

Nutrition Status Related to Clinical Improvement in AFB-Positive Pulmonary Tuberculosis Patients in Primary Health Centres in Medan, Indonesia

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Abstract

Citation: Sari DK, Mega JY, Harahap J. Nutrition Status Related to Clinical Improvement in AFB-Positive Pulmonary Tuberculosis Patients in Primary Health Centres in Medan, Indonesia. *Open Access Maced J Med Sci.* 2019 May 31; 7(10):1621-1627. <https://doi.org/10.3889/oamjms.2019.338>

Keywords: Tuberculosis; Body mass Index; Albumin; Sputum Conversion; Indonesia

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Received: 28-Mar-2019; **Revised:** 02-May-2019; **Accepted:** 03-May-2019; **Online first:** 28-May-2019

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Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

BACKGROUND: Tuberculosis (TB) remains a major public issue in Indonesia, including in North Sumatra province. Despite reported good efficacy of TB treatment in the region, the success of treatment depends on many factors, including nutritional status.

AIM: To determine the relationship between Body Mass Index and Albumin level with sputum conversion in AFB-positive pulmonary TB patients.

METHODS: The study was done in two primary health centres in Medan between October and November 2018. A total of 39 newly diagnosed TB patients with confirmed AFB-positive were included in the study. Participants received TB treatment according to the national guidelines.

RESULTS: The proportion of participants with below normal, normal and above normal BMI status were 13 (33.3%), 21 (53.9%) and 5 (12.8%), respectively. Level of albumin was determined as normal in 25 participants (64.1%), and the remaining as low. Normal BMI status was significantly associated with increased albumin level ($p < 0.05$). At 2 months follow-up, the sputum conversion was observed in 24 individuals (61.5%), and the conversion was significantly associated with normal BMI and/or normal albumin level ($p < 0.05$).

CONCLUSION: We concluded that nutritional status is an important factor in the success of TB treatment.

Introduction

Tuberculosis (TB) is a lungs disease caused by *Mycobacterium tuberculosis bacillus*. The source of transmission is from AFB-positive pulmonary TB patients. When coughing or sneezing, the patients spread germs in the air through sputum (droplet nuclei). One cough produces around 3000 sputum splashes. Thus, TB is included in 10 deadly diseases in the world. According to the data from North Sumatera provincial health office in 2016, the new cases of TB reached 23,097 numbers with 5,714 death rates. Medan is the biggest TB infected area compared to other places in North Sumatera. Since 2010, TB cases in Medan experiences a continuous

increase. In 2010, there were approximately 1,425 new cases, with 38,615 Case Detection Rate (CDR). However, there were 1,425 cure rates in the same year.

Sputum conversion is a strong predictor and the beginning of success in TB therapy. It is determined by the discovery of mycobacteria in sputum culture taken on the second month of treatment. Sputum conversion on TB cases is formed at the end of the first month (60 – 80%), the end of the second month (95%), while 9% do not convert [1]. The success factors in the intensive phase of treatment are patients' life and work, the access to health service, food supply and behaviours (the obedience in medicine consumption, alcohol consumption, smoking habit and nutritional status) [2].

One of the most efficient and economical measurement to describe nutritional status is the Body Mass Index (BMI). The research from Tama et al., (2016) [3] shows that AFB-positive pulmonary TB patients with BMI < 18.5 kg/m² possess the higher cumulative probability of conversion failure compared to those patients with BMI > 18.5 kg/m². The speed of sputum conversion (hazard rate) on patients with a BMI < 18.5 kg/m² is lower compared to patients with BMI > 18.5 kg/m². Sputum conversion will take a longer time if the increase of patients' body weight at the end of the intensive phase is < 1 kg. Therefore, TB patients with low BMI at the beginning of treatment should be monitored for their nutritional improvement. This nutritional improvement must be the focus of attention during treatment, considering the increase of body weight in the last intensive phase is a vital contribution to the success of sputum conversion.

