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The Relationship Between Long Suffering from DM and Cigarette Exposure in DM-TB Lung Patients at RSI Siti Aisyah Madiun

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Abstract

The prevalence of the incidence pulmonary tuberculosis with comorbid diabetes mellitus (DM-TB) increases every year, it was found that the highest incidence in 2021-2022 originating from RSI Siti Aisyah. The purpose of this study was to analyze the long suffered DM and cigarette exposure in DM-TB patients. This research method uses analytical observational research with a case control approach and using questionnaire for the research instrument. The number of respondents was 32 patients (cases) and 32 patients (control). There is relationship between Long Suffered from DM ≥5 years (adj. RR = 0.235, 95% CI: 0.082-0.672, P value 0.0 1 2) and Cigarette Exposure (adj. RR = 4.333, 95% CI: 1.405-13.363, P value 0.018). The conclusion of this study is that DM patients who suffer from DM ≥5 years and are exposed to cigarettes have the opportunity to experience comorbid DM-TB events so it is recommended to routinely do physical activity, and routine blood sugar control.

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Introduction

Non-communicable diseases (NCDs) are commonly known as chronic diseases, long duration of time and are the result of collaboration of physiological, genetic, environmental, and behavioral factors. It is known that NCDs cause the deaths of as many as 41 million people every year (74%) of the total deaths globally. One of the main types of NCDs is Diabetes Mellitus (WHO, 2022). Diabetes mellitus or commonly abbreviated as DM and known as diabetes is a chronic metabolic disorder caused by the hormone insulin in the body which cannot be used effectively in regulating blood sugar balance so as to increase the concentration of sugar levels in the blood (hyperglycemia) (Ministry of Health of the Republic of Indonesia, 2020).

DM patients can be at triple risk of exposure to active TB (Muhadi et al., 2015). According to Setiyowati (2020) in the book Know Tuberculosis defines that Tuberculosis is an infectious disease caused by Mycobacterium tuberculosis bacteria. This disease usually attacks the lung organs and infection occurs for 2-10 weeks. TB cases in Indonesia are estimated at 824,000 cases and East Java province itself has 42,913 TB cases (databoks.ID, 2022). Based on data from the East Java Health Office, in Madiun City the incidence of TB cases reached 10% (East Java Provincial Health Office, 2021)

DM patients automatically experience beta cell failure earlier and more severely than previously predicted due to hyperglycemia which causes insulin resistance so that macrophages and T lymphocytes decrease in small numbers which can interfere with the immune system of DM patients. The increased risk of active TB in patients with DM may be due to immune system disorders, increased adhesion of *Mycobacterium tuberculosis* germs to cells of DM patients, microangiopathy, macroangiopathy and neuropathy (Arliny, 2015),

According to data from the Madiun City Health Office in 2020 , the number of TB cases reached 526 people, in 2021 it reached 447 people. Meanwhile, according to health facilities in Madiun City , namely RSI Siti Aisyah Madiun, it is known that in 2020 the trend of TB cases reached 31 people and in 2021 it reached number 112 people (Madiun City Population Control and Family Planning Health Office, 2021) (Madiun City Population Control and Family Planning Health Office, 2021).

Methods

In this study,it used analytical observation with a case-control study approach. This research was conducted at RSI Siti Aisyah Madiun in May-June 2023. The total sample subjects were 64 respondents at RSI Siti Aisyah Madiun, the division into case groups was 32 respondents and the control group was 32 respondents. Respondents in the case group were given criteria, namely diabetes mellitus patients with comorbid TB, had Form TB 01, and were registered as outpatients at the study location. While the control group used the criteria of non-comorbid tuberculosis diabetes mellitus patients and were willing to be respondents to this study.

This study has inclusion and exclusion criteria in both case and control groups. The case group has inclusion criteria, namely DM patients diagnosed by doctors with pulmonary TB and proven by the TB 01 form and recorded in SITB (Tuberculosis Information System), have complete medical record data and patients are willing to be respondents. Meanwhile, the criteria for exclusion of case groups include pulmonary DM-TB patients diagnosed by doctors with severe complications (stroke, end-stage renal failure), HIV-TB patients and patients who have died. The control group in this study had inclusion criteria, including non-pulmonary TB DM patients recorded in medical records, having complete medical record data. Meanwhile, exclusion criteria include patients who are not willing to become repondents and die.

