte-to-lymphocyte (MLR) and neutrophil-to-lymphocyte (NLR) have emerged as promising diagnostic and prognostic biomarkers (Cursi et al., 2023; Suraidah et al., 2024).

Based on current data, this study intends to assess the relationship between monocytes and neutrophils in TB patients and talk about their clinical implications as markers of inflammatory status and treatment effectiveness.

METHODS

This cross-sectional study encompassed 17 individuals diagnosed with pulmonary tuberculosis at Puskesmas Wonorejo Samarinda from January to April 2024, selected by a total sampling approach involving all pulmonary TB patients undergoing treatment during that timeframe.

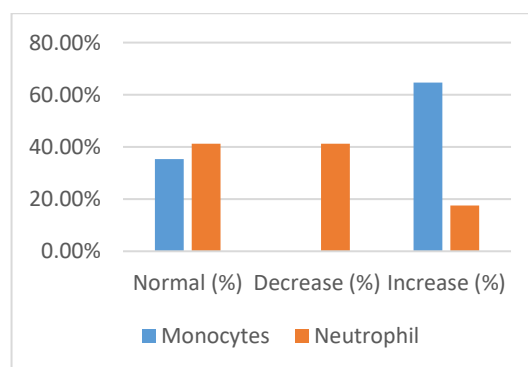
Peripheral blood samples were analyzed for monocyte and neutrophil counts using a complete blood count (CBC) test. Complete blood count (CBC) tests were performed by collecting 3 ml of venous blood from each patient, which was then analyzed using a hematology analyzer. The collected data were analyzed descriptively. Monocyte and neutrophil levels were categorized as normal, increased, or decreased based on standard laboratory reference ranges. The proportions of patients in each category were calculated and presented as percentages.

RESULTS

This research was conducted at the Puskesmas Wonorejo for sampling from January to April 2024, and the examination was conducted at the Samarinda City Provincial Health Laboratory. Total of 17 research samples were collected. The collected data were analyzed descriptively. The results showed an increase and decrease in monocytes and neutrophils.

Table 1 Results of monocytes and neutrophil

No.	Variabel	Normal (%)	Decrease (%)	Increase (%)
1	Monocytes	35,30%	0%	64,70%
2	Neutrophil	41,20%	41,20%	17,60%



These results indicate that most TB patients exhibited elevated monocyte counts, while neutrophil responses were more heterogeneous, with nearly equal proportions of normal and decreased counts, and a smaller proportion showing increased neutrophils.

DISCUSSION

The predominance of elevated monocyte counts (64.70%) among TB patients in this study aligns with recent literature, which consistently reports monocyte elevation as a hallmark of active TB and a marker of ongoing immune activation (Buttle & Bothamley, 2018; Luo et al., 2023). Monocytes play a central role in the immune response against *M. tuberculosis*, being recruited to infection sites where they differentiate into macrophages and dendritic cells, facilitating granuloma formation and pathogen containment (Ahor et al., 2023; Cursi et al., 2023). However, excessive monocyte recruitment can also create a niche for bacterial persistence and dissemination, highlighting the dual nature of monocyte involvement in TB pathogenesis (Rahman, 2024; Sia & Rengarajan, 2019).

The monocyte-to-lymphocyte ratio (MLR) is increasingly recognized as a practical biomarker for TB diagnosis and prognosis, with higher values correlating with active disease and poor outcomes (Cursi et al., 2023; Omair et al., 2024). Several studies have shown that reductions in MLR during treatment are associated with favorable therapeutic responses and sputum conversion (Handoko et al., 2025; Suraidah et al., 2024).

Neutrophil responses in TB are more heterogeneous, as reflected in this study: 41.20% of patients had normal neutrophil counts, 41.20% had decreased, and 17.60% had increased counts. Neutrophils are the most abundant innate immune cells and are rapidly recruited during early infection, where they participate in bacterial killing through phagocytosis, oxidative burst, and the formation of neutrophil extracellular traps (NETs) (Hilda et al., 2020; Kroon et al., 2023). However, excessive or prolonged neutrophil activation can cause tissue damage, increase the risk of cavity formation, and worsen clinical outcomes (Leem et al., 2018; Muefong & Sutherland, 2020; Rachow et al., 2019). High neutrophil counts and neutrophil-to-lymphocyte ratio (NLR) are associated with

more severe disease, while successful anti-TB therapy typically results in normalization or reduction of neutrophil counts and ratios (Brahmbhatt, 2023; Jeon et al., 2019).

The observed decrease in neutrophil counts in 41.20% of patients may reflect the resolution of acute inflammation as treatment progresses, while increased neutrophil counts in 17.60% of patients could indicate ongoing or severe inflammatory responses (Suraidah et al., 2024). The dynamic interplay between monocytes and neutrophils is further supported by evidence that neutrophil-derived chemokines can recruit monocytes, and both cell types contribute to the cytokine milieu that shapes adaptive immunity (Rahman, 2024).

Recent studies have also shown that both monocytes and neutrophils are present in higher numbers in the blood and lungs during the early weeks of infection, with their levels and phenotypes changing as the disease progresses and in response to therapy (Ahor et al., 2023; Gatechompol et al., 2021). The use of simple blood-based biomarkers, such as MLR and NLR, is increasingly recognized as valuable for monitoring disease activity, predicting prognosis, and guiding clinical management in TB (Cursi et al., 2023; Omair et al., 2024). Additionally, new research highlights the importance of integrating these hematological markers with clinical and radiological findings to improve diagnostic accuracy and patient stratification (Handoko et al., 2025; Rahman, 2024).

Furthermore, the variability in neutrophil responses observed in this study may reflect differences in disease stage, bacterial load, host immune status, and response to therapy. It is also possible that genetic and environmental factors, comorbidities, or concurrent infections influence leukocyte dynamics in TB patients (Brahmbhatt, 2023; Gatechompol et al., 2021). In order to provide tailored patient care, future studies should investigate the predictive usefulness of integrating several biomarkers and clarify the mechanisms underlying these changes. In

conclusion, their different and occasionally overlapping roles in TB are highlighted by the prevalence of monocyte increase in TB patients as well as varying neutrophil responses and immune regulation. These findings are consistent with the growing body of literature supporting the use of monocyte and neutrophil counts and their ratios as accessible, cost-effective biomarkers for TB diagnosis, prognosis, and treatment monitoring.

CONCLUSION

In pulmonary tuberculosis patients, monocyte counts increase and remain elevated, reflecting chronic immune activation and inflammation, while neutrophil counts decrease during treatment, indicating resolution of acute inflammation. These contrasting dynamics underscore the distinct immunological roles of monocytes and neutrophils and their potential utility as biomarkers for monitoring therapy and prognosis in TB.

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