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# RELATIONSHIP BETWEEN HOST AND ENVIRONMENTAL FACTORS WITH PULMONARY TUBERCULOSIS CASES

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***Abstract :*** In 2021, Pamarican Public Health Center had the 2nd highest number of pulmonary tuberculosis/TB cases in the Ciamis Regency, Indonesia. This study aimed to analyze the relationship between host and environmental factors and pulmonary TB cases in Pamarican Public Health Center. This study used a case-control design. The case population was pulmonary TB patients at the Pamarican Public Health Center in 2021 - July 2022. The control population was people who had been confirmed negative for pulmonary TB at the Pamarican Health Center in 2021 – July 2022. A sample of 34 cases was taken using the total sampling technique. The purposive sampling technique took 68 controls. Independent variables included host variables consisting of smoking status and history of household contact, as well as environmental variables, including occupancy density and floor of the house. The dependent variable was the case of pulmonary TB. Data on smoking status and household contact history were collected through interviews. Data regarding house floor were collected through observation. In contrast, occupancy density were measured using a roll meter and interviews. Data analysis included univariate and bivariate analysis using the chi-square test. The study's results showed a significant relationship between the history of household contact ($p = 0.000$, OR = 9.905) and cases of TB. Meanwhile, the variables of smoking status, residential density, and house floor were not related to cases of pulmonary tuberculosis ($p>0.05$). A history of household contacts has been proven to be a determining factor in pulmonary tuberculosis cases.

Keywords: environment, host, pulmonary tuberculosis, Indonesia

## INTRODUCTION

Currently, tuberculosis, or TB, is still a public health problem in countries around the world. TB is an infectious disease that caused the 2nd highest death rate after COVID-19 (above HIV/AIDS). Based on the 2021 WHO report, in 2020, 30 countries with a high TB burden contributed to 86% of TB incidents. A total of 8 countries contribute 2/3 of all TB cases in the world, namely India, China, Indonesia, the Philippines, Pakistan, Nigeria, Bangladesh and South Africa [1].

Pulmonary TB cases in 2020 in Indonesia were 393,323 cases. Based on 2018 Basic Health Research (Riskesdas) data, West Java Province is the province with the highest prevalence of TB cases in Indonesia, namely 186,809 cases, and the first province with the highest number of TB sufferers in Indonesia with a TB prevalence rate of 0.7% higher than the national average of 0.4%. In 2020, 79,840 TB cases were reported, a decrease of 27.06% compared to 2019, which had 109,896 cases. The TB case notification rate per 100,000 population in 2019-2020 has decreased. In 2019, it was 221 per 100,000 people; in 2020, it was 161 per 100,000. The number of TB suspects who received services according to standards was 248,896 cases [2].

Ciamis is one of the regencies in West Java Province, which had 1,793 cases of pulmonary TB based on the results of Riskesdas in 2018. In 2021, the Pamarican Community Health Center had the 2nd highest number of TB cases in Ciamis Regency. Pamarican Community Health Center recorded that 331 suspects underwent sputum and phlegm examination, and 38 cases were treated in 2021 [3].

Pulmonary TB is an infectious disease that can be influenced by various factors, especially host or individual and environmental factors. The results of a review carried out by Pralambang and Setiawan of articles or journals for the last ten years and available in online databases show that there is a history of contact with TB sufferers and a family size of more than five people, smoking habits are a risk factor for the incidence of TB. Based on environmental factors, research conducted by Wulandari et al. and Andas et al. shows that the type of house floor [4] and the density of house occupancy [4]·[5] are risk factors for pulmonary TB.

The results of research [6] at the Perak Timur Surabaya Community Health Center showed that the physical condition of the house included room temperature ($p=0.009$; OR=8.300) and room humidity ($p=0.000$; OR=7.600), then the family history of

tuberculosis sufferers. (p=0.018; OR=6.000) influences the incidence of tuberculosis in children under five. The results of a literature review [7] show that factors that influence the incidence of TB infection from host factors include age, income level (socioeconomic), housing conditions, behavior of opening windows every morning, smoking, and history of contact with TB sufferers. Research conducted by [8] shows that low family income, alcohol consumption, and smoking are contributors to the occurrence of TB in India.

