

# ELECTRON

(Journal of Science and Technology)

Vol.7, No.1, January 2025, pp. 1 – 8

ISSN 2622-6618 (Online), ISSN 2623-2219 (Print)

<https://journal.ahmareduc.or.id/index.php/electron>

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## Analysis of monocyte and lymphocyte counts of TBDC patients taking anti-TBC drugs

Eka Susanti<sup>1</sup>✉, Sugiono<sup>1</sup>, Laila Kamilla<sup>1</sup>

<sup>1</sup>Department of Medical Laboratory Technology, Politeknik Kesehatan Kementerian Kesehatan Pontianak, Pontianak, West Kalimantan, Indonesia

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### Info Article

#### Article History:

**Received:**

December 10, 2024

**Revised:**

January 2, 2025

**Accepted:**

January 31, 2025

#### Keywords:

TB, Monocytes,

Lifocytes

### Abstract

Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis that attacks the lungs and spreads through the air. Monocytes and lymphocytes play an important role in the immune response to TB. Changes in their numbers can reflect the immune response and treatment effectiveness. Monitoring patients during treatment provides insight into disease progression and therapy response. This study aims to analyze the number of monocytes and lymphocytes in TB patients taking anti-tuberculosis drugs at Puskesmas Ledo, Bengkayang Regency. The study was descriptive quantitative to describe the number of monocytes and lymphocytes. The population was all TB patients undergoing treatment in the working area of Puskesmas Ledo, with total sampling technique and the number of respondents as many as 30 people. From the results of the study, 21 respondents had high monocyte counts: 8 in the early phase of treatment and 13 in the advanced phase. Meanwhile, 9 respondents had non-high monocyte counts, consisting of 4 in the initial phase and 5 in the continuation phase. Of the total respondents, 3 people had high lymphocyte counts, namely 2 in the initial phase and 1 in the continuation phase, while 27 had non-high lymphocyte counts, consisting of 10 in the initial phase and 17 in the continuation phase. In conclusion, high monocyte counts were more common in the continuation phase (61.9%), while high lymphocyte counts were more common in the early phase (66.7%).

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### Corresponding Author:

✉ Eka Susanti

Department of Medical Laboratory Technology, Politeknik Kesehatan Kementerian Kesehatan Pontianak, Pontianak, West Kalimantan, Indonesia

Email: [eka3730@gmail.com](mailto:eka3730@gmail.com)

## INTRODUCTION

The bacterium *Mycobacterium tuberculosis* is the source of the infectious disease tuberculosis (TB) (Banuls, et al., 2015; Delogu, Sali, & Fadda, 2013; Chai, Zhang, & Liu, 2018; Gagneux, 2018; Miggiano, Rizzi, & Ferraris, 2020). According to the World Health Organization (WHO), TB is the infectious disease that causes the second most deaths after COVID-19 (WHO, 2020). In 2021, about 10.6 million people suffered from tuberculosis (TB), and 1.6 million of them resulted in death (Mulya, 2023). According to the data, in 2022 there were a total of 724,309 cases of TB that have been submitted, covering about 75% of the estimated total cases of 969,000 per year. This means that about 25% of the total cases remain unrecorded, either due to lack of detection, lack of coverage, or lack of reporting altogether. In 2021 there are likely to be 28,000 cases of MDR/RR TB or about 10 cases for every 100,000 population. This is a 17% increase from 24,000 cases in 2020, and the incidence rate per 100,000 people is 15%. Routine detection of TB cases in the same year reached 12,531 cases, with coverage of 51% (Kementerian Kesehatan Republik Indonesia, 2023).

Tuberculosis (TB) is a major cause of increased monocyte counts in the blood. Because they are involved in the cellular response to TB bacteria, monocytes are critical in the immune response to TB infection. When *Mycobacterium tuberculosis* phospholipids are broken down into monocytes and macrophages, the resulting cells turn into epithelioid cells. The presence of monocytosis in the blood can explain the activity of tubercle development. Monocytosis is thought to indicate active tuberculosis. A poor prognosis is indicated by the presence of monocytosis. When a person undergoes OAT (Anti-Tuberculosis Drugs) treatment for TB infection, changes in blood composition, including monocyte counts, may occur as part of the immune response to treatment. The ratio of monocytes to lymphocytes can be used to track disease progression. Typically, there is a ratio of 0.3-1 or less; however, in individuals with active tuberculosis, there may be more monocytes than this ratio (Ritonga, 2020)

