



The Relationship between Leukocyte Counts and BMI Values in Patients with BTA-Positive Pulmonary Tuberculosis

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Abstract

Leukocytes are a component of white blood cells which play a role in helping the body fight various infectious diseases. Leukocytes are part of the immune system. While an increased number of leukocytes indicates an inflammatory process, in the case of tuberculosis, the entry of *M. Tuberculosis* in the body causes the number of leukocytes to increase as a response to the body's immunity. This prompted researchers to be interested in examining the relationship between the number of leukocytes and the BMI value in pulmonary TB sufferers with BTA positive at the Kutorejo Community Health Center, Mojokerto Regency. The population and sample in this study were all patients with pulmonary TB with positive BTA at the Kutorejo Community Health Center, with the number of samples taken from the total population of 25 respondents, this sampling used a total sampling technique. The independent variable used was TB sufferers with positive BTA while the dependent variables were leukocyte count and BMI value. To prove the existence of a relationship between these two variables, a statistical test was carried out using the Spearman correlation test. The results of the research show that there is no relationship between the number of leukocytes and the BMI value in pulmonary TB sufferers with BTA positive at the Kutorejo Community Health Center, Mojok-erto Regency. This is confirmed by the results of the Spearman correlation test analysis which obtained a sig value. = 0.199 ($\alpha < 0.05$).

Introduction

Tuberculosis (TB) is an infectious disease caused by acute or chronic infection with the bacteria *Mycobacterium tuberculosis* (Green, 2023). People who live in overcrowded and poorly ventilated conditions have a greater chance of becoming infected. The source of infection is tuberculosis sufferers. When they cough or sneeze, sufferers spread germs through the air in the form of droplet nuclei (Lippincont, 2011).

According to Lopes (2017), Tuberculosis (TB) is one of the top 10 causes of death in the world. In 2017, 10,000,000 people were infected with TB, and around 1,600,000 people died from the disease (including 300,000 of whom were HIV sufferers). In 2017, the estimated number of children infected with TB was around 1,000,000 and 230,000 children died from TB (including children with HIV which was linked to TB). Multidrug-resistant TB (MDR-TB) remains a public health crisis and health security threat. WHO estimates there are 558,000 new cases with resistance to rifampin - the most effective first-line drug, of which - 82% have MDR-TB. (Lopes, 2017)

TB control in Mojokerto Regency uses the Directly Observed Treatment Shortcourse (DOTS) strategy. With this program we are trying to achieve the target of finding 70% of the estimated new cases of BTA+ TB sufferers with a cure rate of 85%. One of the indicators used in TB control is the Case Detection Rate (CDR), namely the proportion of the number of new BTA+ patients found and treated to the number of new BTA+ patients estimated to exist in the area. Number of New BTA+ Pulmonary TB Sufferers Kab. Mojokerto from 2011 to 2015, can be seen from the diagram below: (Green, 2023).

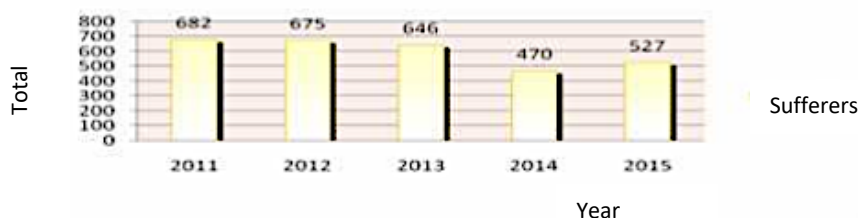


Figure 1. BTA+ Pulmonary TB Patients in Kab. Mojokerto 2011 – 2015 (RENSTRA Health Office, 2016)

The number of BTA+ TB cases was 527 with a death rate during treatment per 100,000 population of 0.47 with a total of 2 deaths. The treatment success rate is 99.47% (Green, 2023). There was an increase in cases of BTA+ TB, but the number of deaths during treatment decreased from 2014. And the treatment success rate increased from 2014. The cure rate in 2015 was 96.26% with the number of BTA+ being treated being 562 and those receiving complete treatment as many as 18 people (Green, 2023).

