Indonesian Journal of Global Health Research
Volume 7 Number 2, April 2025
e-ISSN 2715-1972; p-ISSN 2714-9749
http://jurnal.globalhealthsciencegroup.com/index.php/IJGHR

ANALYSIS OF RISK FACTORS FOR PULMONARY TUBERCULOSIS INCIDENCE

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ABSTRACT
Pulmonary tuberculosis (TB) cases in Nagan Raya have increased every year. Efforts to prevent tuberculosis transmission with healthy lifestyle behaviors have been carried out. However, the prevalence of pulmonary tuberculosis is still high and many factors are associated with the incidence of pulmonary tuberculosis—analytical study with a case-control approach to determine risk factors for tuberculosis in the Nagan Raya district. The sample in this study was 290 people consisting of 58 cases and 232 controls. The sampling technique used purposive sampling. Data was collected by interviewing respondents, observing, and reporting TB case records. Multivariate analysis using multiple logistic regression tests with a 95% confidence level. The results showed that the characteristic factors associated with the incidence of pulmonary TB were primary education (p=0.002), not working (p=0.000), and income <REGIONAL MINIMUM WAGE (p=0.001). Environmental factors associated with the incidence of pulmonary TB were the number of household members >4 people (p=0.036) and no ventilation in each room (p=0.000). Health factors associated with the incidence of pulmonary TB were underweight nutritional status (p=0.019), obese nutritional status (p=0.042), and not containing BCG (p=0.014). The most dominant factor associated with the incidence of pulmonary TB is not working (OR = 4.17; 95% CI = 1.36-12.73). Respondents who did not work had a 4.17 times higher risk of experiencing pulmonary TB than those who did not work after controlling for environmental and health factors. For this reason, it is expected that respondents need to increase their income to prevent transmission of pulmonary TB and maintain cleanliness, improve nutritional status and limit contact with TB sufferers.

Keywords: characteristic factors; environmental factors; health factors; occupation; pulmonary tuberculosis

How to cite (in APA style)
Hasnita, N., Ichwansyah, F., Abdurrahman, F. bin, Usman, S., & Zahara, M. (2025). Analysis of Risk Factors for Pulmonary Tuberculosis Incidence. Indonesian Journal of Global Health Research, 7(2), 219-234. https://doi.org/10.37287/ijghr.v7i2.5553.

INTRODUCTION

Pulmonary tuberculosis (TB) is an infectious disease caused by the Mycobacterium Tuberculosis bacillus. This disease is the second leading cause of death out of the top ten causes of death in the world after HIV/AIDS. The World Health Organization (WHO) in 2018 estimated that 10 million people worldwide suffer from Pulmonary TB, and 1.5 million people die from this disease. In 2019, it was estimated that around 10 million people experienced Pulmonary TB and caused the deaths of around 1.4 million people. Of pulmonary TB cases in 2019, 56% were male (aged> 15 years), 32% were adult females (aged> 15 years), and 12% were children (aged <15 years) (WHO, 2020).The 2018 basic health research report in Indonesia found that the prevalence of pulmonary TB based on a doctor's diagnosis history was 0.42%. Papua Province ranked first for pulmonary TB cases at 0.77% and Aceh Province's pulmonary TB cases at 0.49%. The prevalence of pulmonary TB according to gender group is 0.5% for men and 0.4% for women, while the majority of pulmonary TB sufferers are aged 65-74 years, 1.0% (Kemenkes, 2018b).

TB is a disease that requires continuous treatment for up to six months. TB sufferers who do not undergo treatment will experience complications and even death. Incomplete TB

treatment will cause drug resistance (Anggraini, 2020). Bacteria cause pulmonary TB cases, and several other factors greatly influence pulmonary TB. These factors can come from the patient himself (age, gender, comorbidities, nutritional status, immunization, smoking habits) and external factors (environment, socio-economic) (Andayani & Astuti, 2017). Meanwhile, according to Achmadi (2014), the factors influencing pulmonary TB disease are population, including gender, age, nutritional status, socio-economic conditions and environmental factors, including residential density, house floor, ventilation, lighting, and humidity.Efforts that can be made to prevent risk factors for pulmonary TB include cultivating clean and healthy living behaviour, cultivating ethical coughing behaviour, maintaining and improving the quality of housing and its environment according to healthy home standards, increasing endurance, preventing smoking and alcohol consumption, eating healthy and nutritious food that meets the rules of my plate, and exercising regularly (Kemenkes, 2018a).

