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The Relationship of Risk Factors to the Incidence of Tuberculosis in the Working Area of the Karangpenang Public Health Center, Sampang Regency

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Abstract
Introduction: *WHO reported that the estimated total number of people diagnosed with TB in 2021 globally was 10.6 million cases, an increase of about 600,000 cases from 2021 which was estimated at 10 million TB cases. The incidence of TB cases in Indonesia is 354 per 100,000 population. The target of finding cases and suspected cases of pulmonary tuberculosis at the Karangpenang Public Health Center in 2022 is the first rank of the most out of all Public Health Centers in the working area of the Sampang District Health Office.* ***Objective:*** *To determine the risk factors associated with the incidence of pulmonary TB disease in the working area of the Karangpenang Public Health Center.* ***Method:*** *This type of research is an analytical survey with a case control study design. The total sample was 64 with details of 32 cases and 32 controls.* ***Results and Discussion:*** *Based on analysis with chi-square test, it was concluded that there was a significant relationship between nutritional status and the incidence of pulmonary TB (p = 0.002<0.05), there was a statistically significant relationship between the history of DM disease and the incidence of pulmonary TB (p = 0.018 <0.05), there was a statistically significant relationship between smoking history and the incidence of pulmonary TB (p = 0.024<0.05) in the working area of the Karangpenang Public Health Center.* ***Conclusions:*** *Nutritional status, history of diabetes, history of smoking and other risk factors associated with the incidence of tuberculosis*
Keyword: Tuberculosis; Risk Factor; Tuberculosis Prevention Program;

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Introduction

WHO reported that the estimated total number of people diagnosed with TB in 2021 globally was 10.6 million cases, an increase of around 600,000 cases from 3232 which was estimated at 10 million TB cases (Kamrin et al., 2023). Indonesia itself is in the SECOND position (2nd) with the highest total TB sufferers in the world after India, followed by China, the Philippines, Pakistan, Nigeria, Bangladesh and the Democratic Republic of Congo in a row (Damanik et al., 2023). In 3232, Indonesia is in the third position with the highest total case load. TB cases in Indonesia are estimated at 969,000 TB cases (one person every 33 seconds). The incidence of TB cases in Indonesia is 354 per 100,000 population. The death rate from TB in Indonesia reaches 150,000 cases (one person every 4 minutes, with a mortality rate of 55 per 100,000 population (Global Tuberculosis Report.,2022) in (Himayati, 2023)

The tuberculosis control program is carried out in addition to carrying out promotional and prevention activities, also carrying out early detection activities where active discovery of tuberculosis patients is carried out which also involves the community, as well as providing treatment until recovery. Tuberculosis control programs must also receive commitment support from stakeholders. The suspected achievement of all cases was 9,045 cases, or a case notification rate (CNR) of 97%. The CDR target set is at least 47.5%. In 2021, the total number of TB cases treated was 945 or the TB case detection rate (CDR) was 47.5%. Another program indicator is the success rate of TB sufferers. The success rate of new TB cases in East Java in 2021 is already 90%, while the target set is >90%, meaning that there are still Drop out cases in Sampang Regency (Sampang Regency health profile., 2021).

TB spreads through the air from person to person. When patients with pulmonary TB cough, sneeze or spit, the TB germs will go into the air (Hasina, 2020). These germs are inhaled in people and trigger to become infected. About 1/4 of the world's population has a TB infection, where people have been infected by TB bacteria but have not been sick and have not been able to transmit it to others (Nortajulu et al., 2022). A person is at risk of being infected with TB bacteria by 5-10% for TB disease in his life. A person who has a low immune system has a higher risk for pulmonary tuberculosis (Pang et al., 2019)

When a person has symptoms of active tuberculosis, symptoms will appear such as fever, cough, weight loss or night sweats) may be mild symptoms for months (Nortajulu et al., 2022). This leads to late seeking care, and transmission of the bacteria to others. Active TB in a person can infect as many as 5-15 other people who are in close contact with people with pulmonary TB. About 45% of the incidence of death if pulmonary tuberculosis is not treated properly (Gopalaswamy et al., 2020)

TB is an environment-based disease. Risk factors for TB transmission are environmental factors and behavioral factors. Environmental factors include ventilation, occupancy density, temperature, lighting and humidity (Zolanda et al., 2021). While behavioral factors include the habit of smoking, spitting or throwing phlegm in any place, coughing or sneezing not closing the mouth and the habit of not opening windows (Prihanti &; Rahmawati, 2017)

