



Relationship Between Three Risk Factor of DM-Pulmonary TB Incident at RSI Siti Aisyah Madiun in 2023 (A Case-Control Study)

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Abstract

Diabetes mellitus is non infectious disease that has a three-fold risk of developing pulmonary tuberculosis. The purpose of this study was to analyze the relationship between age, body mass index status, and history of TB exposure and the incidence of DM-TB at Siti Aisyah Madiun Islamic Hospital. This research method utilizes an analytical observational research method with a case-control approach. The case group had a total of 32 patients, while the control group had a total of 32 patients from 2021 to 2023. We used a questionnaire and an observation paper to conduct the research. Age (adjusted RR) served as the basis for this study's findings 5,082, 95% CI: 1,282-20,145, p 0,021), Body Mass Index (BMI) (adj. RR = 0,172, 95% CI: 0,051-0,573, p 0,004) and TB exposure (p 0,439). It has been found in the study that age and BMI status variables are associated with DM-Pulmonary TB. DM patients need to keep up with their diet and adopt a healthy lifestyle.

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Introduction

Diabetes Mellitus is a metabolic disorder that has signs and can be identified by the presence of hyperglycemia without treatment. Heterogeneous etiopathologies include defects or disorders in insulin secretion, insulin action, or both, and abnormalities in carbohydrate, fat, and protein metabolism (World Health Organization, 2019)

The prevalence of diabetes is predicted to increase with the increasing age of the population, reaching 578 million in 2030 and 700 million in 2045 (Ministry of Health of the Republic of Indonesia, 2020). Indonesia is ranked 7th out of 10 states with the highest number of DM sufferers, namely 10.7 million people. The prevalence of DM in East Java Province from the 2018 Basic Health Research (RISKESDAS) reached 2.6% and ranks 5th among the provinces with the most DM sufferers in Indonesia (Ministry of Health, RI, 2020). Meanwhile, according to data from the East Java Provincial Health Office, in 2021, the number of DM sufferers in Madiun City reached 8,111 people (East Java Provincial Health Department, 2021).

DM is known to have specific effects in the long term, including retinopathy, nephropathy, and other complications of neuropathy (World Health Organization, 2019). One of the complications of DM sufferers is that they have a greater risk of getting TB due to a weakened immune system, so they have three times the chance of being exposed to active TB (Muhadi et al., 2015).

Tuberculosis, commonly known as TB, is an infectious disease caused by the bacterium *Mycobacterium tuberculosis* and can attack respiratory organs such as the lungs and other organs. (Muhadi et al., 2015).

The Global TB Report 2021 estimated that there were 824,000 TB cases in Indonesia (Dirjen P2P, 2022). East Java Province alone has a total of 42,913 TB cases. According to East Java Health Office data for 2021, the estimated incidence of TB is 10% in Madiun City (Dinas Kesehatan Provinsi Jawa Timur, 2021).

Hyperglycemia in DM patients causes insulin resistance, so the number of T lymphocytes decreases (Bailin et al., 2020). Macrophages have an important role in defense against pulmonary TB germs, DM also causes a decrease in phagocytosis and reduced bactericidal function (Pavlou et al., 2018). This is associated with an increase in mortality due to delays in microbiological response in the treatment of pulmonary TB (Lin et al., 2019).

The increased frequency of DM events is related to the increase in the TB incidence rate (Muhadi et al., 2015). The prevalence of TB incidence in DM patients is around 10–15%. In the report of the Madiun City Health Service (Dinkes) for 2021–2022, there has been an increase in cases of 54. Based on the results of data from the Madiun City Health Office for 2020–2022, the highest cases of DM-TB patients in Madiun City were obtained from the Siti Aisyah Madiun Islamic Hospital (RSI) of 33 cases, Based on these problems, researchers are interested in conducting an analysis of age, BMI status and history of contact with pulmonary TB patients at RSI Siti Aisyah Madiun.

Methods

This research was conducted from April to June 2023 at the Siti Aisyah Madiun Islamic Hospital, East Java, Indonesia. This study uses analytic observation with a case-control approach. Analysis of research data using multivariate analysis. The data used in this study came from primary sources, namely interviews, observation sheet and secondary sources from patient medical records at RSI Siti Aisyah Madiun. Respondents in this study were divided into two groups, namely the case group and the control group, with a total of 64 respondents. The case group included 32 diabetes mellitus patients with comorbid pulmonary tuberculosis, while the control group consisted of 32 diabetes mellitus patients with a ratio of 1:1. Determination of research samples using purposive techniques. The case group had inclusion criteria, including respondents coming from pulmonary DM-TB patients, as evidenced by the recording on the TB-01 and Tuberculosis Information System (SITB) forms. While the exclusion criteria for the case group included DM-TB patients with severe complications such as end-stage renal failure and stroke, TB-HIV patients. In addition, the control group of this study also had inclusion criteria, including non-pulmonary DM patients who were recorded in the medical record, had complete medical record records. Meanwhile, the exclusion criteria in the control group included patients who refused to be respondents and patients who had died.