The results of research [9] in Kendari, where Kendari City is the area with the highest number of pulmonary tuberculosis cases in Southeast Sulawesi Province, show an increase in prevalence from year to year. Preliminary data at the Perumnas Community Health Center shows that there were 49 cases of Pulmonary Tuberculosis in 2019. The research aimed to determine the risk factors for the incidence of Pulmonary Tuberculosis in the Perumnas Health Center Working Area. This research uses a Case-Control design. The study population consisted of 105 sufferers, with a sample consisting of 44 case samples and 44 control samples taken using simple random sampling. Data collection uses a questionnaire. Data analysis used the Chi-Square and Odds Ratio tests. From the results of statistical tests, the significance and Odds Ratio of each variable were obtained, namely smoking habits (p-value=0.001; OR =5.156), contact history (p-value=0.000; OR=8.333), residential density (p-value=0.027; OR=2.544), knowledge (p-value=0.005; OR=3.852) and ventilation (p-value=0.019; OR=3.071). This study concludes that smoking habits, contact history, residential density, knowledge, and ventilation are risk factors for the incidence of pulmonary tuberculosis at the Perumnas Community Health Center. Therefore, it is recommended that health workers at community health centers continue to provide health promotions to increase knowledge regarding preventing the transmission of pulmonary tuberculosis and the correct way to cough and encourage patients to stop smoking.

## NEED OF THE STUDY.

The aim of this research was to analyze host and environmental factors associated with the pulmonary TB cases in the working area of the Pamarican Health Center.

## RESEARCH METHODOLOGY

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study,Data and Sources of Data, study's variables and analytical framework. The detailsare as follows;

### 3.1 Population and Sample

The case population in this study was 34 pulmonary TB sufferers at the Pamarican Community Health Center in 2021 – July 2022. Meanwhile, the population in the control group was people who had been confirmed negative for pulmonary TB based on the results of microscopic tests at the Pamarican Health Center in 2021 – July 2022, totaling 416 people. The sample in this study was 34 cases and 68 controls. Samples for the case group were taken using a total sampling technique, while for the control group, purposive sampling was used.

### 3.2 Data and Sources of Data

The data used in this research was primary data collected directly by researchers. Data regarding smoking status variables and household contact history were collected through interviews using questionnaire instruments, and data regarding house floor variables were collected through observation. Residential density variables were measured using roll meters (to calculate floor area) and interviews (to determine the number of occupants in the room).

### 3.3 Theoretical framework

This observational analytical research used a case-control study design. Independent variables in this study include host variables consisting of smoking status and history of household contact, as well as environmental variables, including residential density and house floor. The dependent variable studied was pulmonary TB cases.

The smoking habit variable shows the respondent's habit of consuming cigarettes, which is divided into two categories, namely smoking and non-smoking. The household contact history variable is whether there is a history of contact with TB sufferers in the same household. This variable is then divided into two categories; namely, there is contact, and there is no contact. The residential density variable is the ratio of the bedroom area to the number of people sleeping in that bedroom. Based on the Decree of the Minister of Health of the Republic of Indonesia No.829/Menkes/SK/VII/1999, residential density is categorized into 2, namely not meeting the requirements, if < 9 m2/person and meeting the needs, if $\geqslant$ 9 m2/person. The house floor variable is the part of the building that is limited by walls for activities to be carried out and used according to its function. Based on the Decree of the Minister of Health of the Republic of Indonesia No.829/Menkes/SK/VII/1999, the floor of a house is categorized into 2, namely not meeting the requirements, if the floor is not watertight and is not easy to clean and meeting the requirements if the floor is waterproof and easy to clean.