Many factors influence the occurrence of pulmonary TB disease. These factors can be in the form of individual factors, germ factors, and environmental factors (Izzati et al., 2015). Individual factors can be various things that affect the individual's immune system, such as HIV / AIDS, malnutrition, Diabetes Mellitus (DM), and the use of immunosuppressants. Germ factors can be in the form of germ concentration and length of contact with germs. Environmental factors can be ventilation, density, and indoor lighting (National guidelines for tuberculosis control.,2022)

Method

This research is an analytical survey research with case control design, which is an analytical study (survey) that concerns how risk factors are studied using a retrospective approach, where the effect is identified now, then risk factors are identified in the past (Notoatmodjo, 2012)

The study was conducted in the working area of the Karangpenang Public Health Center and primary data collection was carried out in January-March 3223. The samples in the case group are all cases identified by TCM GeneXpert obtained MTB results detected by sensitive Rifampicin obtained data from the medical records of the Karangpenang Public Health Center in 3223 and have complete addresses, aged 32-50 years, namely a total of 32 cases. The total control taken is equal to the total cases. Sampling for case groups is taken all samples that meet the inclusion and exclusion criteria. The control group was randomly drawn by age and sex matching.

The criteria for case inclusion are pulmonary TB patients based on records at the Karangpenang Public Health Center in 2023, fully addressed based on records at the Karangpenang Public Health Center in 2023, and aged 20-50 years. The criteria for exclusion of cases are that the patient is not found at the registered address, unwilling to be a respondent, less than 20 years old or more than 50 years old. The criteria for control inclusion are not at home and do not live around the house of TB patients, are not suspected of pulmonary TB and or if they are suspects (cough 2-3 weeks with or without other symptoms) confirmed by TCM examination whose results are TCM GeneXpert MTB results are not detected, same sex and age 20-50 years. The criteria for exclusion of controls are not willing to be respondents, age less than 20 years or more than 50 years

The independent variables of this study were nutritional status, DM history, and smoking history. Nutritional status is measured by Body Mass Index criteria, weight is weighed with weight scales, and height is measured by microtomies. DM history is tracked by interview and completed with blood sugar checks while with a glucometer. Smoking history was traced by interviews. While the dependent variable is pulmonary TB.

The processing steps are checking, coding, entry, and cleaning data. The data obtained were processed in the SPSS program and analyzed univariately and bivariate. Bivariate analysis using chi square test with degree of significance $p<0.05$

Results and Discussion

Result

The total sample that met the inclusion and exclusion criteria in this study was a total of 32 respondents for the case group and 32 respondents for the control group.

Univariate Results

To determine the frequency distribution of each variable, namely independent variables (nutritional status, DM history, and smoking history).

1. Nutritional Status

Table 1

Distribution of Respondents Based on Nutritional Status

Nutritional status	Case		Control	
	f	%	f	%
Less	18	56,3	5	15,6
Normal / More	14	43,7	27	84,4
Total	32	100	32	100

Based on table 1, it can be seen that in case respondents the total nutritional status was less was 18 people (56.3%) while in the control respondents the nutritional status was less only 5 people (15.6%).

2. History of DM

Table 2

Distribution of respondents based on history of DM

DM History	Case		Control	
	f	%	f	%
Ada	12	37,5	3	9,4
Do not	20	62,5	29	90,6
Total	**32**	**100**	**32**	**100**

Based on table 2, it was found that in the case respondents total DM history 12 people (37.5%) and in the control group 3 people (9.4%).

3. Smoking history

Table 3

Distribution of Respondents Based on Smoking History

Smoking history	Case		Control	
	f	%	f	%
Ada	13	40,6	4	12,5
Do not	19	59,4	28	87,5
Total	**32**	**100**	**32**	**100**

Based on table 3, it was found that in the case respondents there were 13 total smoking history (40.6%) and in the control group there were 4 people (12.5%).