Research conducted in Banda Aceh City showed that most of the conditions of TB sufferers' houses were by standards by having separate rooms between bedrooms, kitchens and family rooms, clean room conditions, having windows and ventilation and having sufficient natural lighting (Ramadhan, Hadifah, & Marissa, 2020). Research in Nagan Raya showed that variables related to the incidence of tuberculosis were occupation (p=0.016, OR= 1.571, 95%CI: 1.242-5.007), knowledge (p=0.027, OR=1.024, 95%CI: 1.088-4.248) and socio-economic (p=0.026, OR=1.129, 95%CI: 0.221-0.866), while age, gender and education were not related to the incidence of tuberculosis (Rafsanjani, Usman, Syam, & Saputra, 2019). Based on the health profile of Aceh Province, it shows that in 2020, the highest number of tuberculosis cases in Aceh was in North Aceh Regency at 13%, followed by Bireuen Regency at 12% and Pidie Regency at 9% of the total number of tuberculosis cases in Aceh (Dinkes Aceh, 2021). Pulmonary TB cases in Nagan Raya are not among the highest areas. However, cases of pulmonary TB in Nagan Raya Regency have increased every year. In 2017, data on 125 cases of pulmonary TB were obtained; in 2018, data on 132 cases of pulmonary TB were received; in 2019, data on 267 cases of pulmonary TB were obtained; and in 2020, data on 156 cases of pulmonary TB were obtained (Dinkes, 2020). The latest data in 2022, 58 people in Nagan Raya Regency were diagnosed positive for pulmonary TB. There is still limited research on the causes of the increase in pulmonary TB cases in Nagan Raya, as well as the most dominant factors related to pulmonary TB cases. This study aimed to determine the analysis of risk factors associated with the incidence of pulmonary tuberculosis in Nagan Raya Regency.

METHOD

This quantitative study has a case-control study design to determine the risk factors for pulmonary tuberculosis in Nagan Raya Regency. Data collection used a backwards-looking (retrospective) approach. The study was conducted in 10 sub-districts in Nagan Raya Regency, namely Alue Bilie District, Alue Rambot District, Beutong District, Cot Kuta District, Jeuram District, Lueng Keube Jagat District, Simpang Jaya District, Suka Mulia District, Ujong Fatihah District, and Ujong Pulo District. The study was conducted from June to July 2022.The population in this study were people in 10 sub-districts in Nagan Raya Regency, Aceh Province. The sample in this study consisted of 2 groups, namely the case group and the control group. The criteria for each group include the case group sample being TB sufferers recorded at each health centre in Nagan Raya Regency, willing to be respondents, and not in a serious condition. The control group sample was the community living around the TB sufferer's house, willing to be respondents, and living around the TB sufferer's house.

The sampling technique used was total sampling. The total number of people with TB was 58. In this study, the case group, namely TB sufferers, and the control group, namely non-TB sufferers, were selected with a ratio of 1 4 so that the sample size in the case group was 58 people, and the control group was 232 people. So, the number of samples in this study was 290 people. The sample for the control group was non-TB sufferers who were around the TB sufferer's residence. The data collection instrument in this study was designed to measure the independent and dependent variables consisting of a questionnaire and microtonal to measure height and scales to weigh weight. The questionnaire measured age, gender, education, occupation, income, area of residence, distance to the health centre, number of household members, house floor materials, toilet ownership, drinking water sources, nutritional status, and smoking. To determine the respondents' pulmonary TB status, a documentation study was conducted on the medical records at each Health Center.

This study uses primary data, namely data obtained directly from the field through the distribution of questionnaires. In contrast, primary data is from the medical records of each respondent at the health centre. This study was assisted by 13 enumerators who were TB program coordinators for each health centre. Before data collection, enumerators were given a briefing on how to fill out the questionnaire. Data collection was carried out by interviewing respondents using questionnaires, observing the type of house, floor material of the house, ventilation in each room, ownership of toilets and use of drinking water sources, and examining medical records to determine body weight and height from the examination results when the respondent was diagnosed with pulmonary TB.Univariate analysis was carried out to descriptively determine each variable presented as a frequency distribution table based on the variables studied, both dependent and independent variables. Bivariate analysis was conducted to determine the relationship between independent and dependent variables using a logistic regression test with a confidence level of 95% (Siswanto, Susila, & Suyanto, 2017).Multivariate analysis was conducted to determine the most dominant independent variables related to the dependent variable using multiple logistic regression tests. The variables included in the multivariate analysis were variables that, in the bivariate analysis, had a p-value <0.25 (Siswanto et al., 2017).