Albumin is one of the indicators of nutritional status, both at the beginning of a malnutrition case or during improvement [4]. To TB patients, albumin in serum will experience a significant decline, assumedly because of nutrition factors (low food supply, anorexia, catabolism increase), enteropathy and acute phase of protein reaction [5]. The decline of total protein and albumin are often caused by the decrease of appetite, malnutrition and malabsorption of TB patients [6]. According to the research by Simbolon et al., (2016) [7], it is found that there are 69.76% TB patients with albumin content < 3.5 g/dL, and the rest 30.24% possess albumin ≥ 3.5 g/dL. This result indicates that there more patients with albumin < 3.5 g/dL, which is caused by chronic inflammation, where albumin production decrease while albumin damage keeps increasing until a situation called hypoalbuminemia or the deficiency of albumin in blood [8].

This research aimed to find a relation between nutrition status clinical improvement in AFB-positive pulmonary TB patients In Medan, North Sumatera, Indonesia.

Methods

The research was conducted in a quantitative method using the correlation study design and cross-sectional approach. The research took place in Amplas and Teladan health centre median from October 01, 2018 until November 30, 2018. The population of this research is the new TB patients with AFB-positive pulmonary at Teladan and health centre Medan. Samples are all AFB-positive pulmonary patients who meet all the inclusive and exclusive criteria. Inclusive criteria include patients < 16 years old; diagnosed as the new AFB-positive pulmonary patients; New TB patients with regular treatment at Teladan and Amplas health centre; Patients agree to

participate in the research and fill the informed consent. The exclusion criteria include pregnant women; new TB patients followed by DM or HIV; TB category II. Total samples are 39 patients.

The sputum examination on patients was conducted in the laboratory of Amplas and Teladan health centre by Ziehl Neelsen method. The sputum collection was a method (Sewaktu-Pagi-Sewaktu): (1) when the patients suspected TB comes to Teladan and Amplas health centre. (2) the morning after the patients suspected TB is waking up before eating and drinking. (3) When the patients suspected TB returns to Teladan and Amplas health centre while carrying morning sputum. Sputum taken is marked with patients' names. Anti-Tuberculosis medicine used were Rifampicin, INH, Pyrazinamide, Streptomycin, Ethambutol with the dosage adjusted to patients' weight. The AFB-positive pulmonary examination was conducted before medication, the second week, the eighth week after the intensive phase of medication. Patients' sputum conversion data were collected from TB 01 patients' card. The measurement of weight and height was conducted in the health centre when patients came for treatment and general anamnesis of history of the disease, gender, age, education, occupation etc. The BMI data were collected from the patients' medical records.

The examination of albumin was conducted by taking 3 cc of venous blood and left for 10 minutes without anticoagulant. After 10 minutes, blood was centrifuged in 3000 rpm speed for five minutes. Serum at the upper part was separated with a micropipette to be examined. The albumin measurement was conducted in Prodia Laboratory Medan in bromcresol green (BCG) method. Patients' albumin data was collected from the test result.

Univariate and Bivariate analysis was conducted using SPSS. Univariate analysis was aiming to describe the characteristics of Body Mass Index variable, Albumin Level and AFB-positive pulmonary Sputum Conversion results. The bivariate analysis was aiming to know the relation between Body Mass Index and Albumin Level with Sputum Conversion Sputum. Statistical analysis using SPSS 20, for analysis relationships, we use the chi-square test.

Results

Characteristics of Respondents

From 39 respondents, there were 22 males (56.41%) and 17 females (43.59%). Their ages range from 18-70 years old with average 43.23 ± 15.45. There were 28 TB patients at a productive age (16-55 years old). Respondents data based on education

background were divided into 27 High School graduates (69.23%) and 28 working people (71.79%).

Table 1: Characteristics of Respondents

Characteristics	n	%	Average ± SD
Gender:			
Male	22	56.41	
Female	17	43.59	
Age:			43.23 ± 15.45
16-35 years old	13	33.33	
36-55 years old	15	38.46	
56-75 years old	11	28.21	
Education:			
Elementary	4	10.26	
Junior High School	7	17.95	
Senior High School	27	69.23	
University	1	2.56	
Work Status:			
Working	34	87.18	
Not Working	5	12.82	

Body Mass Indeks (BMI)

Mass Index Respondents' bodies ranged from 15.14 - 32.19 with a mean of 20.82 ± 4.05. From (Table 2), it is known from 39 respondents there are 13 people (33.33%) patients have BMI < 18.5 kg/m², 21 people (53.85%) patients have BMI < 18.5-25 kg/m² and 5 people (12.82%) patients had BMI > 25 kg/m². These results get the majority of respondents at the time of diagnosis having a Body Mass Index > 18.5-25 kg/m² (normoweight).