Questionnaires, observation sheets, and patient medical records. statistical analysis using the Chi-square test and *p* value is considered related if <0.05 independent variables of the study are long suffering from DM and exposure to cigarettes. The study-bound variable was the incidence of pulmonary tuberculosis.

Results

This research has been conducted on patients with comorbid diabetes pulmonary tuberculosis andpatients with non-comorbid diabetes pulmonary tuberculosis in the outpatient service department and has met the inclusion and exclusion criteria. Sample selection using *purposive sampling* technique. This research was conducted on 64 research subjects.

Table 1.
Characteristics of the subject of study by demographics

Variable	Case		Control		Total	
	f	%	f	%	f	%
Age						
- Productive Life	19	59,4	28	87,5	47	73,4
- Non-Productive Age	13	40,6	4	12,5	17	26,6
Sex						
- Male	18	56,2	12	37,5	30	46,9
- Female	14	43,8	20	62,5	34	53,1

Table 1. showed that DM-TB patients classified as productive age were more in the control group 87.5%. while non-TB DM patients classified as non-productive age were more in the case group 40.6%. Among the age categories in the study subjects who had the most productive age 73.4%. Judging by

gender. The majority of respondents in the case group were male 56.2%. While the control group was the majority of respondents female sex 62.5%.

Table 2.
Bivariate Analysis between Variables using Chi Square Test

Variable	Category	Incidence of Pulmonary Tuberculosis				*P value*
		Cases		Control		
		f	%	f	%	
Long Suffering from DM	- ≥ 5 years	12	37.5	23	71,9	0.012
	- < 5 years	20	62.5	9	28.1	
		RP (95% CI) : 0.235 ((0.082-0.672)				
Cigarette Exposure	- Exposed	26	81.2	16	50	0.018
	- Not exposed	6	18.8	16	50	
		RP (95% CI) : 0.231 (0.075-0.712)				

Based on the table above, it is known that the majority of respondents who suffered from DM ≥5 years occurred in the control group by 71.9%. Meanwhile, respondents who suffer from DM <5 years are the majority in the case group by 20%.

The results of the *chi-square* statistical test obtained *P value* = 0.012 (<0.05) which means that there is a relationship between the length of suffering from DM ≥5 years with the incidence of pulmonary TB at RSI Siti Aisyah Madiun. This variable is included in the category of risk protective factors which means DM patients suffering from DM ≥5 years tend to experience 0.235 times the incidence of pulmonary TB as well as DM patients suffering from DM <5 years.

Based on the variable of cigarette exposure, it can be seen that the majority of respondents were exposed to cigarettes in the case group by 81.2%. While the majority of respondents who were not exposed to the control group amounted to 50%.

The results of the *chi-square* statistical test obtained a *P value* = 0.018 (<0.05) which means that there is a relationship between cigarette exposure and the incidence of pulmonary TB at RSI Siti Aisyah Madiun and and this variable is included in the category of risk protective factors with a risk of 0.231 times to get pulmonary TB.

Discussion

This study aimed to analyze the relationship between the length of suffering from diabetes mellitus and cigarette exposure to the incidence of pulmonary tuberculosis .

Transmission of pulmonary tuberculosis in DM patients results from hyperglycemia which interferes with blood sugar control with the meaning that the body fails to manage sugar into energy, thus disrupting macrophages and T cell lymphocytes in the body (Bailin et al., 2020). The incidence of pulmonary tuberculosis is influenced by multifactors, including HIV, socioeconomic status, gender, age, exposure to cigarettes , history of contact with patients with pulmonary TB.

Diabetes mellitus is one of the risk factors for pulmonary tuberculosis (Utomo et al., 2016). Diabetes mellitus patients automatically have a low immune system so it is easy to contract pulmonary TB germs if treatment is not done.

