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RELATIONSHIP BETWEEN BLOOD SUGAR LEVELS AND THE RESULTS OF ACID-FAST BACILLA EXAMINATION IN PULMONARY TUBERCULOSIS PATIENTS

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ABSTRACT

Introduction: Tuberculosis (TB) is a highly contagious disease and a leading cause of morbidity and mortality worldwide. When Mycobacterium tuberculosis enters the body of an individual with elevated blood glucose levels, it creates a favorable environment for bacterial growth and proliferation. **Objective**: This study aimed to investigate the correlation between blood glucose levels and acid-fast bacilli (AFB) smear results in pulmonary tuberculosis patients at Arifin Achmad General Hospital, Pekanbaru. **Methods**: This study employed a retrospective analytical correlational design using secondary data from medical records. A total sample of 51 cases was analyzed using total sampling. Data was collected using an observation sheet and analyzed using Fisher's exact test. **Results**: A majority of the respondents (43%) had blood glucose levels exceeding 125 mg/dl, and a significant proportion (76.5%) had positive AFB smears. The Fisher exact test revealed a significant correlation between blood glucose levels and positive AFB smear results ($p < 0.05$). **Conclusion**: This study demonstrates a significant association between blood glucose levels and AFB smear results in pulmonary tuberculosis patients at Arifin Achmad General Hospital, Pekanbaru.

Keywords: Acid fast bacillus, Blood glucose levels, Tuberculosis.

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INTRODUCTION

Pulmonary tuberculosis (TB) is an infectious disease that is the main cause of health problems and death in the world. The cause of pulmonary TB is the presence of Mycobacterium tuberculosis which can cause infection. The lungs are one of the organs most frequently affected by pulmonary TB, but pulmonary TB can also attack other parts of the body (World Health Organization, 2022). A person who suffers from tuberculosis of the lungs or throat can transmit pulmonary TB through the air, for example by coughing, sneezing or talking (Apriliani and Rahayu 2020).

Report on data findings obtained from (World Health Organization, 2022) The number of people dying from tuberculosis is increasing worldwide. In 2021, an estimated 187,000 deaths among HIV-positive individuals and 1.4 million deaths among HIV-negative individuals were reported for a combined total of 1.587 million deaths due to pulmonary TB (World Health Organization, 2022).

According to data obtained from global and Indonesian pulmonary TB case reports in 2022, India itself is in second place after India. It is estimated that there are 969,000 cases of pulmonary TB in Indonesia, or one new case every 33 seconds. In Indonesia, there are 354 cases of pulmonary tuberculosis (TB) for every 100,000 residents of whom suffer from pulmonary TB. Apart from the discovery of pulmonary TB cases, in Indonesia, the death rate due to pulmonary tuberculosis (TB) has increased to reach 150,000 cases, or one death every four minutes. This figure has increased by 60% from 93,000 cases of death due to pulmonary TB in 2020. The percentage of

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deaths due to pulmonary TB is 55 per 100,000 population in Indonesia (World Health Organization, 2022). According to the Riau provincial health office, in 2022 the total number of pulmonary TB sufferers in Riau Province from 2020 and 2021 will increase, from initially 7,646 people to 13,360 people, this is a very significant increase. However, in 2022 the figure will decrease slightly from 2021, namely 13,006 people, of course this figure is still very high. This increase in pulmonary TB cases was discovered due to contacting organizations, shelters, businesses and correctional facilities to ask about and screen for pulmonary tuberculosis (BPS Riau, 2022)

Microscopic examination of Acid Fast Bacilli (AFB) from sputum contributes to early diagnosis as well as monitoring treatment of pulmonary TB (Susanti, 2020). Microscopic examination of BTA from sputum is the simplest and fastest examination to diagnose pulmonary TB. This examination is carried out by dripping sputum onto a glass slide and then staining it using the Ziehl-Neelsen method. If there are pulmonary TB bacteria in the sputum, the bacteria will be red and clearly visible under a microscope (Kemenkes RI, 2022).

In the 2020 American Journal of Respiratory and Critical Care Medicine, researchers found that people with uncontrolled DM had a 4.5 times greater risk of developing pulmonary TB than people without DM. High blood sugar levels cause damage to the immune system, especially white blood cells. This condition often occurs in people infected with the HIV virus because the HIV virus attacks CD4 cells, which are white blood cells that play an important role in the body's immune system. As CD4 cells decrease, the body's immune system declines and it becomes more susceptible to disease, such as tuberculosis in the lungs. (American Journal of Respiratory and Critical Care Medicine., 2020).