Table 2: Sample Distribution Based on BMI

Characteristics	N	%	Average ± SD
Body Mass Index (kg/m ²)			20.82 ± 4.05
Skinny (< 18,5 kg/m ²)	13	33.33	
Normal (>18,5-25kg/m ²)	21	53.85	
Fat (> 25 kg/m ²)	5	12.82	
Total	39	100.00	

Level of Albumin

The albumin level in respondents was ranging between 3.10 g/dL – 4.50 g/dL with average 3.73 ± 0.39. From the table, it is seen that from 39 respondents, there were 25 patients (64.10%) possess albumin ≥ 3,5 g/dL and 14 patients (35.90%) possess < 3,5 g/dL. This result shows that there were more respondents with albumin ≥ 3.5 g/dL.

Table 3: Sample Distribution Based on Albumin Content

Characteristics	n	%	Average ± SD
Albumin content (g/dL)			3.73 ± 0.39
≥ 3.5 g/dL	25	64.10	
< 3.5 g/dL	14	35.90	
Total	39	100.00	

Results of Sputum Conversion

Of the 39 respondents diagnosed with AFB-positive pulmonary TB as many as 24 people (61.54%) experienced sputum conversion at the end of the intensive phase of treatment, and 15 people (38.46%) did not experience sputum conversion. These results get more respondents who experienced sputum conversion at the end of intensive phase treatment.

Table 4: AFB-positive pulmonary Sputum Conversion Results

Characteristics	n	%
Conversion	24	61.54
Non-Conversion	15	38.46
Total	39	100.00

Relationship between Body Mass Index and Sputum Conversion

From the results of cross-examination (Table 5), it was found out from 24 pulmonary TB patients who experienced sputum conversion there were 4 people (16.67%) with underweight BMI, 16 people (66.67%) with normoweight BMI and 4 people (16, (67%) with an obese BMI. Of the 15 pulmonary TB patients who did not experience sputum conversion. There were 9 people (60%) with underweight BMI, 5 people (33.3%) had a normal BMI, and 1 person (6.7%) had obese BMI. From the results of the chi-square test, it is known that the value of p-value is 0.02, meaning that there is a significant relationship between the Body Mass index and sputum conversion.

Table 5: Cross Tabulation of the Body Mass Index and Sputum Conversion

Sputum conversion	Body Mass Index (n, %)			Total	p-value				
	Underweight	Normoweight	Obese						
Conversion	4	16.67	16	66.67	4	16.67	24	61.54	0.020
No-Conversion	9	60.00	5	33.33	1	6.67	15	38.46	
Total	11	33.33	21	53.85	5	12.82	39	100.00	

Relationship between Albumin Levels and Sputum Conversion

From the results of cross-tabulation (Table 6), it was found out of 24 pulmonary TB patients who had BTA sputum convergence of 20 people (83.33%) patients had albumin levels ≥ 3.5 g/dL and 4 people (16.67%) patients have albumin levels < 3.5 g/dL. Of the 15 pulmonary TB patients who did not experience sputum conversion as many as 5 people (33.33%) patients had albumin levels ≥ 3.5 g/dL and 10 people (66.67%) patients had albumin levels < 3.5 g/dL. From the results of the chi-square test, it is known that the value of p-value is 0.002, which means there is a significant relationship between albumin levels and sputum conversion.

