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Profile of Erythrocyte Index Values in Patients with Pulmonary Tuberculosis at Bendan Regional Hospital, Pekalongan City

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ABSTRACT

Background & Objective: Pulmonary tuberculosis (commonly known as TB) is an infectious disease caused by Mycobacterium tuberculosis. If not treated properly, this disease has the potential to cause various serious complications, even death. The objective of this study was to describe the erythrocyte index values in patients with pulmonary tuberculosis at Bendan Regional Hospital, Pekalongan City. **Method:** This research used a descriptive approach involving 30 samples. Examination of erythrocyte indices was carried out using an automatic analyzer method. **Result:** The results showed that 13 samples (43%) had microcytic hypochromic anemia, 9 samples (30%) had normocytic normochromic anemia, 5 samples (17%) had microcytic normochromic anemia, and 3 samples (10%) had normocytic hypochromic anemia. **Conclusion:** Overall, the most common type of anemia found in TB patients at Bendan Regional Hospital, Pekalongan City was microcytic hypochromic anemia.

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Introduction

Pulmonary Tuberculosis (commonly known as TB) is an infectious disease caused by Mycobacterium tuberculosis. If not properly treated, this disease has the potential to cause various serious complications and even death. Transmission of pulmonary tuberculosis occurs when a patient with smear-positive pulmonary TB talks, sneezes, or coughs, during which the patient expels mucus droplets into the air—up to ±3000 droplets containing the bacteria. Pulmonary tuberculosis caused by Mycobacterium is transmitted to others through airborne infection when an infected individual coughs or sneezes (Kristini & Hamidah, 2020).

Tuberculosis mostly affects adults in their productive age, but all age groups are at risk. More than 80% of TB cases and deaths occur in low- and middle-income

countries. TB occurs in all regions of the world. In 2022, the highest number of pulmonary TB cases was reported in the WHO Southeast Asia Region (46%), followed by the African Region (23%) and the Western Pacific Region (18%). Approximately 87% of new TB cases occurred in 30 high TB burden countries, with more than two-thirds of the global total found in Bangladesh, China, the Democratic Republic of the Congo, India, Nigeria, Pakistan, and the Philippines (WHO, 2023).

Tuberculosis can affect red blood cell counts and cause hematological abnormalities. The process of erythropoiesis may be influenced by the shortened lifespan of red blood cells in the bone marrow before they circulate throughout the body. This disorder leads to a decrease in red blood cell count, morphological abnormalities, and changes in red cell volume. Involvement of red cell indices in pulmonary TB patients often presents as anemia of chronic disease. This condition arises due to suppression of erythropoiesis by inflammatory mediators, shortened red cell lifespan, iron metabolism disorders, and nutritional deficiencies (Muliyah et al., 2020b).

According to data from the Ministry of Health of the Republic of Indonesia (2023), the number of tuberculosis (TB) cases in Central Java Province in 2022 reached 70,882 cases, or about 10.2% of the national total of 694,808 cases. This figure reflects the high burden of disease in the region. In addition, the cure rate remains below the national target of 86%. Another issue that exacerbates the situation is the increase in the Lost to Follow-Up (LTFU) rate by 37% compared to 2021, with the number of LTFU cases reaching 4,974 in 2022 (Kemenkes, 2024).

Based on a study conducted by Arma Yunis (2018) at Kendari City General Hospital, out of 12 pulmonary tuberculosis patients, 8 patients (67%) had normal MCV values while 4 patients (33%) had abnormal values. For MCH, 4 patients (33%) were normal and 8 patients (67%) abnormal. For MCHC, 10 patients (83%) were normal and 2 patients (17%) abnormal. Overall, 7 patients (58%) had normal red cell indices, while 5 patients (42%) showed abnormal values. It was concluded that in these 12 patients, the number of normal red cell indices was higher than abnormal values (Yunis, 2018). Another study by Asa Qurrotul Ain & Sri Sayekti (2019) found that 40% of patients experienced normocytic normochromic anemia and 60% had microcytic hypochromic anemia among 10 pulmonary TB patients in Bandar Lampung District Health Center. Out of 23 cases, 52.3% were microcytic hypochromic anemia, which is the most common type found (Muliyah et al., 2020b).

Nevertheless, research findings on red cell indices in pulmonary TB patients still show variations and inconsistencies. Therefore, further studies are needed to provide additional data regarding the pattern of hematological changes, particularly red cell indices, in pulmonary TB patients.

Objective

This study aims to determine the profile of red cell indices in pulmonary tuberculosis patients at RSUD Bendan, Pekalongan City.

Method

This study used a descriptive research design. The population consisted of all tuberculosis (TB) patients treated at RSUD Bendan, Pekalongan City during the period January–February 2025, with a total of 30 samples. Sampling was conducted using the total sampling method, with subjects selected based on predetermined criteria.