Patients who regularly follow TB treatment for six months will experience decreased infection and inflammation. This will lead to a decrease in the number of monocytes in the blood and the ESR (Kadarwati et al., 2023). In the treatment of tuberculosis, an increase in the number of lymphocyte cells indicates that the body is responding well to the infection. An increase in lymphocyte cells can also be a sign that the body is in the process of healing from tuberculosis (Alfaiza & Wuryaningsih, 2022). Research conducted by Putra & Nurul (2016), showed that found important variations in the ratio of monocytes to lymphocytes among tuberculosis patients before and after treatment (pre-OAT and post OAT), after OAT, the monocyte/lymphocyte ratio was reduced in TB patients with a value ( $p < 0.05$ ) than before treatment.

Tuberculosis (TB) is a serious global health problem, including in Indonesia, with a significant mortality rate and wide spread. Changes in monocyte and lymphocyte counts may reflect the immune response and effectiveness of TB treatment. Monitoring TB patients during treatment can provide valuable insights into disease progression and response to therapy. Thus, analysis of monocyte and lymphocyte counts in TB patients who are taking anti-tuberculosis drugs at Puskesmas Ledo, Bengkayang Regency will help in further understanding of patients' immune response and treatment effectiveness, as well as contributing to improved TB management at the local level.

## METHOD

This study includes quantitative descriptive research, which aims to describe the number of monocytes and lymphocytes in TB patients who are undergoing anti-tuberculosis drug (OAT) treatment. This is achieved by describing certain variables related to the problem being investigated, using data (Sugiyono, 2019). The population in this study

were all patients undergoing OAT treatment for 1-6 months at the Ledo Health Center. The sample used was 30 respondents with total sampling technique with criteria determined by the researcher.

There are two types of data obtained, including primary data, namely the number of monocytes and lymphocytes of TB patients in the Ledo Health Center Working Area, and secondary data, namely the number of TB patients in the Ledo Health Center Working Area. The data obtained will be analyzed univariately to describe the characteristics of respondents and the characteristics of each variable studied by calculating the frequency and percentage (Sugiyono, 2019) . Variables that are formed categories (gender, age, and education) are presented in the form of proportions, while variables that are formed numerically (age, length of time taking OAT and the results of examining the number of monocytes and lymphocytes in TB patients who take anti-tuberculosis drugs at the Ledo Health Center, Bengkayang Regency).

## RESULTS AND DISCUSSION

Samples of monocyte and lymphocyte count examination were taken as many as 30 people from TB patients who took anti-tuberculosis drugs at the Ledo Health Center. The examination was carried out using EDTA blood from TB patients who received anti-tuberculosis drug (OAT) therapy, then examined the number of monocytes and the number of lymphocytes and processed the data based on the stage of treatment, age, gender, and concomitant diseases of the respondents.

**Table 1.** Age of TB Patients Who Take Anti TB Medicine at Puskesmas Ledo, Bengkayang Regency

Age	Frequency	Percentage
Late Teens (17-25 years old)	6	20%
Early Adult (26-35 years old)	3	10%
Late Adult (36-45 years old)	2	6.6%
Early Elderly (46-55 years old)	11	36.7%
Late Elderly (56-65 years)	3	10%
Seniors (>65 years old)	5	16.7%
Total	30	100%

The table 1 shows data from 30 respondents obtained in number, with early adolescents (17-25 years) 6 respondents as much as 20%, early adults (26-35 years) as many as 3 respondents (10%), late adults 36-45 years) as many as 2 respondents 6.6%, early elderly (46-55 years) as many as 11 respondents (36.7%), late elderly (56-65) years as many as 3 respondents 10% and seniors (> 65 years) as many as 5 respondents 16.7%.

**Table 2.** Description of the Gender of TB Patients Who Take Anti-TB Medicine at the Ledo Health Center, Bengkayang Regency.

Gender	Frequency	Percentage
Male	10	33.3%
Female	20	66.7
Total	30	100%

Table 2 shows 30 respondents, with 10 male respondents (33.3%) and 20 female respondents (66.7%).