Table 6: Cross Tabulation of Albumin Levels and Sputum Conversion

Sputum Conversion	Albumin Level (n, %)		Total	p-value			
	≥ 3.5 g/dL	< 3.5 g/dL					
Conversion	20	83.33	4	16.67	24	61.54	0.002
No-Conversion	5	33.33	10	66.67	15	38.46	
Total	25	64.10	14	35.90	39	100.00	

Relationship of Body Mass Index with Levels of Albumin

From the results of cross-examination (Table 7), it was found out of 13 pulmonary TB patients with thin BMI (15.38%) patients had albumin levels album 3.5 g/dL and 11 people (84.62%) had albumin levels < 3.5 g/dL. Of the 21 pulmonary TB patients with normal BMI there were 18 people (85.71%) patients had

albumin levels ≥ 3.5 g/dL and 3 people (14.29%) had albumin levels < 3.5 g/dL. Of the five obese pulmonary TB patients, there were 5 people (100%) who had albumin levels ≥ 3.5 g/dL. From the Pearson correlation test results, it is known that the P value is 0.001, which means that there is a significant relationship between the Body Mass Index and albumin levels. This concludes if the patient's mass index increases, the albumin level will also increase.

Table 7: Cross Tabulation of the Body Mass Index with Albumin Levels

BMI	Albumin Level (n, %)				Total	p-value	
	≥ 3.5 g/dL		< 3.5 g/dL				
Underweight	2	15.38	11	84.62	13	33.33	0.001
Normoweight	18	65.71	3	14.29	21	53.85	
Obese	5	100.00	0	0	5	12.82	
Total	25	64.10	14	35.90	39	100.00	

Discussions

Characteristics of Respondents

The number of pulmonary TB patients in the Medan Health Center was 22 men (56.41%) while the female sex was 17 (43.59%). These results get more pulmonary TB patients who are male. The results of this study are in line with the research of Puspita et al., (2016) [9] which found that the majority of men with pulmonary TB in the Lung Hospital Arifin Achmad in Pekanbaru had the highest number of men, which amounted to 48 people or 67.60%. Then the Ministry of Health data (2013) found that the incidence of pulmonary TB tends to be more male sex because it is associated with different social interactions between men and women, smoking tobacco, drinking alcohol causes a decrease in the body's defence system, so that when exposed to TB germs can quickly cause symptoms and if checked become positive for pulmonary TB.

Most pulmonary TB patients in Medan Health Center are at a productive age (16-55 years) as many as 71.79%. The results of this study are by the research of Puspita et al., (2016) [9], which states that the age group of pulmonary tuberculosis patients is in the productive age group. Furthermore, the Ministry of Health's statement in 2007 in the national guidelines for tuberculosis prevention states that as many as 75% of individuals infected with TB germs are in the productive age group (15-50 years). One of the factors that cause pulmonary TB patients is in the productive age group because they spend more time outside the home to work and interact with other people, so the risk of TB transmission becomes greater because contact with people suffering from pulmonary tuberculosis becomes more often.

The majority of pulmonary TB patients in Medan Health Center are mostly high school

graduates, which are as many as 27 people (69.23%). The results of this study are similar to the research conducted by Puspita et al., (2016) [9] which found that the distribution of pulmonary tuberculosis patients treated at Lung Poly Arifin Achmad Pekanbaru Hospital based on education was found to have the most secondary education at 35 people (49.3%). Furthermore, the results of research conducted by Andhika in West Bandung Regency in 2012, obtained from a total of 42 people with pulmonary tuberculosis patients as many as 25 people (59.5%) had secondary education. Through education, an individual can understand his illness. The level of education plays an important role in public health. The higher the level of education, the higher the ability to receive health information.

The number of pulmonary TB patients who worked were 35 people (87.18%), and those who did not work were 5 people (12.82%). This result found that the majority of pulmonary TB patients in the Medan Puskesmas were working. This can occur because the work environment is the easiest place to transmit TB disease. Certain types of work have a high risk of spreading and developing TB disease, such as factory workers. The results of the study by Tama et al., (2016)[3] also found that most of the positive smear pulmonary TB patients in Persahabatan General Hospital had a working status of 79 people (65.8%). Another possibility, because patients who work have high mobility than those who do not work, so the possibility of exposure to tuberculosis germs is higher. Lifestyle such as smoking and the risk of work originating from outdoor air pollutants, especially those related to industrial exposure, also increase the risk of being infected with pulmonary TB.