The independent variables in this study were age, BMI status, and history of contact with pulmonary TB patients, while the dependent variable was the incidence of pulmonary tuberculosis. The statistical analysis of this study used the Chi-square test with the SPSS version 16.0 application.

Results

The relationship between the three factors is described in the following table :

Table 1. The relationship between the three factors

Variable	Category	Pulmonary Tuberculosis Incidence				POR (95% CI)	P value
		Cases		Control			
		f	%	f	%		
Age	- Productive age (15–64 years old)	19	59.4	28	87.5	5.082 (1.282-20.145)	0.021
	- Non-productive age (>64 years old)	13	40.6	4	12.5		
BMI status	- BMI is risk (Underweight, Overweight, Obesity)	26	81.2	16	50	0.172 (0.051-0.573)	0.04
	- BMI is not risk (Normal)	6	18.8	16	50		
Experienced pulmonary TB exposure	- Experienced	14	43.8	10	31.2	0.584 (0,210-1.626)	0,439
	- No Experienced	18	56.2	22	68.8		

*** $p < .05$. ¹Multivariate Analysis

Table 1. from the multivariate table results shows respondents with a more productive age in the control group (87.5%). while respondents with non-productive ages were more likely to be in the case group (40.6%).

From the table 1, it is known that the majority of respondents in the case group suffered from DM for 5 years, with a percentage of 62.5%. Meanwhile, the majority of respondents in the control group suffered from DM for 5 years, with a percentage of 71.9%. Age has a relationship with the incidence of pulmonary tuberculosis and a risk of 0.235 to get active pulmonary TB.

BMI status has a frequency of respondents in the majority of case groups having a risky BMI, with a percentage of 26%. Meanwhile, the majority of respondents in the control group had a non-risk BMI of 56.2%.

History of contact with TB sufferers has a frequency in the majority of case groups, but there is no history of contact with pulmonary TB patients with a percentage of 56.2%. Meanwhile, the majority of respondents in the control group had no history of contact with pulmonary TB patients, with a percentage of 68.8%.

Discussion

Age is related to the social environment, such as work; people of productive age tend to still work. A work environment that has a high density level makes it possible to meet many people, causing an increased risk of TB infection among productive age groups (Werdhani, 2013). The productive age referred to in this study is adjusted to the regulations of the Indonesian Ministry of Health based on age groupings, namely those belonging to the productive age, namely 15–64 years (Kemenkes, 2021).

Productive age has a risk of 3.068 for the incidence of tuberculosis compared to non-productive age (Michel Kezia et al., 2021). The aging process in the airways and lung parenchyma has an impact on the barrier system and microbial clearance found in the respiratory system (Risna Dewi et al., 2017). Someone who is 45 years old will have significantly increased risk factors, which increase dramatically after the age of 65. Increasing a person's age can also lead to conditions of insulin resistance, resulting in unstable blood sugar levels due to the age factor, which degeneratively causes decreased body function, especially dysfunction of the pancreas (Ramadhan, 2020).

Research from Sumia Alturki et al. (2021), states that age 50 years has a relationship and is at a risk of 7.5 times getting pulmonary tuberculosis (Alturki et al., 2023). This is because the older a person is, the higher their immune level, which makes them more susceptible to developing TB-DM (Workneh et al., 2016), It was found from observations during the study that the case group was dominated by respondents who were of non-productive age (> 64 years).

BMI status at risk in this study was grouped based on BMI status: underweight, Overweight, Obesity I, and Obesity II, and BMI status was not at risk for respondents who had normal BMI status. BMI can be known based on the calculation of body weight and height. Several BMI categories according to the 2018 Indonesian Ministry of Health include Underweight (<18.5), Normal (18.5-22.9), Overweight (23-24.9), Obesity 1 (25-29.9), and Obesity 2 (≥ 30) (Kemenkes RI, 2018). In the book Integrated Management of Diabetes Mellitus by Sarwono Waspadji (2018) Nutritional status affects body immunity, including DM patients with pulmonary TB; to determine nutritional status, they frequently use the Body Mass Index (BMI). Type 2 DM sufferers who have an obese BMI can cause hyperglycemia, which can affect the immune system so that active TB germs will infect (Restrepo, 2018a). The decline in the immune system can be influenced by various factors, including socioeconomic and nutritional status. Malnutrition is a state of abnormal nutritional status in the body caused by metabolic disorders or body balance, a deficiency of nutritional intake, or an excess of nutritional intake (Hapsari & Isfandiari, 2017). Decreased immune conditions also cause TB germs to be active, resulting in the activation of various inflammatory mediators such as TNF- α , which causes a decrease in appetite, and Interleukin-1, which can increase the basal metabolic rate, and then these two things cause weight loss so that the BMI measurement becomes normal (Restrepo, 2018b).