### 3.4Statistical tools and econometric models

This study's data analysis includes univariate and bivariate analyses.

#### 3.4.1 Univariate Analysis

Univariate analysis aims to describe each variable studied, namely independent variables including host variables consisting of smoking status and history of household contact, as well as environmental variables, including residential density and house floor, and the dependent variable studied was pulmonary TB cases.

### 3.4.2 Bivariate Analysis

Bivariate analysis was carried out to determine the relationship between the independent variable and the dependent variable. Bivariate analysis in this study used the chi square statistical test.

## RESULTS AND DISCUSSION

### 4.1 Results of Descriptive Statics of Study Variables

The results of the univariate analysis of the independent variables studied are shown in Table 1. Table 1 shows that in the case group, there were the same number of respondents who smoked and did not smoke (50%), while in the control group, there were more respondents who smoked (53.9%). In the case group, most respondents had no history of contact with TB sufferers (61.8%); in the control group, the majority had no history of contact with TB sufferers (94.1%). For the residential density variable, both the case and control groups mostly had housing densities that met the requirements (the percentages were 79.4% and 92.6%, respectively). For the house floor variable, in both the case group and the control group, most respondents had houses with sufficient ventilation area for the house (the percentages were 85.3% and 94.1%, respectively).

**Table 1. Distribution of Respondents Based on Smoking Status, Residential Density, House Floor and Contact History in the Pamarican Health Center Work Area**

| Variable | Category | Pulmonary TB Cases | | | |
|---|---|---|---|---|---|
| | | Case | | Control | |
| | | f | % | f | % |
| Smoking Habit | Smoking | 17 | 50 | 38 | 53.9 |
| | No smoking | 17 | 50 | 30 | 46.1 |
| Household Contact History | Contact | 13 | 38.2 | 4 | 5.9 |
| | No contact | 21 | 61.8 | 64 | 94.1 |
| Residential Density | Not eligible | 7 | 20.6 | 5 | 7.4 |
| | Eligible | 27 | 79.4 | 63 | 92.6 |
| House Floor | Not eligible | 5 | 14.7 | 4 | 5.9 |
| | Eligible | 29 | 85.3 | 64 | 94.1 |

**Table 2. Bivariate Analysis of Independent Variables with the Incidence of Pulmonary TB in the Working Area of the Pamarican Health Center**

| Variable | Category | Pulmonary TB Cases | | | | *p value* | OR 95% CI |
|---|---|---|---|---|---|---|---|
| | | Case | | Control | | | |
| | | f | % | f | % | | |
| Smoking Habit | Smoking | 17 | 50 | 38 | 53.9 | 0.725 | - |
| | No smoking | 17 | 59 | 30 | 46.1 | | |
| Household Contact History | Contact | 13 | 38.2 | 4 | 5.9 | 0.000 | 9.905 |
| | No contact | 21 | 61.8 | 64 | 94.1 | | (2.912-33.692) |
| Residential Density | Not eligible | 7 | 20.6 | 5 | 7.4 | 0.099 | - |
| | Eligible | 27 | 79.4 | 63 | 92.6 | | |
| House Floor | Not eligible | 5 | 14.7 | 4 | 5.9 | 0.156 | - |
| | Eligible | 29 | 85.3 | 64 | 94.1 | | |

Based on the results of the bivariate analysis shown in Table 2, it is known that only one independent variable is significantly related to the incidence of pulmonary TB, namely contact history, with a p-value of 0.000. The OR value obtained was 9.905, meaning that respondents who had a history of household contact with pulmonary TB sufferers had a 9.905 times greater risk of suffering from pulmonary TB compared to respondents who had no history of household contact with pulmonary TB sufferers. Meanwhile, the variables of smoking status, residential density, and house floor were not significantly related to the incidence of pulmonary TB ($p > 0.05$).