RESULT

Table 1.
Univariate analysis results

Variable	f	%
Pulmonary TB Incident		
No	232	80,00
Yes	58	20,00
Age		
Teenagers	23	7,93
Adults	140	48,28
Elderly	127	43,79
Gender		
Man	147	50,69
Woman	143	49,31
Education		
Higher	70	24,14
Intermediate	89	30,69
Base	131	45,17
Work		
Work	232	80,00
Doesn't work	58	20,00
Income		

Variable	f	%
≥ Regional Minimum Wage	107	36,90
< Regional Minimum Wage	183	63,10
Region		
City	30	10,34
Village	260	89,66
Distance to Health Center		
≤3 Km	135	46,55
>3 Km	155	53,45
Number of Household Assistants		
≤ 4 people	36	12,41
> 4 people	254	87,59
Home Ownership		
My own house	237	81,72
My own house	39	13,45
House for rent	14	4,83
Type of House		
Permanent	215	74,14
Semi-permanent	63	21,72
Board	12	4,14
House Floor		
Ceramics	99	34,14
Semen	189	65,17
Land	2	0,69
Residential Density		
As per Terms	269	92,76
Not Meet the Requirements	21	7,24
Ventilation in Every Room		
Any	252	86,90
None	38	13,10
Ownership of toilets		
Any	264	91,03
None	26	8,97
Drinking Water Source		
Bottled Water	93	32,07
Well water	197	67,93
Smoke		
No	174	60,00
Yes	116	40,00
Nutritional status		
Normal	196	67,59
Thin	23	7,93
Fat	71	24,48
BCG Immunization		
Any	42	14,48
None	248	85,52

Based on Table 1. shows that there are 20% of pulmonary TB sufferers. Respondents who are adults (25-45 years) are 48.28%, and elderly (>45 years) are 43.79%. Respondents with male gender are 50.69%. Respondents with basic education are 45.17%, and secondary education is 30.69%. Unemployed respondents are 20.00%. Respondents' income <REGIONAL MINIMUM WAGE (<3,000,000) is 63.10%. Respondents who live in rural areas make up 89.66% of the respondents. Respondents whose distance from their homes to the health centre is >3 km are 53.45%. Respondents with several household members >4 people are 87.59%. Respondents whose home ownership is a rented house are 4.83%, and those who live in boarding houses are 13.45%. Respondents with a type of board house are 4.14%, and permanent are 21.72%. Respondents with a house floor made of soil are 0.69%, and a house floor made of cement is 65.17%. Respondents with a density of occupancy in 1 house that does not meet the requirements are 7.24%. Respondents who do not have ventilation in each

room are 13.10%. Respondents who do not have a toilet are 8.97%. Respondents whose drinking water source comes from well water are 67.93%. Respondents who smoke are 40.00%. Respondents with obese nutritional status are 24.48%, and thin are 7.93%. Respondents who do not have a history of BCG immunization are 85.52%.

Table 2.
Bivariate analysis - relationship between characteristic factors, regional characteristic factors, environmental factors and health factors with the incidence of pulmonary TB