The spike in blood sugar levels in pulmonary TB patients who are positive for BTA is a response to pulmonary TB infection. Increased blood sugar levels can have a negative impact on the health of pulmonary TB sufferers, so it is necessary to monitor the blood sugar levels of pulmonary TB sufferers regularly, because apart from that, the condition of pulmonary TB patients will become more serious when they suffer from DM and their blood sugar levels increase (Amri, 2019).

Based on (American Diabetes Association, 2022) Uncontrolled blood sugar levels also increase the risk of death and relapse rates in pulmonary TB sufferers. High blood sugar conditions are a favorable environment for the growth of bacteria including Mycobacterium tuberculosis. According to (Prameyllawati, Saraswati, & Ginandjar, 2019) that the incidence of Diabetes Mellitus in pulmonary TB sufferers is interpreted as the emergence of two diseases in a person so that the person can suffer from pulmonary TB first and then suffer from Diabetes Mellitus, and vice versa.

Based on the results of previous research, it was found that there was a relationship between increasing blood sugar levels and the incidence of pulmonary TB. Research by (Darni, 2021) shows that high severity of pulmonary TB disease also results in increased blood sugar levels (Time). The blood sugar level that influences is 281-300 mg/dl with the severity of pulmonary TB disease in the interpretation of BTA +3. In addition, research (Siburian, 2019) showed that in a special lung hospital there was an increase in blood sugar levels (Time) in outpatient pulmonary TB patients. 13 respondents (43%) had normal blood sugar levels, while 17 respondents (57%) had high blood sugar levels.

On November 2 2023, researchers conducted pre-research in the medical records room at Arifin Achmad Hospital, Pekanbaru. Based on the results of the pre-research, data on pulmonary TB patients who had been treated in the Jasmin room at Arifin Achmad Hospital Pekanbaru in the period from early January to the end of December 2022 had a total of 51 patients. The average number of pulmonary TB patients who receive treatment every month is around 8 pulmonary TB sufferers in 2022. Of all pulmonary TB patients treated in the Jasmin room at Arifin Achmad Hospital Pekanbaru, the most frequent type of blood sugar level is checked, namely GDS. The condition of pulmonary TB patients can cause disturbances in the body's metabolism, including the effect on glucose metabolism. The immune

system's response to infection causes the release of hormones that can increase blood sugar levels.

Research needs to be carried out to determine the relationship between blood sugar levels and the results of acid-fast bacilli examinations in pulmonary tuberculosis sufferers. To determine the relationship between blood sugar levels and the results of acid-fast bacilli examinations in pulmonary TB sufferers at Arifin Achmad Hospital Pekanbaru.

METHOD

This research applies a retrospective analytical correlation research design where the researcher only makes observations without intervening on data collected through research identified in the past. The sampling method was a total sampling of 51 cases. Researchers also used inclusion and exclusion criteria in this study. The inclusion criteria in this study were medical records of patients diagnosed with pulmonary TB, medical records of pulmonary TB patients in the early adult to elderly age category, medical records of TB patients who had data on the variables to be studied. The exclusion criteria in this study were patient medical records that were illegible/damaged, no blood sugar level examination results, no acid-fast bacilli examination results. This research was carried out in the medical records room of Arifin Achmad Regional Hospital. After the researcher obtained a research permit from the campus and Arifin Achmad Hospital Pekanbaru.

Data collection was carried out according to the criteria that had been designed. At the research implementation stage, researchers collected data using observation sheets containing information from respondents including respondent number, medical record number, age, gender and the respondent's latest education. In addition to respondent data, this observation sheet records the results of BTA examinations and blood sugar levels. Was in Pekanbaru. Data collection was carried out using observation sheets. After the data was collected, the researcher managed the data obtained using a computer program, then the researcher carried out univariate data analysis with the aim of looking at each variable studied, with a frequency distribution in the form of percentages and narratives. And also carrying out bivariate analysis aims to understand the differences or relationships between two variables, namely the independent and dependent variables. The statistical test used in this research is the alternative Fisher Exact Test.

RESULTS

Respondent Characteristics

This research found from 51 data from respondents from pulmonary TB patients that the majority were male, namely 30 respondents (58.8%). Judging from age, most of them were in late old age (56-65 years), amounting to 20 respondents (39.2%). Based on the highest level of education, most of them had completed SLTA, amounting to 23 respondents (45.1%).