However, in 2018 in the Mojokerto Regency area, TB sufferers experienced an increase. Nearly 1,500 residents tested positive for TB and had to take medication regularly for six months. Data from the Mojokerto District Health Service, the number of positive TB sufferers throughout 2018 reached 1436 people, of that number, 177 sufferers were declared cured, while 13 sufferers became drug-resistant or MDR, and four people died.

Leukocytes are a component of white blood cells which play a role in helping the body fight various infectious diseases. Leukocytes are part of the immune system. While an increased number of leukocytes indicates an inflammatory process, in the case of tuberculosis, the entry of M. Tuberculosis in the body causes the number of leukocytes to increase as a response to the body's immunity (Kiswari, 2014).

Pulmonary TB patients often experience decreased nutritional status, and can even become malnourished if not balanced with an appropriate diet. Several factors related to nutritional status in pulmonary TB patients are the level of energy and protein adequacy, the patient's behavior towards food and health, the duration of suffering from pulmonary TB, and the patient's per capita income. TB infection results in decreased intake and malabsorption of nutrients as well as changes in body metabolism resulting in a process of decreasing muscle and fat mass (wasting) as a manifestation of protein energy malnutrition (Priyantomo, 2014).

Kutorejo sub-district is one of the sub-districts in Mo-jokerto district with a TB detection rate with BTA+ recorded at 25 people in 2018 (Kutorejo Health Center Data, 2018). Kutorejo Health Center is a health center located in Kutorejo sub-district. Based on the results of observations, patients who come with complaints according to the clinical symptoms of pulmonary TB will undergo a phlegm examination (BTA) and their BMI value will be weighed (Logeshwaran et al., 2022). Patients who come have never had a blood test done to find out whether there really is an increase in the number of leukocytes, which is a sign of an inflammatory process in pulmonary TB, and leukocyte examination is an easy test to do at the Community Health Center. Increased leukocytes indicate signs of infection which causes increased energy use at rest which results in decreased intake and malabsorption of nutrients

as well as changes in body metabolism resulting in a process of decreasing muscle and fat mass as a manifestation of protein energy malnutrition which causes nutritional status to decrease.

Based on the problems above, researchers are interested in examining the relationship between the number of leukocytes and the BMI value in pulmonary TB sufferers with positive BTA at the Kutorejo Community Health Center, Mojokerto Regency.

Methods

Research Design

This research was conducted using the Cross Sectional method. Researchers will measure the dependent variable and independent variables, then analyze the collected data to look for relationships between variables. In this study, data collection will be carried out after the patient has undergone a BTA examination and was declared positive at the Kutorejo Community Health Center, Mojokerto district.

Research Population and Sample

The population and sample in this study were all patients with pulmonary TB with positive BTA at the Kutorejo Community Health Center, with the number of samples taken from the total population of 25 respondents, this sampling used a total sampling technique.

Data analysis

In this research, the data obtained used the Spearman correlation test statistic. The Spearman correlation test is a statistical test aimed at determining the relationship between two or more ordinal scale variables. With data analysis using SPSS 20.00 for Windows.

Result and Discussion

Table 1. Gender Distribution of Pulmonary TB Respondents at Kutorejo Health Center, Kutorejo District, Mojokerto Regency, East Java Province, 2019

Kind Kelamin	Frequency	Percentage %
Man	16	64.0
Woman	9	36.0
Total	25	100.0

Source: Research Data, 2019

Based on the results of the study, it was found that as many as 64% of respondents (16) were male and as many as 36% of respondents (9) were female.

Table 2. Age Distribution of Pulmonary TB Respondents at Kutorejo Health Center, Kutorejo District, Mojokerto Regency, East Java Province in 2019

Age	Frequency	Percentage %
20 – 30 Year	4	16.0
31 – 41 Year	11	44.0
> 40 Years	10	40.0
Total	25	100.0

Source: Research Data, 2019

Based on the results of the study, it was found that from 100% of the respondents studied, as many as 16% of respondents (4) aged 20-30 years, 44% of respondents (11) respondents aged 31-40 years, and respondents aged > 40 years amounted to 40% of respondents (10).