The incidence of hyperglycemia in diabetes mellitus patients causes the body's resistance to more easily invite other diseases to the body of diabetes mellitus patients . Diabetes mellitus causes disruption in chemotaxis function, activation of cell presenting antigens, phagocytosy so that patients are susceptible to infection (Solá et al., 2016). Hyperglycemia in DM patients is considered an important factor in the transmission of Mycobacterium tuberculosis because it affects the body's innate immune system and adaptive immune system (Tiara &; Tri, 2021)

Long suffering from diabetes mellitus is also one of the risk factors for the incidence of pulmonary tuberculosis. Research from Vega Adlanta, et al (2019) states that hyperglycemia in DM patients exceeds normal limits for a long period of time so that it can reduce immunological responses so that bacteria TB easily infects the lungs of DM patients (Adlanta et al., 2022). Long suffering from DM in this study has a relationship with the incidence of pulmonary TB. Consistent research from Amare et al (20, 13) showed that there was an association between the duration of suffering from DM with the incidence of pulmonary

tuberculosis (p 0.008 < 0.05) and had a risk of 8.89 times (Amare et al., 2013). The duration of DM associated with the risk of developing BTA-positive majority already suffered DM of more than 10 years compared to those with DM duration less than five years (Jabbar et al., 2006). Another study from Arulita, et al (2019) is also in line with this study, long suffering from DM has a risk relationship of 1.303 for pulmonary tuberculosis (Fibriana et al., 2020). The duration of suffering from DM causes the immunity of DM patients to be more risky due to micro and macro-vascular complications as a tolerance for disease treatment (Abera &; Ameya, 2018).

In this study, cigarette exposure has a relationship and risk of 0.231 times the incidence of pulmonary tuberculosis. Cigarette exposure in the study was also associated with active and passive smoking. Cigarette exposure can be interpreted as self-exposure through active smoking or passive exposure by others who smoke (Risna Dewi et al., 2017). Based on interviews with respondents, the majority are active smokers in the male sex and passive smokers in respondents who are female. According to research from Muh. Jusman Rau and Mifta Huldjannah (2020) showed that smoking behavior has a risk of 3.8 times to get active pulmonary TB and a p value of 0.030 which means it has a relationship with the incidence of DM-TB (Muh. Jusman Rau, 2021). In addition to the consequences of smoking behavior, long smoking can also contribute to cigarette exposure in respondents, in this study it was found that the majority of male respondents smoked ≥10 year. Prolonged exposure to cigarettes will cause alveolar macrophages of the lungs to be damaged, thus affecting the number of T lymphocytes in increasing immunity every time the body of DM patients is exposed to pathogens. Nicotine in cigarettes also causes a decrease in insulin secretion (Sasmita et al., 2019). The presence of active smokers Another study from Bebita Sharma et al (2019) shows that a history of smoking has a risk of 2.463 times to get active pulmonary TB and has a p value of 0.001 which means it has a relationship with the incidence of DM-TB (Sharma et al., 2019)

Cigarettes have components that can weaken the immune system, so smokers are susceptible to lung infections. Exposure to passive smoking increases the risk of tuberculosis infection becoming active (Lin et al., 2019). One of the cigarette ingredients is nicotine which is proven to be more sensitive in type 2 DM patients by interfering with insulin work in lowering blood glucose levels (Price et al., 2002). (Price et al., 2002). Alveolar macrophages in smokers are more difficult to respond to bacteria in the lungs. In addition, the immune system response is suppressed in people who smoke. Exposure to cigarettes causes the person to cough more often transmitting M. tuberculosis in the air from the lungs of infected smokers can increase the transmission of the spread of the disease (Ardhi, 2014). Based on a longitudinal study based on African-American and white adult populations in four U.S. cities to evaluate the association of smoking and passive exposure to tobacco smoke with the risk of glucose intolerance events (fasting glucose disorder or diabetes) and to explore potential causes of risk, including weight distribution, insulin resistance, and inflammation. Current smokers will have a higher incidence of impaired fasting glucose and diabetes during follow-up than never-smokers and that people exposed to secondhand tobacco smoke will have a moderate risk (Houston et al., 2006).

Conclusion

The conclusion of this study was found a relationship between the length of suffering from Diabetes Mellitus and exposure to cigarettes with the incidence of Pulmonary Tuberculosis. Long suffering from DM has a risk of 0.235 times, while exposure to cigarettes has a risk of 0.231.