**Table 3.** Comorbidities of TB Patients Who Take Anti-TB Medicine at Puskesmas Ledo, Bengkayang Regency.

Participant's illness	Frequency	Percentage
DM	8	26.7%
No DM	22	73.3%
Total	30	100%

Table 3 shows that among 30 tuberculosis (TB) patients taking anti-TB medication at Puskesmas Ledo, Bengkayang Regency, 8 patients (26.7%) also suffer from diabetes mellitus (DM), while 22 patients (73.3%) do not have DM. This indicates that more than one-fourth of TB patients in this study have diabetes as a comorbidity. The presence of DM among TB patients is clinically significant, as diabetes can weaken the immune system and affect the effectiveness of TB treatment, potentially prolonging recovery or increasing the risk of complications.

**Table 4.** Duration of Taking Medication TB Patients Who Take Anti-TB Medication at Puskesmas Ledo, Bengkayang Regency.

Duration of Medication	Frequency	Percentage
Initial Phase	12	40%
Advanced Phase	18	60%
Total	30	100%

The table 4 shows the length of time respondents consumed OAT, with 12 respondents (40%) in the initial phase of taking medication and 18 respondents (60%) in the continuation phase.

**Table 5.** Analysis of Monocyte Counts in TB Patients Who Take Anti-TB Medications at Puskesmas Ledo, Bengkayang Regency

Monocyte Count	Duration of medication				Total	
	Initial Phase		Advanced Phase		n	%
	n	%	n	%		
High	8	38.1	13	61.9	21	70
Not High	4	44.4	5	55.6	9	30

Table 5 shows that the number of respondents examined for monocytes was 30 respondents, with a high monocyte count of 21 respondents (70%) consisting of 8 respondents (38.1%) in the initial phase of taking medication and 13 respondents (61.9%) in the continuation phase. The non-high category was 9 respondents (30%) consisting of 4 (44.4%) in the initial phase of taking the drug and 5 respondents (55.6%) in the continuation phase.

**Table 6.** Analysis of Lymphocyte Counts in TB Patients Taking Anti-TB Medications at Puskesmas Ledo, Bengkayang Regency

Lymphocyte Count	Duration of medication				Total	
	Initial Phase		Advanced Phase		n	%
	n	%	n	%		
High	2	66.7	1	33.3	3	10
Not High	1	33.3	17	63.0	27	90

Table 6 shows that the number of respondents examined for lymphocytes was 30 respondents, with a high number of lymphocytes in the category of 3 respondents (10%) consisting of 2 respondents (66.7%) who were in the initial phase of taking medication and 1 respondent (33.3%).

## DISCUSSION

The results showed that 11 (36.7%) of the 30 respondents who used anti-tuberculosis drugs in the working area of Puskesmas Ledo were senior citizens, aged 46 to 55 years. So that it shows that in that age range is a productive age range in working and social interaction, causing activities outside the home to be very high and the risk of exposure to tuberculosis bacteria is also high. This is in line with the research of Zeng et al (2021) which reported that tuberculosis most often attacks people aged 15 to 55 years who are classified as productive. Age is an important factor in susceptibility to TB. Research shows that the prevalence of TB is significantly higher in adults aged over 45 years (Sutriyawan et al., 2023). The immune system tends to deteriorate with age, increasing the risk of diseases such as tuberculosis (Mishra et al., 2024).

Research findings regarding the gender distribution of research participants showed that out of a total of 30 research participants, 20 people (66.7%) were women. This is because women are more likely to visit health services, in this case the Ledo health center, as evidenced by the dominant number of female patient visits compared to men, thus enabling increased early detection of tuberculosis in women and social factors such as household responsibilities and the role as primary caregiver can also increase exposure to the disease, as women are more likely to interact with family members who may have TB. This is consistent with the findings of research Susilawati & Octrisdey (2023) which explains why women have a greater proportion of TB patients than men.

The results of the study on the duration of taking medication showed that the majority of respondents in the advanced phase of treatment were more dominant than in the initial phase of treatment. This is due to the fact that in the early phase of treatment, people with TB already feel healthy so they take medicine irregularly. While in the advanced phase of treatment, people with TB are more motivated to complete their treatment therapy. Factors such as family support, are a motivation to remain consistent in taking medication, so that in this advanced phase it is rare to find TB patients who no longer take their medicine. Emotional and practical support from family can help patients in the advanced phase to stay focused and consistent in following the medication schedule (Vajapey & Horn, 2021)