Body Mass Index

From the results of the cross-tabulation test showed that of the 39 pulmonary TB patients in the Medan Health Center it was found that at most pulmonary TB patients had a BMI > 18.5 -25 kg/m² which was as many as 21 people (53.85%). A study conducted by Puspita et al., (2016) [9] which found that the nutritional status of pulmonary TB patients based on body mass index (BMI) in Lung Poly Arifin Achmad Pekanbaru Hospital was 33 people (46.5%) with normal nutritional status, 31 people (43.7%) with underweight nutritional status, 4 people (5.6%) with overweight nutritional status and as many as 3 people (4.2%) with obesity nutritional status. Furthermore, the results of Suliyanti's research on the description of nutritional status and level of protein-energy consumption in pulmonary tuberculosis patients in Medan Johor Health Center in 2013, as many as 51.7% of patients with normal nutritional status. The Wokas et al., (2015) [10] study also found more pulmonary TB patients at Prof. Dr R. D. Kandou Manado Persahabatan General Hospital which has

BMI > 18.5-25 which is as much as 48.5%.

Level of Albumin

The results showed that from 39 patients there were 25 people (64.10%) pulmonary TB patients had albumin levels ≥ 3.5 g/dL and 14 people (35.90%) had albumin levels < 3.5 g/dL. These results indicate that more pulmonary TB patients in Medan Health Center have albumin levels of ≥ 3.5 g/dL. The results of this study are in line with the research conducted by Wokas et al., (2015) [10], which found more tuberculosis patients who had albumin levels ≥ 3.5 g/dL. On the other hand, the results of the study by Simbolon et al., (2016) [7] found that more tuberculosis patients had albumin levels < 3.5 g/dL. The occurrence of differences in the results of this study with the study of Simbolon et al., (2016) [7] due to differences in the number of samples used or the possibility of patients who have albumin levels ≥ 3.5 g/dL are still in the early stages of tuberculosis.

Sputum Conversion

The results showed that AFB-positive pulmonary TB patients in Amplas and Teladan Medan Health Centers were more likely to experience sputum conversion after undergoing intensive phase treatment for two months than those without sputum conversion. Of the 39 pulmonary TB patients with AFB-positive, there were 24 people (61.54%) who experienced sputum conversion while those who did not experience sputum conversion were 15 people (38.46%). The results of this study obtained more pulmonary TB patients with AFB-positive who experienced sputum conversion after undergoing intensive treatment for two months at 61.54%. The results of this study are in line with the research of Aliyah et al., (2016) [11] that the results of sputum conversion in the intensive phase were 55 subjects (62.5%) experienced sputum conversion and in 33 subjects (37.5%) did not experience conversion. The results of the study by Tama et al., (2016) [3] obtained a cumulative probability of pulmonary TB patient survival rates of 17% and 9.2% of patients experienced failed conversions. Then the Intiyati et al., (2012) [12] study found that the recovery of pulmonary TB patients based on the results of sputum examination was mostly positive as many as 27 people (57%) and the negative as many as 20 people (43%).

The conversion number is one indicator to assess the progress and success of TB prevention. This indicator is useful to know the results of treatment quickly and to find out whether direct supervision of swallowing drugs is done correctly (Ministry of Health, 2007) [13]. To assess the success of treatment for pulmonary TB disease can be seen from the results of sputum examination at the end of treatment. AFB conversion occurs due to drug

administration during treatment and is a predictor of the success of TB treatment. Although in this study pulmonary TB patients who experienced sputum conversion were greater when compared to the number of TB patients who did not experience conversion, the results were not by the WHO sputum conversion target of 85%. The healing of each person is different because the patient has a bad response or a good response after treatment. Good response is determined by changes (conversion) of sputum after 30 days of adequate treatment, but a poor response occurs if sputum changes are more than 30 days (Khairil et al., 2017) [14]. There are several factors that cause the failure of sputum conversion in the intensive phase. Among them are lack of supervision in the intensive phase, poor adherence to medication, the inappropriate dosage of medication recommendations, comorbidities, and the presence of multiple drug-resistant TB (Liu, 2008) [15].