Table 3. Distribution of Leukocyte Number of Pulmonary TB Patients at Kutorejo Health Center, Kutorejo District, Mojokerto Regency, East Java Province in 2019

Leukosit	Frequency	Percentage %
Tall	19	76.0
Low	6	24.0
Total	25	100.0

Source: Research Data, 2019

Based on the results of the study, it was found that as many as 76% of respondents (19) respondents had a high leukocyte count while 24% of respondents (6) other respondents had a low leukocyte count.

Table 4. Distribution of BMI (*Body Mass Index*) of Pulmonary TB Patients at Kutorejo Health Center, Kutorejo District, Mojokerto Regency, East Java Province in 2019

BMI	Frequency	Percentage %
Underweight	21	84.0
Normal weight	4	16.0
Total	25	100.0

Source: Research Data, 2019

Based on the results of the study, it was found that, as many as 84% of respondents (21) had a body weight classified as *underweight*, and only 16% of respondents (4) respondents who had a body weight classified as *normal weight*.

Uji Statisticians

Once the characteristics of each variable (univariate) are known, it can be forwarded with bivariate analysis to determine the relationship between variables. The following will be presented test results using the *Spearman Correlation test*.

Table 5. The Relationship Between Leukocyte Number and BMI Value in Pulmonary TB Patients with BTA Positive at Kutorejo Health Center, Mojokerto Regency in 2019

Leukosit	BMI		Total	<i>Spearman Correlation</i>
	Underweight	Normalweight		
Tall	17 (89,5%)	2 (10,5%)	19 (100%)	0,199
Low	4 (66,7%)	2 (33,3%)	6 (100%)	
Total	21 (84,0%)	4 (16,0%)	25 (100%)	

Source: Research Results, 2019

Based on the research results, it shows that of the 100% of respondents with low leukocyte counts, 66.7% of respondents had a Body Mass Index (BMI) in the underweight category. Likewise, of the 100% of respondents with high leukocyte counts, 89.5% of respondents had a Body Mass Index (BMI) in the underweight category. The results of the Spearman correlation test calculations obtained a sig value. = 0.199 ($\alpha < 0.05$) which means there is no relationship between the number of leukocytes and the BMI value in pulmonary TB sufferers with BTA positive at the Kutorejo Community Health Center, Mojokerto Regency.

Research Limitations

This research was only carried out in one place so it is difficult to identify the factors that cause a decrease in BMI in pulmonary TB patients. A limitation in this study is the number of respondents who have received treatment, which affects leukocytes and BMI

Discussion

Respondent Characteristics

Gender

The gender proportion in this study was more men than women. It was found that 64% of respondents (16) were male and 36% of respondents (9) were female.

According to research by Oktavia et al. (2016), male respondents can reduce the risk of developing pulmonary TB by 0.79 times (21%) compared to female respondents.

Age

Respondents in this study were mostly aged between 31-40 years. These results are shown by the acquisition of 44% of respondents (11) aged 31 - 40 years

According to Suprijono (2005), his research reported that there were more pulmonary tuberculosis patients aged < 45 years than those aged > 45 years. Pulmonary tuberculosis is common among people aged < 45 years due to high mobility so the risk of infection is high (Nainggolan, 2013)

Leukocytes

The majority of respondents in this study had relatively high leukocyte counts. This is shown by 76% of respondents (19) having leukocyte counts in the high category, while 24% of respondents (6) other respondents had low leukocyte counts.

According to Sadikin (2002), the smallest number of leukocytes in the body is around 4,000-10,000/mm³ which functions to protect the body from infection. Therefore, the number of leukocytes changes from time to time, according to the number of foreign objects encountered within the limits that the body can still tolerate without causing functional disorders.