Variable	Pulmonary TB Incident				OR (95% CI)	p-value
	Control (No)		Case (Yes)			
	f	%	f	%		
Characteristic Factors						
Age						
Teenagers	18	7,76	5	8,62		
Adults	118	50,86	22	37,93	0,67 (0,22 – 1.99)	0,474
Elderly	96	41,38	31	53,45	1,16 (0,39 – 3,39)	0,783
Gender						
Man	120	51,72	27	46,55		
Woman	112	48,28	31	53,45	1,23 (0,69 – 2,18)	0,481
Education						
Higher	63	27,16	7	12,07		
Intermediate	77	33,19	12	20,69	1,40 (0,52 – 3,77)	0,503
Base	92	39,66	39	67,24	3,81 (1,60 – 9,07)	0,002
Work						
Work	198	85,34	34	58,62		
Doesn't work	34	14,66	24	41,38	4,11 (2,17-7,77)	0,000
Income						
≥ Regional Minimum Wage	97	41,81	10	17,24		
< Regional Minimum Wage	135	58,19	48	82,76	3,44 (1,66 – 7,15)	0,001
Regional Characteristic Factors						
Region						
City	24	10,34	6	10,34		
Village	208	89,66	52	89,66	1	1,000
Distance to Health Center						
≤3 Km	108	46,55	27	46,55		
>3 Km	124	53,45	31	53,45	1	1,000
Environmental Factors						
Number of Household Assistants						
≤ 4 people						
> 4 people	24	10,34	12	20,69	0,44 (0,20 – 0,94)	0,036
	208	89,66	46	79,31		
Home Ownership						
My own house	186	80,17	51	87,93		
My own house	35	15,09	4	6,90	0,41 (0,14 – 1,22)	0,112
House for rent	11	4,74	3	5,17	0,99 (0,26 – 3,69)	0,994
Type of House						
Permanent	177	76,29	38	65,52		
Semi-permanent	46	19,83	17	29,31	1,72 (0,89 – 3,32)	0,105
Board	9	3,88	3	5,17	1,55 (0,40 – 6,00)	0,524
House Floor						
Ceramics	84	36,21	15	25,86		
Semen	147	63,36	42	72,41	1,6 (0,83 – 3,05)	0,155
Land	1	0,43	1	1,72	5,59 (0,33 – 94,49)	0,232
Residential Density						
As per Terms	213	91,81	56	96,55		
Not Meet the Requirements	19	8,19	2	3,45	0,40 (0,09 – 1,77)	0,227

Variable	Pulmonary TB Incident				OR (95% CI)	p-value
	Control (No)		Case (Yes)			
	f	%	f	%		
Ventilation in Every Room						
Any	210	90,52	42	72,41		
None	22	9,48	16	27,59	3,63 (1,76 – 7,50)	0,000
Ownership of toilets						
Any	215	92,67	49	84,48		
None	17	7,33	9	15,52	2,32 (0,97 – 5,51)	0,056
Drinking Water Source						
Bottled Water	76	32,76	17	29,31		
Well water	156	67,24	41	70,69	1,17 (0,62 – 2,20)	0,615
Health Factors						
Smoke						
No	142	61,21	32	55,17		
Yes	90	38,79	26	44,83	1,28 (0,71 – 2,29)	0,402
Nutritional status						
Normal	155	66,81	41	67,93		
Thin	13	5,60	10	17,24	2,90 (1,19 – 7,10)	0,019
Fat	64	27,59	7	12,07	0,41 (0,17 – 0,97)	0,042
BCG Immunization						
Any	41	17,67	1	1,72		
None	191	82,33	57	98,28	12,2 (1,64 – 90,92)	0,014

Based on table 2. shows the characteristic factors associated with the incidence of pulmonary TB are basic education (p=0.002; OR=3.81; 95%CI=1.60-9.07), not working (p=0.000; OR=4.11; 95%CI=2.17-7.7), and income <REGIONAL MINIMUM WAGE (p=0.001; OR=3.44; 95%CI=1.66-7.15). Environmental factors associated with the incidence of pulmonary TB are the number of ART>4 people (p=0.036; OR=0.44; 95%CI=0.20-0.94) no ventilation in each room (p=0.000; OR=3.63; 95%CI=1.76-7.50). Health factors associated with the incidence of pulmonary TB are thin nutritional status (p=0.019; OR=2.90; 95%CI=1.19-7.10), obese nutritional status (p=0.042; OR=0.41; 95%CI=0.17-0.97), and no history of BCG immunization (p=0.014; OR=12.2; 95%CI=1.64-90.92). Multivariate analysis was conducted to determine the most dominant independent variables related to the dependent variable. Multivariate analysis in this study used multiple logistic regression tests. Independent variables are eligible for inclusion in the multivariate test (variables with p-value <0.25). Variables that are eligible for multivariate analysis are characteristic factors (education, occupation and income), environmental factors (number of household members, home ownership, type of house, floor of the house, density of housing, ventilation in each room, ownership of a toilet) and health factors (nutritional status and BCG immunization).