The factors that led to the success of sputum conversion did not reach 85% as targeted by the government and WHO in this study, one of which was due to the level of positivity of sputum in pulmonary TB patients at the beginning of treatment. Of the 15 pulmonary TB patients who did not experience sputum conversion at the end of the intensive phase treatment consisted of 8 patients with AFB-2positive (2+), 3 patients with AFB-3positive (3+) and 4 people with AFB-positive (1+). The results of this study found that the majority of pulmonary TB patients with AFB-2positive (2+) and AFB-3positive (3+) at the start of treatment did not experience sputum conversion. The results of this study are in line with the research of Tama et al., (2016) [3] which states that the higher the level of positivity of a patient's sputum at the beginning of treatment, the greater the cumulative probability of the conversion rate (survival rate). Patients with a positive level of sputum 3+ have the greatest cumulative probability of survival rate, followed by 2+, 1+, and scanty (1-9 stems).

The majority of pulmonary TB patients who did not experience sputum conversion in this study had BMI < 18.5 kg/m². Conversion failure experienced by patients with thin BMI can occur due to Anti-Tuberculosis Drugs malabsorption. The low nutritional status of patients affects the decrease in drug concentration in blood plasma and improves kidney function to perform disposal. As a result, the effectiveness of TB treatment is not optimal so that it can increase the risk of treatment failure for TB patients; it can even increase the risk of recurrence [3]. The last factor that caused the failure of sputum conversion in this study was pulmonary TB patients with albumin levels < 3.5 g/dL. Decreasing albumin levels will cause a decrease in the number of albumin bonds with Anti-Tuberculosis Drugs so that it will have an impact on the TB healing process [16].

Relationship of Body Mass Index with Level of Albumin

From the Pearson correlation test results obtained that the value of p-value is $0.001 < 0.05$ means that there is a positive and significant relationship between the Body Mass Index and albumin levels. This proves that every patient's body mass index increases; the albumin level will also increase. The results of this study are in line with the results of the study of Wokas et al., (2015) [10] which found that every increase in BMI then albumin levels would also increase. This illustrates that BMI affects albumin levels and vice versa.

Increased food intake in TB patients will increase albumin levels. The results of this study are in accordance with the theory which states that albumin is one of the largest proteins in blood plasma, where at the time of infection there is a decrease in blood plasma values, injury or stress may be the cause of increased metabolic needs to repair damaged tissue and to neutralize existing free radicals in the body. This decrease in total protein values and albumin levels can be caused by a decrease in appetite in patients, malnutrition and malabsorption often occur in tuberculosis patients.

Relationship of Body Mass Index with Sputum Conversion

According to the results of the study, 24 of the pulmonary TB patients who had sputum conversion mostly had BMI > 18.5 - 25 kg/m^2 , which was 16 people (66.67%) while most of the 15 pulmonary TB patients who did not have sputum conversion had BMI $< 18.5 \text{ kg/m}^2$ which is 9 people (60%). These results indicate that pulmonary TB patients who have a BMI $< 18.5 \text{ kg/m}^2$ more do not experience sputum conversion, whereas pulmonary TB patients who have a BMI $> 18.5 - 25 \text{ kg/m}^2$ more experience sputum conversion. The results of this study prove that one of the important factors that can influence the success of BTA sputum conversion in pulmonary TB patients is the patient's initial nutritional status when diagnosed with TB. The results of this study are in accordance with the results of the study of Tama et al. (2016) [3] which stated that smear-positive pulmonary TB patients with BMI < 18.5 needed longer time to experience sputum conversion and risked experiencing conversion failure of 1.32 - 8.86 times compared with patients who have BMI > 18.5 .

The results of the study by Dillon, 1995 and by Intiyati et al., (2012) [12], which said that TB patients who were malnourished would result in inhibited production of antibodies and lymphocytes so that the healing process was hampered. The results of this study are consistent with the results of the Amaliah (2012) [17] study that pulmonary TB patients with underweight nutritional status will have a risk of conversion failure 3.5 times greater than patients with

normal nutritional status. Furthermore, the results of Khariroh (2006) [18] 's study found that TB patients with thin nutritional status would be at risk of conversion failure 8,861 times greater than TB patients with normal nutritional status and TB patients with very poor nutritional status would be at risk of conversion failure 30,918 times greater than sufferers TB with normal nutritional status.