Tabel 1
Distribusi Frekuensi karakteristik responden (n=51)

Respondent Characteristics	Frekuensi (n)	Persentase (%)
Gender		
– Male	30	58,8
– Female	21	41,2
Age		
– Early adulthood (26-35 years)	6	11.8
– Late adulthood (36-45 years)	7	13,7
– Early elderly (46-55 years)	12	23,5
– Late elderly (56-65 years)	20	39,2
– Seniors (>65 years)	6	11,8
Last education		
– SD	10	19,6
– SLTP	12	23,5
– SLTA	23	45,1
– College	6	11,8
Total	51	100

Blood Sugar Levels

This research found that from 51 respondents' data on pulmonary TB patients, the majority of respondents had diabetes levels, 22 respondents

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(43.2%). All respondents had the results of an interim blood sugar level check.

Tabel 2
Distribusi Frekuensi Responden Berdasarkan Kadar Gula Darah (n=51)

Variabel	Frekuensi (n)	Persentase (%)
Blood sugar levels	12	23,5
– Normal (<100 mg/dl)	17	33,3
– Pre diabetes (100-126 mg/dl)	22	43,2
– Diabetes (>126 mg/dl)		
Total	51	100

Acid Fast Bacillus Results

This research found from 51 data from respondents from pulmonary TB patients that the majority of respondents had positive BTA results 1, namely 16 respondents (31.4%) and when combined, 39 respondents (76.5%) had positive BTA results.

Tabel 3
Distribusi Frekuensi Responden Berdasarkan Hasil Basil Tahan Asam (BTA) (n=51)

Variabel	Frekuensi (n)	Persentase (%)
Acid fast bacillus results	12	23,5
– Negatif	16	31,4
– Positif 1	14	27,5
– Positif 2	9	17,6
– Positif 3		
Total	51	100

This research found from 51 data from respondents from pulmonary TB patients that the majority of respondents with positive BTA had diabetes blood sugar levels, namely 22 respondents (43%). Statistical tests using the alternative Fisher Exact Test between the blood sugar level variable and the acid-fast bacilli variable in pulmonary TB sufferers at Arifin Achmad Pekanbaru Regional Hospital showed that there was a significant relationship with a p value of 0.00 <α (0.05).

Tabel 4.4
Hubungan Kadar Gula Darah Dengan Hasil Basil Tahan Asam (n=51)

Kadar Gula Darah									
BTA	**Normal**		**Pre diabetes**		**Diabetes**		**Total**		***P value***
	n	%	n	%	n	%	n	%	
Negatif	11	21,6	1	2,0	0	0	12	23,5	0.00
Positif	1	2,0	16	31,4	22	43	39	76,5	
Total	12	23,6	18	33,4	26	43	51	100	

DISCUSSION

Gender

The research results showed that of the 51 respondents, 30 respondents were male (58.8%) and 21 respondents were female (41.2%). These results are in line with research (Harahap 2023) the proportion of men is greater than women. Compared with women, men are more susceptible. This is consistent with other studies showing a higher incidence of pulmonary TB in men. On research (Meilenia, Dewi, & Islami, 2023) It was found that more men suffered from pulmonary TB, namely 16 (56.29%). The high incidence of pulmonary tuberculosis in men is due to smoking habits which result in a decrease in the defense mechanism of the respiratory tract due to toxins from cigarette smoke making it susceptible to infections in the respiratory tract (Meilenia et al., 2023).

Apart from smoking behavior, men can become infected with pulmonary TB due to excessive alcohol consumption. In addition, alcohol can also cause a decrease in macrophage function and the cell-mediated immune system, as well as inhibit macrophage responses to cytokines (Ekawati, Singga, Mauguru, Sanitasi, & Kupang, 2022).

Age

The research results showed that of the 51 pulmonary TB respondents, the majority were in the late elderly group, namely 20 respondents (39.2%). As we age, the body's metabolism experiences significant changes that affect the body's ability to

fight infection (Apriliani and Rahayu, 2020). Research (Sutrisna & Elsi Rahmadani, 2022) shows that a decrease in metabolism in the late elderly results in a decrease in the efficiency of the immune system, making it susceptible to pulmonary TB infection.

Last Education

The research results showed that of the 51 respondents, the majority of pulmonary TB patients had upper secondary/high school education, 23 respondents (45.1%). Research by (Mildani, 2019) states that the level of education can also influence healthy living behavior. If the level of education is high then receiving information is easier to understand and applying it in life is also easier, while with a low level of education receiving information will require repetition of the information conveyed until it is understood, of course this will influence the implementation of healthy living behavior.

Blood Sugar Levels

The research results showed that of the 51 respondents, the majority of respondents had blood sugar levels >125 mg/dL with a total of 22 respondents (43.1%). This shows that someone with pulmonary TB tends to have high blood sugar. Findings of assessing respondents' blood sugar levels using random blood sugar tests (GDS). Research results (Siburian, 2019) from concluding that blood sugar levels increased in pulmonary TB sufferers totaling 17 respondents (57%) and normal blood sugar levels totaling 13 respondents (43%). Patients with active pulmonary TB can have increased blood sugar levels and the risk of diabetes. The body's inflammatory response releases pro-inflammatory cytokines that increase insulin resistance, preventing glucose from entering cells and remaining in the bloodstream. At the same time, active immune cells require more energy but due to insulin resistance glucose cannot be used optimally. These factors cause an increase in blood sugar levels when an infection occurs (Yusransyah, Stiani, & Sabilla, 2022).

Acid Fast Bacillus Results

The research results showed that of the 51 respondents, the majority of respondents had positive BTA results, namely 39 respondents (76.5%), the majority of respondents had positive BTA result 1, namely 16 respondents (31.4%). Meanwhile, those who had negative BTA results were 12 respondents (23.5%). Research by (Mildani, 2019) It is known that pulmonary TB sufferers who are diagnosed with DM have high blood sugar levels, making it easier for TB infections to multiply and affecting the increase in BTA results. Research by (Baliasa, Pingkan, Kaunang, Harold, & Kairupan, 2020), It was found that most people with pulmonary TB had a positive BTA result of 1. A positive BTA result of 1 indicates that bacteria were detected but in lower numbers than a positive result of 2 or 3, which indicates a higher bacterial load. Conditions of high blood sugar levels can also create an environment that is more conducive to the growth and reproduction of TB bacteria in the body which in turn increases the possibility of a positive BTA result.

The results of the analysis of the relationship between blood sugar levels and the results of acid-fast bacilli (BTA) examinations at the Arifin Achmad Pekanbaru Regional Hospital, which was carried out on 51 respondents, which was carried out based on statistical tests with the Fisher Exact alternative test between blood sugar level variables and acid-fast bacilli variables in TB sufferers. lungs at Arifin Achmad Hospital Pekanbaru showed that there was a significant relationship with a p value of 0.00 <α (0.05).

According to research (Mildani, 2019) There is a relationship between blood sugar levels and BTA results, where if blood sugar levels are high it will affect the patient's immune system and create an environment that supports the development of Mycobacterium tuberculosis bacteria. High blood glucose also results in low immune system. Therefore, it is necessary to manage blood sugar control so that blood sugar returns to normal so that the body's immune system becomes stronger and is able to prevent infections.

This research shows that there is a relationship between blood sugar levels and the BTA results of pulmonary TB patients. If the blood sugar level of someone infected with pulmonary TB increases, it influences the BTA results to become positive, which is caused by the immune system and

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sugar metabolism in the body. High blood sugar levels result in changes in the body's environment which allows bacteria to multiply. In addition, conditions such as diabetes, which are often associated with high blood sugar levels, can worsen the body's ability to fight pulmonary TB infection.
Blood glucose screening should be conducted on all newly diagnosed pulmonary TB patients. For patients with normal blood glucose levels, periodic monitoring is necessary to detect any increase in blood glucose. The medical records used in this study only included a single diagnostic blood glucose test from a complete blood count. This limitation hindered the researchers' ability to continuously monitor blood glucose levels.

CONCLUSION

This research shows that there is a significant relationship between blood sugar levels and acid-fast bacillus (BTA) examination results in pulmonary TB patients at Arifin Achmad Hospital Pekanbaru, which means that increasing blood sugar levels can affect the severity of pulmonary TB infection. A recommendation for future researchers is to utilize a glucometer for direct monitoring of blood glucose levels in pulmonary TB patients at specific time points: upon admission, mid-treatment, and at discharge. By employing a glucometer, researchers can obtain accurate and real-time primary data on patients' blood glucose levels.

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