Bivariate Results

Table 4

Relationship of Nutritional Status with the Incidence of Pulmonary TB

Nutrient	Incidence of Pulmonary TB						OR	P Value
	Case		Control		Total			
	f	%	f	%	f	%		
Less	18	56,3	5	15,6	23	35,9	6,943	0,002
Normal/more	14	43,7	27	84,4	41	64,1		
Total	**32**	**100**	**32**	**100**	**64**	**100**		

From table 4, it is known that p = 0.002 (p < 0.05) which means that a significant relationship is obtained between nutritional status and the incidence of pulmonary TB in the working area of the Karangpenang Public Health Center. The odds ratio of 6.943 means that respondents with undernourished status are 6.9 times more likely to suffer from pulmonary TB compared to respondents with normal or excess nutritional status.

Table 5

Relationship of DM History with the Incidence of Pulmonary TB

DM History	Incidence of Pulmonary TB						OR	P Value
	Case		Control		Total			
	f	%	f	%	f	%		
Ada	12	37,5	3	9,4	15	23,4	5,800	0,018
Do not	20	62,5	29	90,6	49	76,6		
Total	32	100	32	100	64	100		

From table 5, it is known that using the chi square test, p-value = 0.018 (p<0.05) means that there is a statistically significant relationship between the history of DM disease and the incidence of pulmonary TB in the working area of the Karangpenang Public Health Center. The odds ratio in this study was 5,800, meaning that someone with a history of DM disease was at risk of suffering from pulmonary TB 5.8 times greater than those who did not.

Table 6

Relationship of Smoking History with the Incidence of Pulmonary TB

Smoking history	Incidence of Pulmonary TB						OR	*p-value*
	Case		Control		Total			
	f	%	f	%	f	%		
Ada	13	40,6	4	12,5	17	26,6	4,789	0,024
Do not	19	59,4	28	87,5	47	73,4		
Total	**32**	**100**	**32**	**100**	**64**	**100**		

From table 6, it is known that using the chi square test, p value = 0.024 (p <0.05) means that there is a statistically significant relationship between smoking history and the incidence of pulmonary TB in the work area of the Karangpenang Public Health Center.

The odds ratio in this study was 4.789 meaning that someone with a history of smoking was at risk of suffering from pulmonary TB 4.7 times greater than those who did not.

Discussion

Relationship of Nutritional Status with the Incidence of Pulmonary TB

The relationship between nutritional status and the incidence of pulmonary TB was carried out on 64 respondents consisting of 32 case group respondents and 32 control group respondents. Based on the results of the chi square test obtained p value = 0.002<0.05 this shows a significant relationship between nutritional status and the incidence of pulmonary TB in the working area of the Karangpenang Public Health Center. The odds ratio of 6.943 means that respondents with undernourished status are 6.9 times more likely to suffer from pulmonary TB compared to respondents with normal or excess nutritional status. Thus, the hypothesis that there is a meaningful relationship is statistically proven.

Based on research conducted by Nabilla Niken et al, it shows a significant relationship between nutritional status and the incidence of tuberculosis in all Indonesian provinces with p value = 0.020 and OR 1.78 (95% CI 1.1-2.9) (Widyastuti et al., 2021). Research conducted by Rahmi Novita et al also stated a significant relationship between nutritional status and tuberculosis with p = 0.006. (Hermawati, n.d.)

TB and nutritional status are interconnected in a complex two-way relationship. Nutritional deficiencies can exacerbate the risk of pulmonary TB disease and increase the risk of developing from latent TB infection to active TB. There are several ways in which malnutrition can affect TB. The main ways in which malnutrition can alter the pathogenesis of TB is by increasing the risk of developing from TB infection to primary disease in the short term, or increasing the risk of reactivation of TB disease in the long term (Musuenge et al., 2020)

The cause of low nutritional status is due to disease attacks so that it can trigger a decrease in endurance, lack of appetite which causes a person to be susceptible to disease. Socioeconomic and lifestyle factors also affect nutritional status. Socioeconomic such as type of work, level of education that can affect family income. Low income is often a problem to meet adequate nutrition due to low purchasing power (Wulanta et al., 2019)

In line with Beatrice's research (2020) malnutrition in tuberculosis patients reflects socioeconomic background, low demographics and unhealthy behavior greatly affect nutritional status, it can be seen that 63.9% of tuberculosis sufferers with primary school education, male sex 62%, total large families 53.7%, urban residence 81.5%, smoking habits 65% and alcohol consumption 60.2% suffer from malnutrition. (Musuenge et al., 2020)

Relationship of DM History with the Incidence of Pulmonary TB

The relationship between DM history and the incidence of pulmonary TB was carried out on 64 respondents consisting of 32 case group respondents and 32 control group respondents. Based on the results of the chi square test obtained p value =

0.018<0.05 this shows a significant relationship between the history of DM and the incidence of pulmonary TB in the work area of the Karangpenang Public Health Center. Odds Ratio 5,800 means that respondents with a history of DM are 5.8 times more likely to suffer from Pulmonary TB compared to respondents with no history of DM. Thus, the hypothesis that there is a meaningful relationship is statistically proven.

