THE RELATIONSHIP OF BODY MASS INDEX (BMI) LEVEL AND SEVERITY OF PULMONARY TUBERCULOSIS IN PATIENTS AGED 18-64 YEARS AT GOTONG ROYONG HOSPITAL SURABAYA

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ABSTRACT

Introduction: Tuberculosis (TB) infection remains a concern for developing countries especially Indonesia due to its high prevalence and mortality rate. Malnutrition is often observed in TB patients. Malnutrition can be assessed through the Body Mass Index (BMI) level. Low BMI levels can increase the progression of pulmonary TB and resulting more severe manifestations in chest X-ray. The severity of pulmonary TB is determined based on the assessment of chest X-ray lesions, which categorized as mild, moderate, and severe.
Objective: The aim of this study is to analyze the relationship between BMI levels and the severity of pulmonary TB in patients aged 18-64 years at Gotong Royong Hospital, Surabaya.
Method: The method of this research is observational analytical with a cross-sectional design on pulmonary TB patients who underwent chest X-ray examinations before treatment. The study utilizes secondary data from the patient's medical records, including weight, height, and chest X-ray images. Additional supporting data which is not available in the medical records were obtained through the patient responses using Google Form. Samples were taken according to the inclusion criteria and all data were collected at Gotong Royong Hospital from July to September 2023.
Results: There are 39 samples collected in this research, consisted of 17 men and 22 women. The result based on Spearman correlation analysis revealed that the correlation between BMI levels and the severity of pulmonary TB has a p-value=0,397 ($p > 0,05$).
Conclusion: There is no significant relationship between BMI levels and the severity of pulmonary TB in patients aged 18-64 years at Gotong Royong Hospital Surabaya

Keyword: body mass index level, pulmonary tuberculosis, severity

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INTRODUCTION

Tuberculosis (TB) is one of the infectious diseases and ranks as the 13th leading cause of death worldwide. The prevalence of TB remains high, especially in developing countries. Indonesia is among the eight countries contributing to more than two-thirds of global cases, accounting for 9.2%.[1]

The dominance of TB cases occurs in the age group of 18-64 years, the productive age.[2] TB infection is caused by acid-resistant bacteria transmitted through the air and is influenced by several factors, including the number of organisms released into the air, the concentration of organisms in the air (dependent on room volume and ventilation), and the duration of exposure to contaminated air.[3,4] Other influencing risk factors include immunocompromised conditions, malnutrition, poverty, lifestyle factors such as smoking and alcohol consumption, as well as age and gender.[5-7]

Malnutrition often occurs in TB patients, which is characterized by an imbalance between nutritional intake and the nutrition that our body needs for metabolism. Malnutrition can be assessed using the Body Mass Index (BMI), and a low BMI/underweight (<18.5 kg/m^2) can increase the severity of TB in patients.[8]

BMI is a way to measure the nutritional status of individuals aged 18 years and older. The calculation involves the ratio of body weight in kilograms (kg) to height in square meters (m^2).[9] BMI values can be influenced by factors such as age, gender, lifestyle (dietary habits, smoking, physical activity), genetics, economics, health conditions, infections, and duration.[10,11]

In order to against TB infection requires an adequate natural and adaptive immune system. However, low BMI can lead to a decrease in the body's immune system (immunomodulatory effect), resulting in a more severe presentation of the disease and cavitation based on chest X-rays when compared to the normal BMI population.[12] Increased catabolism and anabolic block usually happen in TB patients, leading to energy deficiency and a low BMI.[13]

A study by Hoyt et al. in 2019 found that moderate malnutrition was not related to an increase in the percentage of extensive disease, while severe malnutrition associated and resulting an increase up to 11.1% in the percentage of extensive disease.[14]

This study aims to analyze the relationship between BMI levels in pulmonary TB patients aged 18-64 years and the severity of the disease at Gotong Royong Hospital in Surabaya. BMI values are calculated using a formula and classified based on levels, while the severity of the

disease is measured based on lesion severity criteria (extent of lung involvement and the number and size of cavities) on chest X rays. The total assessment score is then categorized as mild (≤ 2.5), moderate (2.5-6), or severe (≥ 6).

METHOD

This research uses an observational analytical method with a cross-sectional design. The study population was pulmonary TB patients in the period 2022 who underwent chest radiography examination before the tuberculosis treatment began. The sample size used a formula with a known population size and the minimum number obtained was 31. Samples were taken in accordance with the inclusion and exclusion criteria or purposive sampling technique. Inclusion criteria were all patients with a diagnosis of pulmonary TB aged 18-64 years, who had not received anti-tuberculosis drugs at the time of diagnosis, and had chest x-ray data, body weight and height in medical records. Meanwhile, patients with HIV/AIDS infection, uncontrolled diabetes mellitus, cancer, and cases of drug-resistant TB were excluded. The independent variable in this study is the BMI level and the dependent variable is the severity of pulmonary TB.

The research was conducted at Gotong Royong Hospital in Surabaya from July 18 until September 9, 2023 and started with the collection of primary data from medical records and characteristic data obtained through a Google Form distributed to patients via the hospital's mobile phones. The collected data were processed using the Statistical Product and Service Solution (SPSS) program and analyzed using the Spearman correlation test.

RESULTS

Table 1. Characteristic of The Research Samples

	Frequency (n)	Percentage (%)	p- value
Gender			
Male	17	43,6	0,000
Female	22	56,4	
Total	39	100,0	
Age			
18-24	12	30,8	0,000
25-34	8	20,5	
35-44	7	17,9	
45-54	7	17,9	
55-64	5	12,8	
Total	39	100,0	
Education level			
Junior high school	2	5,1	0,000
Senior high school	15	38,5	
Bachelor	22	56,4	
Total	39	100,0	

Based on data from table 1, it is known that there are 39 samples taken. The majority of the research sample was female (56.4%), aged 18-24 years (30.8%), and had a recent educational history at bachelor's level (56.4%).