This study found a relationship between BMI status and a risk of 5.571 times the incidence of pulmonary tuberculosis. In line with research from Kezia Yosephine et al. (2021), DM sufferers with nutritional status at risk are those with undernourished status (BMI < 18.5) and overweight status (BMI > 25) (Michel Kezia et al., 2021). Researchers found that many DM patients still had overweight BMI status, but there were also DM patients when they were initially diagnosed with DM who had obesity BMI status 1. Finally, after suffering from DM for a long time, their weight returned to normal.

DM sufferers who have a BMI 30 have a 23.24 percent chance of being at risk of developing TB (Chukwu et al., 2019). In one of the categories of BMI is overweight or obesity, the presence of excessive fat deposition in the body will affect metabolism and cardiometabolic risk through changes in adipokine secretion, such as free fatty acids. Exposure to free fatty acids in peripheral tissues can induce insulin resistance (Sulistianingrum, 2010). As a result of insulin resistance, it can interfere with the body's immune system, which can invite pulmonary TB bacteria to infect the bodies of DM sufferers. Research from Hayoung Choi et al. (2009) states that respondents who have an underweight BMI have an increased risk of pulmonary TB and have a correlation in the opposite direction with BMI. Researchers believe that there is a mechanism linking underweight BMI to the occurrence of TB in the lungs, and that this mechanism can be explained by the detrimental impact that poor nutritional status has on the immune system's ability to withstand infection. (Choi et al., 2021).

The history of contact with TB sufferers has no relationship with the incidence of pulmonary tuberculosis. Research from Golub (2001), Someone who comes into contact with active tuberculosis patients through droplets is one of the risk factors for tuberculosis transmission. DM sufferers with increasingly severe levels have a greater chance of developing pulmonary tuberculosis (Yuniarti, 2016). Transmission in households with more than one sufferer has a risk of four times higher compared to households with only one sufferer. This incident occurs because TB sufferers who are in the house and around it can increase the duration of contact with TB germs (Guwatudde et al., 2003). Individuals with TB who are indoors may infect indoors for <15 hours per week or >180 hours total during the infectious period at 3-month intervals before the first collection of culture-positive sputum or from the date of onset of cough to 2 weeks (Reichler et al., 2018). Infection can be transmitted to a susceptible person who breathes the same air as someone with TB up to 30 minutes after the person with TB has left the area (Australian Commission for Safety and Quality in Healthcare, 2010). The absence of a relationship in this study was caused by a lack of knowledge about the transmission of pulmonary tuberculosis in patients with diabetes mellitus, this is evidenced by the recognition that the questions asked by respondents to researchers. The education level of the majority of respondents at the high school level also contributed in terms of knowledge.

This study is in line with Wenjing Zhao et al. (2013), who showed that there was no relationship between a history of contact with pulmonary TB sufferers and the incidence of DM-TB but that there was a 4.11-times higher risk of getting active pulmonary TB (Zhao et al., 2013). In addition, Lusiani (2019) shows that a history of contact with TB sufferers has no relationship with the incidence of DM-TB but has a risk of 9.4 times the incidence of DM-TB (Lusiani, 2019).

Conclusion

The study's conclusion is that contact age and BMI status are the risk factors most closely linked to the occurrence of pulmonary tuberculosis (TB), although a person's history of treating TB patients does not influence the incidence of TB. The probability of acquiring pulmonary tuberculosis is 5,082 times for the age variable and 0.172 times for the BMI status variable.

Patients with diabetes should balance their BMI so that it approaches or stays normal, manage their nutrition, and have a clean, healthy lifestyle. Although in this study the history of contact with pulmonary TB sufferers was not related, DM patients should keep their distance and use masks when meeting directly with pulmonary TB sufferers.

Author Contributions

Author 1 contributed to collecting, processing, and compiling data; author 2 contributed in terms of providing references; and author 3 contributed to assisting with permits for research activities.

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Institutional Review Board Statement

This research was conducted by multi-centers that had been approved by research ethics and human protocols from both research educational institutions, namely STIKes Bhakti Husada Mulia Madiun and the research location at RSI Siti Aisyah Madiun, and declared feasible to use humans as research subjects.

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Conflicts of Interest:

The authors declare no conflict of interest.

Appendix A

None

Appendix B

None

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