Advice for readers, especially DM patients, to stay away from exposure to cigarettes and smoking behavior, keep using masks when in places that are usually used for smoking. As well as trying to control blood sugar levels to stay within normal limits

Patents

This section is not mandatory but may be added if there are patents resulting from the work reported in this manuscript.

Author Contributions

For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, First Author, Second Author and Third Author.; methodology, first Author; software, Second Author.; validation, , First Author, Second Author and Third Author.; formal analysis, First Author.; investigation, Second Author.; resources, Third Author.; data curation, First Author.; writing—original draft preparation, Second Author.; writing—review and editing, First Author.; visualization, Third Author.; supervision, First Author.; project administration,

First Author.; funding acquisition, First Author, Second Author and Third Author. All authors have read and agreed to the published version of the manuscript." Authorship must be limited to those who have contributed substantially to the work reported.

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This research has been approved by the Code of Ethics of STIKes Bhakti Husada Mulia Madiun and RSI Siti Aisyah Madiun to be conducted with human respondents and has met the requirements of human protocol approval as a research subject.

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Conflicts of Interest:
The authors declare no conflict of interest."

Appendix A
None

Appendix B
None

References
Abera, A., &; Ameya, G. (2018). Pulmonary Tuberculosis and Associated Factors Among Diabetic Patients Attending Hawassa Adare Hospital, Southern Ethiopia. *The Open Microbiology Journal*, *12*(1), 333–342. https://doi.org/10.2174/1874285801812010333

Adlanta, V., Sari, R. S., &; Octavia, N. A. H. (2022). The incidence of pulmonary tuberculosis in type II diabetes mellitus patients hospitalized at Dr. Pirngadi Medan Regional General Hospital. *Ibn Sina: Journal of Medicine and Health - Faculty of Medicine, Islamic University of North Sumatra*, *21*(2), 223–232. https://doi.org/10.30743/ibnusina.v21i2.303

Amare, H., Gelaw, A., Anagaw, B., &; Gelaw, B. (2013). Smear positive pulmonary tuberculosis among diabetic patients at the Dessie referral hospital, Northeast Ethiopia. *Infectious Diseases of Poverty*, 2(1), 2–9. https://doi.org/10.1186/2049-9957-2-6

Ardhi, T. june. (2014). DESCRIPTION OF THE RESULTS OF SPUTUM EXAMINATION ON SMOKING AND NON-SMOKING PULMONARY TB PATIENTS IN THE WORKING AREA OF THE VILLAGE HEALTH CENTER IN EAST PONTIANAK DISTRICT IN 2012-2013. in *Publication Manuscripts*.

Arliny, Y. (2015). Tuberculosis and diabetes mellitus have clinical implications of two epidemics. *Kuala Journal of Shia Medicine*, *15*(1), 36–43.

Bailin, S. S., McGinnis, K. A., McDonnell, W. J., So-Armah, K., Wellons, M., Tracy, R. P., Doyle, M. F., Mallal, S., Justice, A. C., Freiberg, M. S., Landay, A. L., Wanjalla, C., &; Koethe, J. R. (2020). T Lymphocyte Subsets Associated with Prevalent Diabetes in Veterans with and without Human Immunodeficiency Virus. *Journal of Infectious Diseases*, *222*(2), 252–262. https://doi.org/10.1093/infdis/jiaa069

databoks.ID. (2022). *Provinces with the Most TB Cases in 2021*. https://databoks.katadata.co.id/datapublish/2022/08/23/ini-provinsi-dengan-kasus-tbc-terbanyak-pada-2021

Health Office of Population Control and Family Planning of Madiun City. (2021). *Health Profile of Madiun City in 2020*.

East Java Provincial Health Office. (2021). Health Profile of the East Java Provincial Health Office 2021. In *East Java Provincial Health Office*.