BMI

In this study, it was discovered that the majority of respondents were classified as underweight (<18.5 kg/m²). This was shown by the majority of respondents, 84% of respondents (21) were classified as underweight.

The results of this research are in line with research conducted by Paton et al. (2004). From the results of the research, it was stated that the majority of respondents with an initial diagnosis of tuberculosis had a BMI below normal.

Relationship between Leukocyte Count and BMI Value in Pulmonary TB Patients with BTA Positive at Kutorejo Health Center, Mojokerto Regency

Based on the results of the Spearman correlation test, the sig value was obtained. = 0.199 ($\alpha < 0.05$) which means that there is no relationship between the number of leukocytes and the BMI value in pulmonary TB sufferers with BTA positive at the Kutorejo Community Health Center, Mojokerto Regency. There is no relationship in this study because the number of leukocytes in the respondents studied in this study was relatively high and all respondents were pulmonary TB sufferers.

According to Effendi (2003) Tuberculosis can cause an increase in the number of leukocytes related to their function as the body's defense so that blood deposition accelerates more quickly due to an increase in the number of blood cells, this causes the plasma volume to become higher. The number of leukocytes per mm³ of blood in normal adults is 4000 – 10,000, at birth it is 15,000 to 25,000 and by the fourth day it decreases to 12,000 at the age of four years according to the normal number.

Types of leukocytes have a role in destroying bacteria that infect the body. Under normal circumstances, tuberculosis infection stimulates T lymphocytes to activate macrophages so they can more effectively kill germs, while neutrophils are found in 20% of tuberculosis sufferers by infiltrating the bone marrow (Oehadian, 2003).

The results of this study show that of the 100% of respondents with low leukocyte counts, 66.7% of respondents had a Body Mass Index (BMI) in the underweight category. Likewise, of the 100% of respondents with high leukocyte counts, 89.5% of respondents had a Body Mass Index (BMI) in the underweight category.

Leukocytes act as the body's resistance to foreign objects entering the body, an increased number of leukocytes indicates an inflammatory process, in the case of tuberculosis, the entry of M. Tuberculosis in the body causes the number of leukocytes to increase as a response to the body's immunity (Bili, 2018).

At the beginning of diagnosis, tuberculosis patients have a BMI below normal (Zachariah et al., 2002) but in the final phase of TB treatment they will experience some increase in BMI which indicates the success of treatment. The same theory was expressed by Kenangalem (2013), according to which TB patients generally experience an increase in body mass index after 6 months of treatment with OAT (anti-tuberculosis drugs). Increasing BMI in TB patients is a good marker of reducing the possibility of relapse (recurrence) of TB infection. However, this is only possible in patients with normal BMI. With overweight BMI, the possibility of TB reinfection can occur if excessive BMI leads to metabolic disease which can increase the risk of TB reinfection such as diabetes mellitus (Priyantomo, 2014).

An unhealthy lifestyle can trigger disease, as can an unhealthy environment and irregular exercise. Besides that, poor nutrition will cause someone who has been affected by this disease to not be able to recover quickly (Fadhalna et al., 2017)

The condition of TB sufferers with poor nutritional status will slow down the healing period and will increase the death rate compared to TB sufferers with normal nutritional status. So adequate nutritional intake has a very important influence on increasing BMI to normal. The recommended food intake for TB sufferers is food that is rich in protein and sufficient calories to prevent tissue damage and help healing. Recommended foods include low-fat meat, fruit and vegetables (Fadhalna et al., 2017).

Conclusion

As many as 76% of respondents (19) had leukocyte counts in the high category at the Kutorejo Community Health Center, Mojokerto Regency. As many as 84% of respondents (21) were classified as underweight at the Kutorejo Health Center, Mojokerto Regency. From the results of the Spearman correlation test analysis, the sig value was obtained. = 0.199 ($\alpha < 0.05$). So it can be concluded that there is no relationship between the number of leukocytes and the BMI value in pulmonary TB sufferers with BTA positive at the Kutorejo Community Health Center, Mojokerto Regency.

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