The results of the study of the number of monocytes as many as 30 respondents, obtained a high monocyte count of 21 respondents consisting of 8 respondents in the initial phase of taking medication and 13 respondents in the advanced phase. The number of monocytes was not high as many as 9 respondents, consisting of 4 respondents in the initial phase of taking medication and 5 respondents in the advanced phase. As a component of the innate immune system, monocytes help phagocytosis of pathogens as well as an active immune response to *Mycobacterium tuberculosis* infection which shows intense immune activity in fighting infection that can be detected in blood tests. Patients who consistently undergo TB treatment for 6 months tend to experience an increase in monocytes because monocytes play a role in phagocytosis of TB bacteria. An increase in the number of monocytes in the blood is often taken as an indication that the body is trying to more actively fight the TB infection. However, in some cases, it can also signal that the infection has spread more widely or that the immune system is having trouble controlling the bacteria (Nabilah et al., 2023)

The results showed that the difference in monocyte counts between the respondent groups in the initial and follow-up phases of taking medication could be caused by a number of factors including the severity of TB disease, comorbid conditions such as diabetes, high monocyte activation, lifestyle factors such as alcohol consumption and genetic factors that affect the immune response to TB infection. The increased number of monocytes can occur because monocytes play an important role in the immune response to TB infection, so when the bacteria that cause TB disease enter the body, monocytes multiply to phagocytize them. *The Mycobacterium tuberculosis* bacteria that cause TB disease have phospholipids in their

cells, so that some of the phospholipids from *Mycobacterium tuberculosis* are degraded by monocytes and macrophages in the epithelium. Monocytes are the main cells in the formation of tubercles. Activation of tubercle formation can be illustrated by the presence of monocytosis in the blood (Nabilah, 2020) .

The results of the lymphocyte count study showed that there were 30 respondents, with a high lymphocyte count of 3 respondents consisting of 2 respondents in the initial phase of taking medication and 1 respondent in the advanced phase. The number of lymphocytes was not high as many as 27 respondents consisting of 10 respondents in the initial phase of taking medication and 17 respondents in the continuation phase. difference in lymphocyte counts between the groups of respondents in the initial and continuation phases of medication in the study may be due to the response to anti-tuberculosis therapy, malnutrition, and vitamin D status. The difference in lymphocyte counts between the initial and continuation phases of treatment may be related to the body's response to ongoing anti-tuberculosis therapy (Wondmagegn et al., 2020) . Changes in lymphocyte counts during TB treatment may indicate how the body is responding to therapy and could be an indicator of treatment success. Therefore, differences in lymphocyte counts between early and advanced phases of treatment may reflect differences in the body's response to TB treatment (Chedid et al., 2020) addition, factors such as malnutrition and vitamin D status may also affect lymphocyte counts. Research suggests that malnutrition may lead to a decrease in the number of T lymphocytes, which may affect the immune response to TB infection and explain the difference in lymphocyte counts between patients in the early and advanced phases of treatment (Riefani, 2024)

Administration of anti-tuberculosis therapy (OAT) can affect lymphocyte levels, which in turn affects the immune system and results in changes in lymphocyte counts. Long-term consumption of OAT can reduce neutrophil production, which can weaken the immune system and consequently lead to a decrease in lymphocyte counts. This can be caused by the movement of lymphocyte cells in the bloodstream to the site of bacterial infection to recognize antigens through antigen *presenting cells*, IFN- $\alpha$ , IL-1 and IL-6 produced by macrophages so that lymphocytes in the bloodstream decrease. Further activation of lymphocyte cells can be done after the lymphocyte cells at the site of infection recognize the antigen and give signals in the form of cytokines and chemokines to produce more lymphocyte cells. This therapy can affect the immune system which can change the number of lymphocytes. OAT can reduce neutrophil production, which weakens the immune system and results in a decrease in lymphocyte count (Putra, 2020) .

## CONCLUSION

Based on the results of the study, it is known that as many as 21 respondents with high monocyte counts, 8 respondents were in the early phase of treatment, while 13 respondents were in the advanced phase. A total of 9 respondents with non-high monocyte counts consisted of 4 respondents in the initial phase of treatment and 5 respondents in the continuation phase. High lymphocyte counts were found in 3 respondents, 2 of whom were in the early phase of treatment and 1 was in the advanced phase. A total of 27 respondents had a non-high lymphocyte count, consisting of 10 respondents in the initial phase of treatment and 17 respondents in the continuation phase. In conclusion, high monocyte counts were more common in the continuation phase (61.9%), while high lymphocyte counts were more common in the early phase (66.7%).

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