Table 2. Distribution of Research Sample Based on BMI Level

BMI Level	Frequency (n)	Percentage (%)
Underweight (< 18,5)	24	61,5
Normal (18,5 – 22,9)	9	23,1
Overweight Risk (23 – 24,9)	2	5,1
Obese I (25 – 29,9)	4	10,3
Obese II (>30)	0	0
Total	39	100

Table 2 shows that the sample had a low or underweight BMI of 24 people (61.5%), a normal BMI of 9 people (23.1), BMI at risk of 2 people (5.1%), and obesity I as many as 4 people (10.3%).

Table 3. Distribution Research Sample Based on Severity of Pulmonary TB

Severity	Frequence (n)	Percentage (%)
Mild	10	25,6
Moderate	12	30,8
Severe	17	43,6
Total	39	100,0

Table 3 shows that 10 people in the sample (25.6%) had a mild pulmonary TB, 12 people had a moderate pulmonary TB (30.8%), and 17 people had a severe degree of pulmonary TB (43.6%).

Table 4. Analysis of the Relationship between BMI Level and Severity of Pulmonary TB

IMT Level	Severity of Pulmonary TB				
	Mild	Moderate	Severe	Total	p-value
	n (%)	n (%)	n (%)	n (%)	
Underweight	2 (8.3)	9 (37.5)	13 (54.2)	24 (61.5)	0.397
Normal	5 (55.6)	2 (22.2)	2 (22.2)	9 (23.1)	
Risk	1 (50)	0 (0)	1 (50)	2 (5.1)	
Obese I	2 (50)	1 (25)	1 (25)	4 (10.3)	
Obese II	0 (0)	0 (0)	0 (0)	0 (0)	
Total	10 (25.6)	12 (30.8)	17 (43.6)	39 (100)	

Table 4 shows that 2 people (8.3%) out of the sample with an underweight BMI experienced mild pulmonary TB, 9 people had moderate degree (37.5%), and 13 people had severe degree (54.2%). There were 5 people (55.6%) in the sample with normal BMI who had mild pulmonary TB, then 2 people each had moderate and severe degrees (22.2%). Samples with at-risk (overweight) BMI had mild and severe pulmonary TB each (50%), and none had moderate degrees. There were 2 people (50%) in the sample with obesity BMI I who had mild pulmonary TB, followed by 1 person each (25%) with moderate and severe degrees. There were no obese II sample in this study.

DISCUSSION

Characteristic of The Research Samples

The sample for this study consisted of 39 pulmonary TB patients at Gotong Royong Hospital in Surabaya, 22 of whom were women (56.4%) and 17 men (43.6%). This is not in line with the theory and research of Abdulkadir et al. in 2022, the majority of TB cases are suffered by men and this is due to lifestyle risk factors such as smoking and alcohol which affect immunity.[3,15]

TB cases often occur at young and productive ages because this age group often has activities and contact with people or the environment so they have a greater risk of being exposed to TB.[13] The results of

this study showed that the majority of the sample was aged 18-24 years with a total of 12 people (30.8%), and this is according to theory above.

A person's educational background also influences knowledge and the incidence of pulmonary TB. The results of this research are in accordance to the research of Edson Beyker et al. in 2021, which shows that more than half of the sample has a bachelor degree.[16]

BMI Level and Severity of Pulmonary Tuberculosis

More samples had a low BMI or were underweight (< 18.5 kg/m2) and this was supported by research by Farina Angelia et al. in 2020 and Windri Aryani et al. in 2022.[8,17] Low BMI is often due to an infectious process and is also influenced by its duration. This plays a role in changes in the body's immunity and it is known that in TB, there is an increase in catabolism and anabolic block which will then make the sufferer experience a lack of energy if the diet is inadequate, resulting in a lower BMI.[13,18]

The results of this study showed that samples with underweight BMI experienced more severe pulmonary TB. Low BMI in TB infection can affect the immune system and resistance to bacteria due to changes in hormone and cytokine levels. These changes are a decrease in the production of cytokines such as tumor necrosis factor-alfa (TNF-a), interferon-gamma (IFN-g), and nitric oxide synthase (NOS-2) which play a role in the bactericidal process in granulomas. Apart from that, there is also a decrease in T-helper1 (Th1) cells and an increase in T-helper2 (Th2) cells so that this combination can inhibit the body's immunity and result in the appearance of the lesion getting worse.[14,19]

Analysis of the relationship between BMI level and severity of pulmonary TB in this study used the Spearman correlation statistical test and obtained a p value of 0.397, which means there is no significant relationship between these two variables. This is not in line with research by Hoyt et al and Edwina et al. Hoyt et al. Categorizing the samples into moderate and severe malnutrition, then statistical tests showed that there was no relationship between moderate malnutrition and an increase in the lung area involved, but there was a significant relationship with severe malnutrition. The results in this study may be due to confounding factors such as economic level, lifestyle (activity, smoking, alcohol), and infections and duration which were not studied. The clinical manifestations of TB sufferers vary, as does the duration of the infection, making it difficult to control this.[12,14] Also, in this study the availability of samples

according to the inclusion criteria was relatively small.

CONCLUSION

Many pulmonary TB patients are in a malnutrition state, which is underweight (BMI < 18.5 kg/m2), and the majority of samples in this study had severe pulmonary TB based on chest x-ray lesion assessment criteria, however the results of statistical tests showed that there was no significant relationship between BMI level and severity of pulmonary TB in patients aged 18-64 years at the Gotong Royong Hospital in Surabaya.

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