Tabel 3.
Model explains characteristic factors related to the incidence of pulmonary TB

Variables	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)
Education					
Higher					
Intermediate	0,89 (0,31-2,56)			1,14 (0,36-3,55)	0,90 (0,28-2,88)
Base	2,14 (0,82-5,56)			3,23 (1,05-9,90)*	2,10 (0,64-6,90)
Work					
Work					
Doesn't work	3,04 (1,53-6,04)*			4,64 (1,65-13,05)*	4,17 (1,36-12,73)*

Variables	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)
Income					
≥ Regional Minimum Wage	1,87 (0,82-4,27)			1,56 (0,63-3,85)	1,77 (0,68-4,60)
< Regional Minimum Wage					
Number of Household Assistants					
≤ 4 people		0,47 (0,20-1,06)		2,08 (0,61-7,08)	2,03 (0,55-7,44)
> 4 people					
Home Ownership					
My own house		0,34 (0,10-1,14)		0,43 (0,12-1,49)	0,51 (0,14-1,83)
My own house		0,57 (0,13-2,50)		0,62 (0,13-2,89)	0,62 (0,12-3,09)
House for rent					
Type of House					
Permanent					
Semi-permanent		1,16 (0,52-2,55)		0,99 (0,42-2,33)	1,18 (0,48-2,87)
Board		0,89 (0,17-4,45)		1,31 (0,26-6,54)	1,84 (0,35-9,51)
House Floor					
Ceramics					
Semen		1,48 (0,70-3,11)		0,74 (0,30-1,82)	0,82 (0,32-2,07)
Land		6,42 (0,29-139,1)		3,54 (0,14-85,57)	3,82 (0,15-96,98)
Residential Density					
As per Terms		0,32 (0,05-1,86)		0,34 (0,05-2,07)	0,23 (0,03-1,46)
Not Meet the Requirements					
Ventilation in Every Room					
Any		3,38 (1,52-7,52)*		3,92 (1,62-9,51)*	3,92 (1,56-9,85)*
None					
Ownership of toilets					
Any		1,95 (0,69-5,48)		1,42 (0,46-4,27)	1,04 (0,33-3,25)
None					
Nutritional status					
Normal			2,44 (0,99-6,00)		3,10 (1,04-9,19)*
Thin			0,43 (0,18-1,02)		0,42 (0,16-1,07)
Fat					
BCG Immunization					
Any			10,42 (1,39-77,98)*		6,22 (0,77-50,11)
None					

Based on table 3. shows that Model 1 explains the most dominant characteristic factors related to the incidence of pulmonary TB. The variables analyzed in model 1 consist of education, employment and income. The results of statistical tests show that the most dominant factor

related to the incidence of pulmonary TB is respondents who do not work (OR = 3.04; 95% CI = 1.53-6.04). Respondents who do not work have a 3.04 times greater risk of experiencing pulmonary TB compared to respondents who do not work after being controlled by education and income variables.Model 2 explains the most dominant environmental factors related to the incidence of pulmonary TB. The variables analyzed in model 2 consist of the number of household members, home ownership, type of house, floor of the house, density of housing, ventilation in each house, and toilet ownership. The results of statistical tests show that the most dominant factor related to the incidence of pulmonary TB is not having ventilation in each room (OR = 3.38; 95% CI = 1.52-7.52). Respondents who do not have ventilation in every room of their house have a 3.38 times greater risk of experiencing pulmonary TB compared to respondents who have ventilation in every room of their house.

Model 3 explains the most dominant health factors related to the incidence of pulmonary TB. The variables analyzed in model 3 consist of nutritional status and BCG immunization variables. The results of statistical tests show that the most dominant factor related to the incidence of pulmonary TB is not being immunized with BCG (OR = 10.42; 95% CI = 1.39-77.98). Respondents who are not vaccinated with BCG have a 10.42 times greater risk of experiencing pulmonary TB compared to respondents who are vaccinated with BCG.Model 4 explains the combination of models 1 and 2 most dominantly related to the incidence of pulmonary TB. After interacting with model 2, the most dominant factor associated with the incidence of pulmonary TB is respondents who do not work with a change in the OR value to 4.64. Respondents who do not work have a 4.64 times greater risk of experiencing pulmonary TB compared to respondents who do not work after being controlled by environmental factors.

Model 5 explains the combination of model 1, model 2 and model 3, which is most dominantly related to the incidence of pulmonary TB. After interacting with model 2 and model 3, the most dominant factor associated with the incidence of pulmonary TB is respondents who do not work with a change in OR value to 4.17. Respondents who do not work have a 4.17 times greater risk of experiencing pulmonary TB compared to respondents who do not work after being controlled by environmental factors and health factors.

DISCUSSION

Characteristic Factors with Pulmonary TB Incidence

The results of the study showed that characteristic factors associated with the incidence of pulmonary TB were basic education (p=0.002; OR=3.81; 95%CI=1.60-9.07), not working (p=0.000; OR=4.11; 95%CI=2.17-7.7), and income < Regional Minimum Wage (p=0.001; OR=3.44; 95%CI=1.66-7.15). This study shows a relationship between low education and the incidence of pulmonary TB. Respondents with basic education have a 3.81 times greater risk of experiencing pulmonary TB compared to respondents with higher education. This study is in line with the study of Fitrianti, Wahyudi, and Murni (2022), which showed that there was a relationship between education level and the incidence of pulmonary TB at Talang Ubi Hospital, Penukal Abab Lematang Ilir Regency. A person with higher education will more easily absorb and accept information about TB to pay more attention to preventing TB transmission (Fitrianti et al., 2022).Chung et al. (2021) study showed that education level was related to TB deaths in Korea in 2008-2017. TB is very common among people with low incomes, and this may be due to education level based on the annual report on wage gaps by education level (OECD Publishing, Organisation for Economic Co-operation, Development Staff, & Centre for Educational Research Innovation, 2020).

Education will make someone want to know something, including health knowledge. The higher a person's education, the broader their knowledge will be (Pakpahan et al., 2021). A person's level of education will influence their response to something that comes from outside. People with higher education will respond more rationally to incoming information and reasons for thinking about how much benefit they might get from the idea. The higher a person's education, the easier it is to receive information, and they have more knowledge (Notoatmodjo, 2010).The results of this study also showed that respondents who did not work had a 4.11 times greater risk of experiencing pulmonary TB compared to respondents with higher education. This study is in line with the study of Jurcev-Savicevic et al. (2013) which showed that respondents who were unemployed or unemployed had a 2.69 times greater risk of developing tuberculosis. Likewise, the study of Fitrianti et al. (2022), showed that there was a relationship between work and the incidence of pulmonary TB at the Talang Ubi Regional Hospital, Penukal Abab Lematang Ilir Regency.

There is no specific type of work that can cause pulmonary tuberculosis because all respondents have the opportunity to get pulmonary tuberculosis, depending on behaviour that can influence the mycobacterium tuberculosis germs to enter the body to cause pulmonary tuberculosis and frequent exposure to other risk factors that can cause pulmonary tuberculosis (Siregar & Ashar, 2013).The statistical test results in this study also showed a relationship between income < Regional Minimum Wage and the incidence of pulmonary TB (p = 0.001; OR = 3.44; 95% CI = 1.66-7.15). Respondents with income < Regional Minimum Wage have a 3.44 times greater risk of experiencing pulmonary TB compared to respondents with income ≥ Regional Minimum Wage.This study is in line with the study of Bhat et al. (2017), which showed that low-income would have a 1.32 risk of experiencing TB in India. This study is not in line with the study of Fahdhienie (2020), which showed no relationship between income and the incidence of tuberculosis in the Pidie Health Center Work Area, Pidie Regency. This is because more than half of TB sufferers have incomes above the Regional Minimum Wage (Fahdhienie, 2020). The regional minimum wage for Nagan Raya Regency is 3,000,000. Family income affects the family's ability to provide the facilities and needs needed to support the family's life and survival. A person's economic resources also affect the type and level of personal hygiene practices (Purnama, 2017).

A family's economic level greatly influences the community's nutritional status. Pulmonary TB is relatively easy to transmit and is very susceptible to infection in family members of sufferers. This disease requires proper treatment because it can attack anyone regardless of their productive age group or families with a weak economy and low levels of education (Manalu et al., 2022).

Regional Characteristic Factors with Pulmonary TB Incidence

This study's results show no relationship between regional characteristic factors and the incidence of pulmonary TB. This differs from a systematic review of pulmonary TB patients in India, which showed that rural areas have a higher prevalence of bacteriologically positive pulmonary TB than urban areas (Sathiyamoorthy, Kalaivani, Aggarwal, & Gupta, 2020). According to Mutembo et al. (2019), the prevalence of TB is slightly higher in urban areas than in urban areas. This is because the population density is higher in urban areas.However, the risk of death from TB is higher in rural areas than in urban areas. In general, patients in rural areas have worse TB treatment outcomes than patients in urban areas (Musaazi et al., 2017). A qualitative study in Uganda highlighted geographic barriers in rural areas as barriers to providing routine TB diagnostic and treatment services (Cattamanchi et al., 2015).The study's results also showed that respondents whose home distance to the health centre was >3

km in respondents with pulmonary TB were 53.45%, and respondents who did not have pulmonary TB were 53.45%. The statistical test results showed a relationship between the distance from home to the health centre and the incidence of pulmonary TB (p = 1,000).The distance from home to the health centre>3 km did not affect respondents in obtaining health services. Currently, each head of household has a means of transportation to obtain health services at the health centre. The study by Novalisa, Susanti, and Nurmainah (2022) showed that the distance from home to health facilities had no relationship with compliance in consuming tuberculosis drugs.

Environmental Factors with Pulmonary TB Incidence

The results of the study showed environmental factors associated with the incidence of pulmonary TB, namely the number of household members >4 people (p = 0.036; OR = 0.44; 95% CI = 0.20-0.94) no ventilation in each room (p = 0.000; OR = 3.63; 95% CI = 1.76-7.50). This study is in line with the study of Nurjana and Tjandrarini (2019) which showed that the number of household members ≤4 people is more at risk of being infected with pulmonary TB compared to the number of household members >4 people in 1 house. Research conducted in South East Ethiopia showed that the number of families >5 people is at risk of experiencing tuberculosis 4.1 times (Tulu, Dida, Kassa, & Taye, 2014). Research conducted in Metana showed that the number of family members >4 people in one house is 3.09 times at risk of tuberculosis transmission (Tesema, Tadesse, Gebrehiwot, Tsegaw, & Weldegebreal, 2015). Several studies have shown that the number of family members in 1 house is at high risk of contracting pulmonary TB. This is because other family members play a role in caring for and looking after pulmonary TB sufferers, so they are at greater risk of infection. However, prevention of transmission of this disease can be done by maintaining cleanliness, having adequate ventilation, wearing masks, covering the mouth when coughing, and taking medication regularly (Rohmah & Wicaksana, 2015).

The results of this study also showed that respondents who did not have ventilation in each room had a 3.36 times greater risk of experiencing pulmonary TB compared to respondents who had ventilation in each room. This study is in line with the study of Manalu et al. (2022) which shows that there is a relationship between the extent of ventilation and the incidence of pulmonary TB. Ventilation can affect air dilution, so that TB germs or other germs can be carried out and can die if exposed to sunlight (Manalu et al., 2022).This study is not in line with the study of Wahyuningsih (2020) which shows that there is no relationship between ventilation and the incidence of pulmonary TB. This is because most respondents are already aware of the habit of opening their windows every day. Transmission generally occurs indoors where sputum droplets are present for a long time. Ventilation can reduce the number of droplets, while direct sunlight can kill germs. Droplets can survive for several hours in dark and humid conditions (Rohmah & Wicaksana, 2015). Ventilation has a major influence on the incidence of pulmonary TB, because the presence or absence of ventilation affects other factors that trigger tuberculosis germs to grow and reproduce well.

Health Factors with Pulmonary TB Incidence

The study results indicate that health factors associated with pulmonary tuberculosis (TB) incidence include underweight nutritional status (p=0.019; OR=2.90; 95%CI=1.19-7.10), overweight nutritional status (p=0.042; OR=0.41; 95%CI=0.17-0.97), and lack of BCG immunization history (p=0.014; OR=12.2; 95%CI=1.64-90.92). Respondents with underweight nutritional status have a 2.90 times higher risk of developing pulmonary TB compared to respondents with normal nutritional status. Similarly, respondents with overweight nutritional status are 0.41 times less likely to develop pulmonary TB compared to

those with normal nutritional status.This study aligns with Yuniar and Lestari (2017), who found that individuals with poor nutritional status are 3.4 times more likely to develop pulmonary tuberculosis than those with adequate nutritional status. Poor nutritional status is one of the factors influencing the likelihood of developing pulmonary TB. Poor nutrition increases the risk of pulmonary tuberculosis, while pulmonary TB contributes to poor nutritional status due to the disease process, which affects the body's immune system (Ernawati et al., 2018).

Nutritional status is one of the key factors in maintaining immunity against TB transmission. Individuals classified as malnourished experience a decline in immune function, reducing the body's ability to defend against infections (Fatriany & Herlina, 2020). The study also reveals that respondents without a history of BCG immunization are 12.2 times more likely to develop pulmonary TB compared to those with a history of BCG immunization. This finding is consistent with Ruhyandi, Yunika, and Manan (2022), who reported a correlation between BCG immunization and pulmonary TB incidence in children. BCG immunization is administered to prevent tuberculosis. The BCG vaccine is a freeze-dried vaccine containing live attenuated Mycobacterium bovis (Bacillus Calmette-Guérin), Paris strain (Mulyati et al., 2014). The BCG vaccine effectively prevents 60-80% of pulmonary TB infections, particularly in children (Roy et al., 2014). Therefore, one of the measures to prevent pulmonary TB transmission is to administer the BCG vaccine.