Fibriana, A. I., Azam, M., Maryuni, S., Indrawati, F., Windraswara, R., &; Turnbull, N. (2020). Risk Factors of Pulmonary Tuberculosis Among Diabetes Mellitus Patients: a Case-Control Study in Dr. Kariadi General Hospital, Seamrang, Indonesia. *Malaysian Journal of Public Health Medicine*, *20*(2), 101–

107. https://doi.org/10.37268/mjphm/vol.20/no.2/art.307

Houston, T. K., Person, S. D., Pletcher, M. J., Liu, K., Iribarren, C., &; Kiefe, C. I. (2006). Active and passive smoking and development of glucose intolerance among young adults in a prospective cohort: CARDIA study. *British Medical Journal*, *332*(7549), 1064–1067. https://doi.org/10.1136/bmj.38779.584028.55

Jabbar, A., Hussain, S. F., &; Khan, A. A. (2006). Clinical characteristics of pulmonary tuberculosis in adult Pakistani patients with co-existing diabetes mellitus. *Eastern Mediterranean Health Journal*, *12*(5), 522–527.

Ministry of Health of the Republic of Indonesia. (2020). Stay Productive, Prevent and Overcome Diabetes Mellitus. In *Data and Information Center of the Indonesian Ministry of Health*.

Lin, Y., Harries, A. D., Kumar, A. M. V, Critchley, J. A., Crevel, R. van, Owiti, P., Dlodlo, R. A., &; Dejgaard, A. (2019). Management of Diabetes Mellitus-Tuberculosis: a guide to the essential practice. In *International Union Against Tuberculosis and Lung Disease*. https://theunion.org/technical-publications/management-of-diabetes-mellitus-tuberculosis-a-guide-to-the-essential-practice

Yep. Jusman Rau. (2021). RISK ANALYSIS OF DIABETES MELLITUS EVENTS IN TB PATIENTS IN THE WORKING AREA OF THE KAMONJI HEALTH CENTER, PALU CITY. *Health*, *3*(2), 1–13.

Muhadi, Kamelia, T., Nawas, A., Isbaniah, F., Giriputro, S., Rudijanto, A., Yunir, E., Aswar, A., Indawati, E., Triningsih, E., Soesanti, F., Widyahening, I., Abdurohim, K., Suryanto, B., Ervita, Laksono, S., Sihombing, B., Apsari, P., Putri, F., ... et al. (2015). *National consensus TB-DM*.pdf.

Price, T. B., Krishnan-sarin, S., Rothman, D. L., Thomas, B., Krishnan-sarin, S., & Rothman, D. L. (2002). Smoking impairs muscle recovery from exercise. *American Physiological Society*, *06510*, 116–122. https://doi.org/10.1152

Risna Dewi, D. P., Eka Putra, I. W. . A., Sagung Sawitri, A. A., &; Pradnyaparamita Duarsa, D. (2017). Risk factors of pulmonary tuberculosis among diabetes mellitus patients in Denpasar City. *Public Health and Preventive Medicine Archive*, *5*(1), 24. https://doi.org/10.24843/phpma.2017.v05.i01.p04

Sasmita, H. Y., Prasetyowati, I., &; Wahjudi, P. (2019). *PREVALENCE AND RISK FACTORS OF DIABETES MELLITUS IN TUBERCULOSIS PATIENT AT PATRANG DISTRICT INDONESIA*. *7*(4).

Sharma, B., Khanal, V. K., Jha, N., Pyakurel, P., &; Gurung, G. N. (2019). Study of the magnitude of diabetes and its associated risk factors among the tuberculosis patients of Morang, Eastern Nepal. *BMC Public Health*, *19*(1), 2–7. https://doi.org/10.1186/s12889-019-7891-x

Solá, E., Rivera, C., Mangual, M., Martinez, J., Rivera, K., &; Fernandez, R. (2016). Diabetes mellitus: An important risk factor for reactivation of tuberculosis. *Endocrinology, Diabetes and Metabolism Case Reports, 2016*(July). https://doi.org/10.1530/EDM-16-0035

Tiara, R., &; Tri, A. (2021). The relationship between type 2 diabetes mellitus and the increased risk of pulmonary tuberculosis. *National Seminar on Medical Research 2 (SENSORY)*, *2*(1), 95.

Utomo, R., Nugroho, H. K. H., &; Margawati, A. (2016). The relationship between type 2 diabetes mellitus status and pulmonary tuberculosis status is extensive lesions. *Diponegoro Medical Journal*, *5*(4), 1536.

WHO. (2022). *Noncommunicable diseases*. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases