

Analysis of Risk Factors Affecting Incidents of Confirmed Pulmonary Tuberculosis in The Region North Sumatra in 2023

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Abstract

TB is one of the deadliest infectious diseases in the world, namely an infectious disease caused by infection with the Mycobacterium tuberculosis bacteria in the lungs. Tuberculosis (TB) is a major global health problem with an estimated 10.4 million new TB cases worldwide. The aim of this research is to determine the relationship between risk factors and the confirmed incidence of pulmonary TB in North Sumatra in 2022. The research method uses case control with a purposive sampling technique, the sample size is rounded up to 750 cases, with a ratio of 1:1 so the number of controls is also 750 so the total sample a total of 1500 Cases. This data is then analyzed using Path Analysis to predict the incidence of pulmonary TB. The results of the research obtained using a logistic regression test showed that the factor most at risk for transmission of pulmonary TB was house density with a value of OR = 3.32. Meanwhile, based on Path Analysis, the factors associated with confirmed pulmonary TB were house density and physical environment, while disease history and Smoking was not associated with confirmed pulmonary TB ($t < 1.96$). It is recommended to pay attention to lighting at home and environmental cleanliness to stop transmission of the virus through the air inhaled by susceptible individuals.

Keywords: *Pulmonary TB, House Overcrowding, Physical Environment*

Introduction

Pulmonary TB is a chronic disease that can affect the sufferer's quality of life. Patients living with tuberculosis (TB) will experience significant disruption to their social life and will be exposed to stigma and discrimination. (1) Pulmonary tuberculosis causes serious problems, based on the concept of quality of life which consists of physical, psychological, social and environmental health aspects. (2) Tuberculosis (TB) is a disease with a high risk of transmission, this disease causes health problems in millions of people every year and is the second infectious disease that causes death after the Human Immunodeficiency Virus (HIV). (3)

On 26 September 2018, the United Nations (UN) held its first high-level meeting on tuberculosis (TB), at its headquarters in New York. The title of the meeting - United to End TB: An Urgent Global Response to a Global Epidemic - highlights the need for urgent

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action to accelerate progress towards the goal of ending the TB epidemic by 2030. The specific target for 2030 set out in the End TB Strategy is a 90 percent reduction in absolute numbers TB deaths and an 80 percent reduction in TB incidence (new cases per 100,000 population per year) (4).

Based on the WHO Global TB Report 2020, malnutrition is the highest risk factor contributing to TB disease. Based on this, TB and Stunting are inseparable and it is very important to harmonize the interests of policy stakeholders across sectors in order to synergize efforts to support the process of eliminating TB by 2030. (5) The burden of disease caused by tuberculosis can be measured by incidence, prevalence, and mortality/death. (6)

The World Health Organization reports that the estimated number of people diagnosed with TB in 2021 globally will be 10.6 million cases, an increase of around 600,000 cases from 2020, which was estimated at 10 million TB cases. Of the 10.6 million cases, there are 6.4 million (60.3%) people who have been reported and undergoing treatment and 4.2 million (39.7%) other people have not been found or diagnosed and reported. TB can be suffered by anyone, of the total 10.6 million cases in 2021, at least 6 million cases are adult men, then 3.4 million cases are adult women and the other TB cases are children, namely 1.2 million cases. With an estimated number of TB cases of 824,000 in 2021, Indonesia is ranked third in the world (WHO Global TB Report 2021), one of the five countries with the largest number of TB cases in the world, which accounts for around 56% of the total number of TB cases in the world. Of this number, one third of cases are undetected. (7)

Based on the WHO Global Tuberculosis Report 2022, Indonesia is in second place (2nd) with the highest number of TB sufferers in the world after India, followed by China, the Philippines, Pakistan, Nigeria, Bangladesh and the Democratic Republic of Congo respectively. In 2020, Indonesia was in third place with the highest number of cases, so 2021 will clearly not be better. TB cases in Indonesia are estimated at 969,000 TB cases (one person every 33 seconds). This figure is up 17% from 2020, namely 824,000 cases. The incidence of TB cases in Indonesia is 354 per 100,000 population, which means that for every 100,000 people in Indonesia there are 354 people who suffer from TB. (8) In Indonesia the prevalence of pulmonary TB is grouped into 3 regions, namely Sumatra (33%), Java and Bali. (23%), Eastern Indonesia (44%), The death toll from pulmonary TB in Indonesia is estimated at 61,000 deaths each year (2)

Based on the performance report of the Indonesian Ministry of Health (Kemenkes RI) in 2021, it is known that there are still many health indicators that have not been achieved, one of which is the percentage of TB discovery, prevention and treatment coverage which has only been achieved at 35.2% of the target of 65% (9). TB is one of the deadliest infectious diseases in the world, namely an infectious disease caused by infection with the mycobacterium tuberculosis bacteria in the lungs. (10) Tuberculosis bacteria that attack the lungs can cause respiratory problems, such as chronic cough and shortness of breath. (11) According to the 2021 Ministry of Health report, there were 385,295 cases of TB found and treated in Indonesia throughout 2021. This number decreased by 2.04% from the previous year, namely 2020, when the number of TB cases found and treated was 393,323 cases. In ten years Lastly, the number of TB cases has a fluctuating trend. In 2011, for example, 321,308 cases of TB were discovered and treated. Then, the number tended to increase in each subsequent year until it reached 570,289 cases in 2018. New TB cases began to decline in 2019 to 568,997 cases. Then, the figure dropped again in 2020 to 393,323 cases and in 2021 to 385,295 cases. Entering the COVID-19 pandemic, efforts.

Non-compliance with treatment for pulmonary TB sufferers causes low patient recovery rates, high death rates and increased recurrence and what is more fatal is the occurrence of germ resistance to several anti-tuberculosis drugs or multi-drug resistance, so that pulmonary tuberculosis is very difficult to cure (13) Pulmonary TB disease can occur when

decreased body resistance. From an epidemiological perspective which views disease incidence as the result of interactions between the three components of host, agent and environment, risk factors can be studied from these nodes. On the host side, susceptibility to *Mycobacterium tuberculosis* infection is greatly influenced by a person's immune system at that time. (14) People with HIV AIDS or people with poor nutritional status are more easily infected and contract TB. (15)

The low recovery rate coverage has a negative impact on public health and the success of program achievements, because it still provides opportunities for transmission of pulmonary TB disease to family members and the surrounding community. (16) Apart from that, it is possible for pulmonary TB germs to become resistant to anti-tuberculosis drugs (OAT), thereby increasing the spread of pulmonary TB disease, increasing morbidity and mortality due to pulmonary TB. (17) Active TB sufferers also need to receive TB treatment. This treatment needs to be done regularly for at least 6 months. Treatment that is not completed or stopped midway can result in bacterial resistance to TB drugs, also known as MDR TB. (18)

To achieve healing, regularity or adherence to treatment is required for each sufferer. The combination of short-term OAT and the role of the Drug Swallowing Supervisor (PMO) is a strategy to ensure the patient's recovery. Even though the combination of drugs used is good, if the patient does not seek treatment regularly then the results of the treatment will generally be disappointing. (19)

Methods

This research is an analytical observational study with a case control design, namely an epidemiological research design to study the relationship between exposure levels and various disease states or other health problems. (14) This observation is based on observations of existing or existing disease events so that it is possible to analyze retrospectively there are two specific groups, namely the case group and the control group. The case group is the group that suffers from the disease or is affected by the consequences studied, while the control group is the group that does not suffer or is not affected by the consequences studied. The selection of the case group in this study was based on the presence of pulmonary TB events listed in the patient's medical record status, while the controls were based on the absence of pulmonary TB events selected from the same hospital, and in the same treatment year period. This data was then analyzed using Path Analysis to predict the incidence of pulmonary TB and determine the model of pulmonary TB incidence that best suits the increase in the incidence of pulmonary TB. (20) This research was carried out in the North Sumatra region, which is the province with the highest prevalence of pulmonary TB based on the diagnosis of health workers and the highest symptoms, namely 17.9%. To get case representation based on the profile of the North Sumatra Provincial Health Service, Bunda Thamrin Hospital and Adam Malik Hospital were chosen. This data collection was carried out in July – December 2023 (4).

Population and Sample

The population in this study were all pulmonary TB patients recorded in medical records at hospitals in 2023. Based on the profile of the North Sumatra provincial health service, there were 1698 confirmed cases of pulmonary TB in the city of Medan. The sample was patients at Bunda Thamrin Hospital and Hospital. Adam Malik using a non-random sampling technique, namely a purposive sampling technique, where samples are taken based on certain considerations made by the researcher himself, based on previously known characteristics or characteristics of the population. Determining the sample in this study uses the sample size formula for research control cases by estimating the Odds Ratio (OR) within 50% of the actual OR with 95% confidence where the sample size was

rounded up to 750 cases, with a ratio of 1:1, the number of controls was also 750 so the total sample size was 1500 cases.

Results and Discussion

Trend rate for Tuberculosis Cases or Case Notification Rate (CNR)

Case Notification Rate (CNR) is the number of all cases of tuberculosis treated and reported among 100,000 residents in a certain area. This figure, if collected serially, will illustrate the tendency (trend) of increasing or decreasing case detection from year to year.

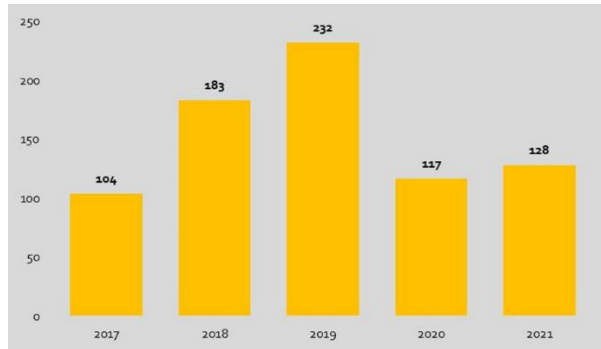


Figure 1. Notification Rates for All Tuberculosis Cases Per 100,000 Population 2017-2021

In 2021, the CNR (new cases) of BTA (+) pulmonary TB in North Sumatra Province is known to be 128 per 100,000 population, an increase compared to the CNR in 2020 which reached 117 per 100,000 population, and lower than the CNR in 2019 of 232 per 100,000 population.

Based on respondent characteristics

Table 1. Frequency Distribution based on Respondent Characteristics in the North Sumatra region

Respondent Characteristics	n	%
Gender		
Man	773	51,5
Woman	727	48,5
Age group (Years)		
10-19	2	,1
20-29	43	2,9
30-39	61	4,1
40-49	185	12,3
50-59	479	31,9
60-69	436	29,1
70-79	230	15,3
>=80	64	4,3
Education		
No school	159	10,6
SD	494	32,9
SLTP	164	10,9
SLTA	483	32,2
Diploma	43	2,9
S1	146	9,7

S2	11	,7
Work		
IRT	467	31,1
Civil servants	295	19,7
Private	222	14,8
Self-employed	66	4, ³
Farmer	114	7,6
Doesn't work	87	5,8
Retired	226	15,1
students/students	23	1,5
Marital status		
Marry	1416	94,3
Not married yet	79	5,3
Widow	4	,3
Widower	1	,1

Table 1. Shows that the incidence of pulmonary TB is more common in men, namely 53.5%, while in women it is 46.5%, in the age group 50 - 59 years, it is 32.1%, with elementary school education, namely 32.0%, with housewife work being 31.2%, and 94.7% being married. Based on the chi square test, it is known that gender, age group, education and marital status of respondents are homogeneous ($p>0.05$).

Bivariate Analysis

Table 2. Risk factors associated with confirmed pulmonary TB

House Density	Pulmonary TB				Amount		p	OR
	Case		Control		n	%		
	n	%	n	%				
Yes	581	77,5	344	45,9	925	61,7	0,000	4,06 3,25-5,07
No	169	22,5	406	54,1	575	38,3		
Amount	750	100	750	100	1500	100,0		

The results of statistical tests using chi square obtained a value of $p=0.000$ ($p<0.05$) which means there is a relationship between house density and the incidence of confirmed pulmonary TB with an OR value = 4.06 with a 95%CI of 3.25-5.07 meaning it is a factor. risk of pulmonary TB.

Table 3. Risk factors with confirmed disease history of pulmonary TB in North Sumatra in 2023

Disease History	Pulmonary TB				Amount		p	OR
	Case		Control		n	%		
	n	%	n	%				
Yes	171	22,8	117	15,6	288	19,2	0,001	1,60 1,23- 2,07
No	579	77,2	633	84,4	1212	80,8		
Amount	750	100	750	100	1500	100,0		

Source: Primary Data

The results of statistical tests using chi square obtained a value of $p=0.000$ ($p<0.05$) which means there is a relationship between disease history and confirmed incidence of pulmonary TB with an OR value = 1.60 with 95%CI 1.23-2.07 meaning it is a factor. risk of pulmonary TB occurrence. The OR value = 1.60 means that respondents who have a history of the disease will be at risk of experiencing pulmonary TB with a value of 1.6 times compared to respondents who have no history of the disease.

Table 4. Risk factors for smoking with confirmed pulmonary TB in patients in North Sumatra in 2023.

Smoke	Pulmonary TB				Amount		p	OR
	Case		Control		n	%		
	n	%	n	%				
Tall	117	15,6	78	10,4	195	13,0	0,004	1,60 1,17-2,16
Normal	633	84,4	672	89,6	1305	87,0		
Amount	750	100	750	100	1500	100,0		

Source: Primary Data

The results of statistical tests using chi square obtained a value of $p=0.003$ ($p<0.05$) which means there is a relationship between smoking and the incidence of pulmonary TB with an OR value = 1.60 with a 95%CI of 1.17-2.16 meaning smoking is a risk factor. incidence of pulmonary TB.

Table 5. Risk factors for household contacts with confirmed pulmonary TB in North Sumatra in 2023

Household Contact	Pulmonary TB				Amount		p	OR
	Case		Control		n	%		
	n	%	n	%				
Yes	208	27,7	131	17,5	339	22,6	0,000	1,81 1,42-2,32
No	542	72,3	619	82,5	1161	77,4		
Amount	750	100	750	100	1500	100,0		

Source: Primary Data

The results of statistical tests using chi square obtained a value of $p=0.000$ ($p<0.05$) meaning there is a relationship between household contact and the incidence of pulmonary TB with an OR value = 1.81 with a 95%CI of 1.42-2.32 meaning physical activity is a factor. risk of pulmonary TB incidence OR value = 1.81 means that respondents who have household contacts will have a risk of experiencing pulmonary TB 1.81 times compared to respondents who do not share the same household.

Table 6. Alcohol risk factors for confirmed pulmonary TB in North Sumatra in 2023

Alcohol	Pulmonary TB				Amount		p	OR
	Case		Control		n	%		
	n	%	n	%				
Yes	650	86,7	595	79,3	1245	83,0	0,000	1,69 1,29-2,23
No	100	13,3	155	20,7	255	17,0		
Amount	750	100	750	100	1500	100,0		

Source: Primary Data

The results of statistical tests using chi square obtained a value of $p=0.000$ ($p<0.05$) which means there is a relationship between alcohol and the incidence of pulmonary TB with an OR value = 1.69 with a 95%CI of 1.29-2.23 meaning that alcohol is a risk factor. incidence of pulmonary TB. The OR value = 1.69 means that respondents who consume alcohol will be at risk of experiencing pulmonary TB 1.69 times compared to respondents who do not consume alcohol.

Table 7. Pollution Risk Factors with confirmed pulmonary TB among respondents in North Sumatra in 2023

Pollution	Pulmonary TB				Amount		p	OR
	Case		Control		n	%		
	n	%	n	%				
Yes	416	55,5	287	38,3	703	46,9		2,00

No	334	44,5	463	61,7	797	53,1	0,000	1,64- 2,47
Amount	750	100	750	100	1500	100,0		

Source: Primary Data

The results of statistical tests using chi square obtained a value of $p=0.000$ ($p<0.05$) which means there is a relationship between pollution and the incidence of pulmonary TB with an OR value = 2.00 with a 95%CI of 1.64-2.47 meaning pollution is a risk factor. The incidence of pulmonary TB with an OR value = 2.0 means that respondents who are exposed to pollution will have twice the risk of experiencing pulmonary TB compared to respondents who are not exposed.

Table 8. Analysis of the relationship between physical environmental risk factors and confirmed pulmonary TB in patients in North Sumatra in 2023

Physical Environment	Pulmonary TB				Amount		P	OR
	Case		Control		n	%		
	n	%	n	%				
Good	148	19,7	83	11,1	231	15,4	0,000	1,98
No	602	80,3	667	88,9	1269	84,6		1,48-
Amount	750	100	750	100	1500	100,0		2,64

Source: Primary Data

The results of statistical tests using chi square obtained a value of $p=0.000$ ($p<0.05$) which means there is a relationship between the physical environment and the incidence of pulmonary TB with an OR value = 1.98 with a 95%CI of 1.48-2.64 meaning the physical environment is Risk factors for confirmed pulmonary TB with an OR value = 1.98 means that respondents who have an unhealthy physical environment will be at risk of being confirmed as TB 1.98 times compared to respondents who have a good physical environment.

Table 9. Factors that most influence confirmed pulmonary TB in patients

Variable	B	Wald	p	OR	95% CI
House density	1,200	100,564	0,000	3,32	2,63-4,20
Disease History	0,303	5,406	0,036	1,35	1,02-1,80
Smoke	0,195	1,326	0,250	1,22	0,87-1,70
Physical Activity	0,509	14,096	0,000	1,66	1,28-2,17
Alcohol	0,443	8,405	0,004	1,56	1,15-2,10
Pollution	0,487	18,324	0,000	1,63	1,30-2,03
Physical environment	0,468	8,640	0,003	1,60	1,17-2,18
Constant	-5,591	89,109	0,000		

Source: Primary Data

Table 9 shows that the results of the logistic regression test show that the risk factor for transmission of pulmonary TB is housing density with an OR = 3.32.

Path Analysis of Confirmed Risk Relationship to Pulmonary TB Transmission

The relationship between confirmed risk factors and pulmonary TB transmission was analyzed using path analysis. The results of path analysis on the relationship between exogenous variables and the incidence of pulmonary TB showed a significant relationship between several variables ($p < 0.05$), while the variables that were not significant were smoking and history of the disease ($p > 0.05$). For more details, see the image below.

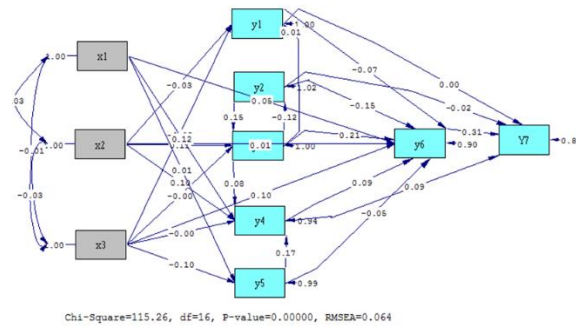


Figure 2. Risk Factor Analysis Model that influences confirmed pulmonary TB

Shows that the results of the path analysis of the occurrence of pulmonary TB show that the variables that influence the causes of pulmonary TB are house density, disease history, physical environment. Because all the variables were significant in the incidence of pulmonary TB, no variables were excluded so that the model causing the occurrence of pulmonary TB did not change, but the paths created were based on existing theory, many of which were not significant.

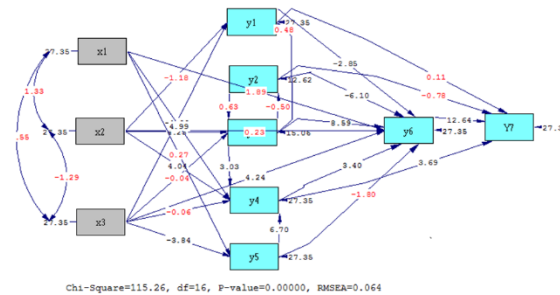


Figure 3. Factors causing confirmed pulmonary TB using the t test

Based on the t test analysis, it shows that the variables associated with pulmonary TB are smoking, history of disease, pollution and physical environment ($t > 1.96$), while physical activity, history of disease and stress are not related to pulmonary TB ($t < 1.96$). . Meanwhile, factors associated with confirmed pulmonary TB were house density and physical environment, while disease history and smoking were not associated with confirmed pulmonary TB ($t < 1.96$).

Discussion

Tuberculosis is one of the oldest diseases in humans caused by the bacterium *Mycobacterium tuberculosis* which was discovered by Robert Koch (Barberis, Bragazzi, et al, 2017). This disease generally attacks the lungs and about a third of TB cases also attack other organs. Almost all cases of TB that are treated adequately will be cured. Meanwhile, untreated cases will become fatal within 5 years. The spread of TB disease is generally through the air, originating from the coughing or sneezing of active TB sufferers.

Patients with smear positive TB are a source of transmission of tuberculosis. Coughing or sneezing from TB patients will spread germs into the air in the form of droplet nuclei (sputum splashes). Approximately 3000 splashes of phlegm are produced during one cough. Splashes of phlegm that remain in a room for a long time will facilitate the transmission of TB disease. The number of splashes can be reduced by providing adequate ventilation or air flow and *Mycobacterium tuberculosis* germs will die when exposed to direct sunlight. In dark and damp conditions, splashes of phlegm can last for several hours. A person can contract tuberculosis, apart from being determined by the concentration of germs inhaled, the length of time the germs are inhaled, the virulence of the germs, age is

also influenced by the state of the person's genes. Not all germs that enter the body can cause illness, this depends on the body's vulnerability as a result of the interaction of several factors in the body, for example nutritional status, immunization, housing density and the individual's genes.

Pulmonary TB, is a type of TB where bacteria are found in the lungs. This shows that there is a danger of spreading it more easily to other people because every infected person exhales, coughs and laughs. According to the Ministry of Health of the Republic of Indonesia (2018), (23) Mycobacterium as the cause of tuberculosis can attack everyone depending on risk factors for complications, namely patients with disorders that weaken the immune system, people who have close contact with active TB sufferers, people who live or work in densely populated areas. population, those who have little to no access to adequate health services, Users of illegal drugs and alcohol, People who travel to areas where TB cases are endemic. (23) The risk of being infected with TB is mostly external risk factors, especially are environmental factors such as unhealthy houses, dense housing and slums. Meanwhile, the risk of becoming ill with TB is mostly internal factors in the sufferer's own body which are caused by disruption of the immune system in the sufferer's body such as malnutrition, infection, treatment with immunosuppressants (14).

One of the pillars of overcoming tuberculosis with the DOTS strategy is finding cases as early as possible. This is intended to make the treatment of sufferers more effective and avoid transmission from contact people which is a subclinical infection. (24) Factors that influence the health of individuals, groups and communities are grouped into 4, namely: environment (including physical, social, cultural, political, economic and so on), behavior, health services and heredity. These four factors in influencing health do not stand alone, but each influence each other. Environmental factors besides directly influencing health also influence behavior, and the opposite behavior also influences (3)

The source of infection is BTA positive tuberculosis sufferers, when they cough or sneeze, the sufferer spreads germs into the air in the form of droplets (sputum splashes). Several factors that cause the spread of the disease are the bad habits of pulmonary TB patients who spit carelessly. (3) Apart from that, environmental cleanliness can also influence the spread of the virus. For example, a house that does not have good ventilation. (23) Humid conditions due to lack of smooth air and sunlight changes can help viruses reproduce. Therefore, healthy people who share a household with pulmonary TB sufferers are a group that is very vulnerable to transmission of the disease. (25). The home environment, length of household contact and preventive behavior by both sufferers and susceptible people greatly influence the transmission process of pulmonary TB disease. The characteristics of rural areas are a separate determinant of the incidence of TB disease. (26)

Conclusions

The most dominant risk factor of all that influences confirmed pulmonary TB is house density with 3.32 times compared to other risk factors. The most effective prevention model for reducing the incidence of pulmonary TB is by modifying the risk factors of alcohol, physical environment and housing density.

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