The Most Dominant Factors Associated with the Incidence of Pulmonary TB

The research findings indicate that the most dominant factor associated with TB incidence in Nagan Raya Regency is unemployment. Respondents who are unemployed have a 4.17 times higher risk of developing pulmonary TB compared to those who are employed, after being controlled for environmental and health factors.This study aligns with the findings of Majdi (2021), which identified occupation as the most dominant factor associated with pulmonary TB (OR=3.45). Similarly, other studies have also shown a relationship between occupation and the incidence of pulmonary TB (Loihala, 2016; Mardjoen, Kepel, & Tumurang, 2019; Nurjana, 2015; Versitaria & Kusnoputranto, 2011).According to Lawrence Green's theory, one factor influencing an individual's health behavior is occupation, which is part of the predisposing factors (Nursalam, 2015). Thomas suggests that work is a necessity that must be undertaken, especially to support one's life and family. Work is not a source of pleasure but rather a means of earning a livelihood, often monotonous, repetitive, and full of challenges. Additionally, work typically demands significant time, which in certain situations requires prioritization over concurrent activities (Widiyaningsih & Suharyanta, 2020).Work is an activity essential for supporting personal and family life (Pakpahan et al., 2021). Individuals who work earn an income to meet daily needs, including physical and health-related necessities. The income derived from work can be used to create a healthy living environment, access healthcare services, and prevent factors that contribute to pulmonary TB infections.

Conversely, unemployed individuals tend to stay at home more frequently, increasing their risk of TB infection, especially when living in unhealthy home environments. Unhealthy housing conditions, such as dampness and lack of ventilation, promote the growth of TB bacteria, making transmission within the household more likely. Majdi (2021) also noted that employed individuals spend less time at home, thereby reducing their contact with pulmonary TB patients.The Innovative Socioeconomic Intervention Against Tuberculosis Project (ISIAT) addresses pulmonary TB transmission by offering a range of psychosocial and economic support to improve access to TB care, prevention, and recovery. This includes

education, community mobilization, psychological and social support integrated with poverty alleviation interventions such as food and cash assistance, universal health insurance links, microcredit, micro-enterprises, and vocational training. These interventions have proven to enhance TB treatment success and the completion of preventive therapy among household contacts (Rocha et al., 2011).Socioeconomic interventions for TB are impactful and feasible but require localized adaptations to meet the diverse needs of underserved populations. To end TB, medications must be integrated with socioeconomic strategies that address poverty (Wingfield, Tovar, Datta, Saunders, & Evans, 2018).

TB patients who do not adhere to their medication regimens, take incorrect doses, or fail to complete their treatment are at risk of developing multidrug-resistant TB (MDR-TB). MDR-TB is a form of TB resistant to first-line anti-TB drugs (Sembiring, 2019). Another factor contributing to MDR-TB is employment status (Sari, 2020). According to Aibana et al. (2017), occupation is a significant factor influencing MDR-TB treatment success..The researchers conclude that occupation is the most dominant factor associated with pulmonary TB. Employed individuals can fulfill their health needs to prevent TB transmission, whereas unemployed individuals face challenges in meeting basic needs due to limited income.

CONCLUSION

The characteristics associated with pulmonary TB incidence in Nagan Raya Regency include basic education, unemployment, and income below the regional minimum wage (RMW). Environmental factors linked to pulmonary TB incidence include households with more than four members and the absence of ventilation in every room. Health factors associated with pulmonary TB incidence are underweight nutritional status, overweight nutritional status, and lack of BCG immunization history. The most dominant factor associated with pulmonary TB incidence is unemployment (OR=4.17; 95%CI=1.36-12.73).It is recommended that respondents address their physical needs, ensure adequate housing, and meet health requirements to prevent the transmission of tuberculosis infection. Healthcare workers should provide counseling to the community about creating proper living conditions and educate them on the importance of immunization and maintaining a balanced diet. Additionally, healthcare workers must remind pulmonary TB patients to take their medication regularly and teach proper cough etiquette to prevent spreading the infection to others.Furthermore, the prevention of pulmonary TB should not only be carried out by the P2PM program (Prevention and Control of Infectious Diseases) but also in collaboration with other programs to achieve comprehensive prevention efforts.

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