The inclusion criteria were: (a) willingness to participate as respondents, (b) positive result by Molecular Rapid Test (TCM), and (c) confirmed diagnosis of pulmonary tuberculosis. The exclusion criteria were: (a) withdrawal of participation during sample collection, and (b) TB patients who were discharged against medical advice or who died. This study was conducted from September 2024 to February 2025 at RSUD Bendan, Pekalongan City. Sample examination was performed using an automated method. Primary data were obtained from red cell index examinations in the RSUD Bendan laboratory, while secondary data were collected from scientific journals, the official websites of the Ministry of Health and WHO, as well as TB patient medical records. All data were processed and presented descriptively in tables and further explained through narrative descriptions.

Results

The study of red cell indices in 30 pulmonary tuberculosis patients at RSUD Bendan, Pekalongan City, conducted in the laboratory from January 1 to February 28, 2025, yielded the following results:

TABLE 1. Results of Erythrocyte Indices Examination in Patients with Pulmonary Tuberculosis at RSUD Bendan, Pekalongan City

Description	N	%
Microcytic Hypochromic	13	43
Normocytic Normochromic	9	30
Microcytic Normochromic	5	17
Normocytic Hypochromic	3	10
Total	**30**	**100%**

Based on Table 1, the results of the erythrocyte index examination in patients with pulmonary tuberculosis showed that 9 samples (30%) had normocytic normochromic anemia, 3 samples (10%) had normocytic hypochromic anemia, 5 samples (17%) had microcytic normochromic anemia, and 13 samples (43%) had microcytic hypochromic anemia.

Discussion

Based on the table above regarding erythrocyte indices in tuberculosis patients, this study was conducted at RSUD Bendan Kota Pekalongan over a period of 3 months from January to March 2025 with a total of 30 samples. The results showed that 43% (13 patients) had microcytic hypochromic anemia, 30% (9 patients) had normocytic normochromic anemia, 17% (5 patients) had microcytic normochromic anemia, and 10% (3 patients) had normocytic hypochromic anemia. This study is consistent with the research conducted by Asa Qurrotul (2019), which stated that most tuberculosis patients experienced microcytic hypochromic anemia (Muliyah et al., 2020a).

Microcytic hypochromic anemia in tuberculosis (TB) patients is the most common type of anemia because the disease is long-lasting and causes chronic inflammation in the body. In this condition, red blood cells become smaller than normal (microcytic) and appear paler due to reduced hemoglobin content (hypochromic). This occurs because of iron deficiency, where the body lacks sufficient iron to produce hemoglobin and red blood cells. Symptoms may include fatigue, dizziness, weakness, pallor, and shortness of breath.

Normocytic normochromic anemia is a type of anemia characterized by red blood cells with normal size and hemoglobin content, but with a reduced number of erythrocytes. In TB patients, this condition occurs due to chronic inflammation that interferes with iron utilization in the body. This type of anemia often appears in the early stages of infection or when TB is still active, and may progress to microcytic anemia if inflammation persists for a long time.

Normocytic hypochromic anemia is a condition in which the size of red blood cells (MCV) remains within the normal range, but the hemoglobin content per cell (MCH) decreases, making the cells appear paler (hypochromic). In tuberculosis patients, this type of anemia can occur as a transitional stage between normocytic normochromic anemia and microcytic hypochromic anemia. This disorder is generally associated with reduced hemoglobin levels due to chronic inflammation, while erythrocyte size has not yet undergone significant changes. This condition indicates that hemoglobin production is impaired, even though the morphology of red blood cells has not fully changed.

Microcytic normochromic anemia is a type of anemia characterized by smaller-than-normal red blood cells (microcytic), but with hemoglobin content still within the normal range (normochromic). In tuberculosis patients, this type of anemia is rarely found, but may appear in the early stages of iron metabolism disorders, when cell size begins to decrease but hemoglobin production is not yet fully impaired.

In this study, the most common type of anemia found in pulmonary tuberculosis patients was microcytic hypochromic anemia, where red blood cells are small and contain less hemoglobin. This is influenced by various risk factors in TB, such as high population density in patients' residential areas that accelerates transmission, poor air quality due to pollution, and comorbidities such as diabetes mellitus, HIV, and chronic lung disease, which can weaken the immune system and disrupt iron metabolism, ultimately leading to anemia.

Conclusion

From the results of the erythrocyte index examination in pulmonary tuberculosis patients at RSUD Bendan Kota Pekalongan with 30 samples, it can be concluded that the majority of samples experienced microcytic hypochromic anemia, with a total of 13 samples (43%), 9 samples (30%) with normocytic normochromic anemia, 3 samples (10%) with normocytic hypochromic anemia, and 5 samples (17%) with microcytic normochromic anemia. Future researchers are expected to consider additional examinations such as routine blood tests and complete blood count (CBC).

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