The results showed a statistically significant relationship between the age of people with Diabetes Mellitus and the incidence of pulmonary tuberculosis. Diabetes Mellitus patients who are in productive age have a 3,068 times higher risk of developing pulmonary tuberculosis (OR=3,068; 95%CI: 1,154-8,155) than Diabetes Mellitus patients in non-productive age groups. The productive age group is the population in the age range of 15 to 64 years (Ministry of Health RI, 2018)

In the study of Abera and Ameya (2018) on Diabetes Mellitus patients at Hawassa Adare Hospital showed results stating that Diabetes Mellitus patients who have suffered from Diabetes Mellitus for ≥10 years have a 7.03 times higher risk of developing pulmonary tuberculosis compared to Diabetes Mellitus patients suffering from Diabetes Mellitus ≤5 years (Adjusted OR= 7.03; 95%CI:(1,357-73,6).

The incidence of lung infection in patients with DM is the result of a failure of the body's defense system, in this case the lungs experience impaired function in the respiratory epithelium and also ciliary motility. Impaired function of pulmonary vascular capillary endothelium, stiffness of the corpus of red blood cells, changes in the oxygen dissociation curve due to long hyperglycemia conditions are factors in the failure of defense mechanisms against infection (Consensus Management of Tuberculosis and Diabetes mellitus, 2015)

Some studies have also shown alveolar macrophages in pulmonary TB patients with complications of DM to be less activated. Resting values in TNF-K, IL-6 and IL-8 were found to be increased in diabetic patients compared to non-diabetic controls. Chemotaxis is also lower found in PMN in diabetic patients. This can cause tuberculosis infection to spread and can cause lesions to become more extensive (Koo, 2013)

Relationship of Smoking History with the Incidence of Pulmonary TB

The relationship between smoking history and the incidence of pulmonary TB was carried out on 64 respondents consisting of 32 case group respondents and 32 control group respondents. Based on the results of the chi square test obtained p value = 0.024<0.05 this shows a significant relationship between smoking history and the incidence of pulmonary TB in the work area of the Karangpenang Public Health Center. The odds ratio of 4.789 means that respondents with a history of smoking are 4.7 times more likely to suffer from pulmonary TB compared to respondents with no history of smoking. Thus, the hypothesis that there is a meaningful relationship is statistically proven.

The results of Eliandy's (2020) research on the relationship between smoking behavior and the incidence of pulmonary tuberculosis disease suggest that there is a significant relationship between the quantity of smoking (heavy smokers) and the

incidence of BTA Positive Pulmonary TB at 3,731 times greater risk compared to non-smokers and there is a significant relationship between the length of smoking (> 10 years) with the incidence of BTA positive Pulmonary TB which has a risk of 4,822 times greater than those who do not smoke.

Based on the results of research Smoking behavior will damage the lung defense mechanism called mucociliary clearance. The entry of these bacteria can damage macrophages in the lungs which are phagocytosis cells, so that TB germs can become resistant to treatment, resulting in patients who still smoke during treatment require a longer time to achieve sputum conversion compared to patients with pulmonary TB who do not smoke (Susanti, 2013)

Research on the effects of nicotine substances has revealed that the substance may increase the risk of TB by reducing local TNF in the lungs. Tobacco smoke contains about 4500 compounds that are most likely to have biologically active effects. Anti-inflammatories and immunosuppression were also found to be concentrated in nicotine substances. An early hypothesis was that nicotine is immunosuppressive because it activates the hypothalamopituitary adrenal axis (HPA axis) via nicotine receptors within the central nervous system. However, it was later discovered that the HPA axis is only important for the acute effects of nicotine, while chronic anti-inflammatory effects persist after adrenalectomy. The body's resistance, especially in the lungs, goes down, making tuberculosis lesions that are initially not extensive can become extensive (Davies et al., 2006)

Conclusion

This study concluded that there was a significant relationship with risk factors for nutritional status, DM history, smoking history to tuberculosis incidence in the Karangpenang Public Health Center area

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