From the results of the chi-square test, it is known that the value of p-value is $0.020 < 0.05$ means that there is a relationship between body mass index and sputum conversion in pulmonary TB patients at Amplas and Teladan Medan Health Centers. The results of this study are in line with the research of Intiyani et al., (2012) [12] which found that there was a relationship between nutritional status (BMI) and recovery in pulmonary TB patients in Lung Poly RSD Sidoarjo. In line with the research of Tama et al., (2016) [3], which states that the nutritional status of patients measured by BMI is known to be a predictor of sputum conversion in positive smear pulmonary TB patients. Individuals who have good nutritional status will be able to develop their immune response so that the healing process of tuberculosis can run well, whereas, in individuals whose nutritional status is poor, they are more at risk of failure in the healing process (Isselbacher et al., 1999) [19].

Relationship between Levels of Albumin and Sputum Conversion

From the results of cross-tabulation, it was found out from 25 patients who had albumin levels $\geq 3.5 \text{ g/dL}$ as many as 20 people (80%) experienced sputum conversion and 5 people (20%) who did not experience sputum conversion. While of the 14 patients who had albumin levels $< 3.5 \text{ g/dL}$ as many as 4 people (28.57%) who experienced sputum conversion and 10 people (71.43%) who did not experience sputum conversion. From these results indicate that the majority of pulmonary TB patients who have albumin levels $\geq 3.5 \text{ g/dL}$ will experience sputum conversion while pulmonary TB patients with albumin levels $< 3.5 \text{ g/dL}$ the majority will not experience sputum conversion. The results of this study are in line with the research of Khairil et al., (2017) [14] who found the mayor over TB patients in the Integrated TB Services of dr. Zainoel Abidin Banda Aceh Regional Public Hospitals, which has a decrease in albumin levels, will experience poor clinical improvement of 54.20%.

Furthermore, the results of the Kulsum et al., (2017) [20] study found that one of the risk factors for failed sputum conversion in TB patients was low albumin levels. The level of albumin as a protective factor or an increase in albumin will reduce the failure of sputum conversion — albumin as a means of transporting drugs such as rifampicin which is a TB therapy drug. Albumin is a plasma protein, and TB drugs bind to plasma proteins. Anti-TB drugs are

metabolised in the liver and excreted with bilirubin by bile (Mercer et al., 2007) [21].

From the results of the chi-square statistical test, it is known that the value of p-value is 0.002, meaning that there is a significant relationship between the levels of albumin and sputum conversion. The results of this study are supported by the results of a study conducted by Matos and Lemos (2006) [22] who reported that albumin has a significant relationship to sputum changes in TB patients, so it is important to take action to improve nutritional status in TB patients during the treatment process. Sputum changes in TB patients are influenced by C-reactive protein (CRP) and albumin levels. The Kulsum et al., (2017) [20] study found that blood albumin levels act as protective factors that will reduce the failure of AFB sputum conversion. Furthermore, the research of Khairil et al., (2017) [14] found that albumin levels influenced clinical improvement in TB patients in the Integrated TB Services Installation of Dr Zainoel Abidin Banda Aceh Regional Public Hospitals. Rifampicin, as a drug for pulmonary TB, is strongly linked to albumin in pulmonary TB patients. In addition to rifampicin, other pulmonary TB drugs, namely isoniazid, also bind strongly to albumin. This strong bond is expected to increase the antimicrobial effect of Anti-TB Drugs, thereby reducing inflammatory cytokines and accelerating healing (Lassen et al., 2006) [23]. Decreasing albumin levels will cause a decrease in the number of albumin bonds with Anti-TB Drugs so that it will have an impact on the TB healing process [16].

In conclusion, there was a significant correlation between Body Mass Index and albumin level on AFB-positive pulmonary TB patients at Medan health centre in this research, and there was a significant correlation between Body Mass Index and sputum conversion on AFB-positive pulmonary TB patients at Medan health centre. There was also a significant correlation between albumin level and sputum conversion on AFB-positive pulmonary TB patients at Medan health centre.

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