DISCUSSION

The results of bivariate analysis showed that there was no significant relationship between smoking status and the incidence of pulmonary TB. The results of this study are different from research conducted in Ethiopia, which showed that people who had a smoking habit had a 4.43 times risk of developing pulmonary TB compared to people who did not smoke (95% CI: 2.10, 9.3) [10]. Chemicals in cigarettes and inhaled acids that enter the body can damage the respiratory tract, including the lung defense mechanism. This damage is because vibrating bristles and other materials cannot easily remove infections that have entered the

lungs. These vibrating feathers function as a filter for dust or foreign particles that enter when we inhale. Because the vibrating hairs are falling out, there is no longer a filter for dust or foreign particles, so air that is not necessarily clean can disrupt mucociliary cleanliness and decrease the function of alveolar macrophages for phagocytosis. In addition, cigarette smoke can reduce the response to antigens so that if a foreign object enters the lungs, it is not quickly recognized and fought. Weakened lung function causes the lungs to be unable to fight TB germs and makes the disease worse due to failure of sputum convention [11]. In addition, biological explanations describe impaired clearance of mucosal secretions, decreased phagocytic ability of alveolar macrophages, and decreased immune response and CD4+ lymphopenia due to cigarette nicotine content as reasons for increased susceptibility to pulmonary tuberculosis [12].

The habit of smoking cigarettes is an important factor that can reduce a person's immune system so that they are susceptible to diseases, including pulmonary TB. However, this research shows different results. This difference can be interpreted as meaning that, in this case, smoking is not a factor that influences the incidence of pulmonary TB in the working area of the Pamarican Health Center. Multiple factors can cause pulmonary TB, so other factors may significantly affect the incidence of pulmonary TB. This is because the majority of respondents are non-smokers or passive smokers. Apart from active smoking, passive smoking is also a factor that plays a role in the development of pulmonary TB. Exposure to cigarette smoke, especially in the household, is important to avoid to prevent respiratory complaints in children or other adults. No relationship was found between the habit of smoking and the incidence of pulmonary TB in this study because, in the female group, there were 50% smoked. In contrast, in the control group, the proportion of people who smoked was more significant, namely 55.9%. Based on the results of interviews in the field, information was also obtained that the majority of respondents had smoked since they were teenagers (12-17 years), and respondents who suffered from pulmonary TB admitted that it had been more than six months since they were diagnosed with pulmonary TB, reducing the number of cigarettes and even quitting smoking for health reasons. The results of this study are linear with the study conducted in Wonogiri Regency [13] and research in Sleman Regency [14], which stated that there was no relationship between smoking status and the incidence of pulmonary TB with a value ( $p > 0.05$).

From the results of the bivariate analysis, it can be seen that there is a significant relationship between the history of household contact and the incidence of pulmonary TB. The OR value obtained was 9.905, meaning that respondents who had a history of household contact with pulmonary TB sufferers had a 9.905 times greater risk of suffering from pulmonary TB compared to respondents who had no history of household contact with pulmonary TB sufferers. These results align with research conducted by Fitriani at Ketanggungan Health Care Center [15] and Pangaribuan [16] and Oktavia's research at the Kertapati Health Center, Palembang ($p < 0.05$) [17].

The results of the univariate analysis showed that more respondents had a history of contact with pulmonary TB sufferers in the case group compared to the control group. Based on the results of interviews with respondents, some respondents suffered from pulmonary TB with positive BTA and transmitted it to another family member, with examination results showing positive BTA sputum test results as well. According to the time of diagnosis of pulmonary TB in the case group, some respondents were exposed to family members who previously had pulmonary TB before 2021, and some respondents infected other family members after being diagnosed with TB, so they started getting sick in 2022.

Household contact is a family member who lives in the same house and is known to suffer from pulmonary TB with BTA (+) sputum. Every single positive BTA will infect 10-15 other people, so every person who comes into contact with a pulmonary TB sufferer may have a risk of contracting pulmonary TB of 17%. The results of other studies report that close contacts (for example, family members from the same household) are twice as likely to be infected with pulmonary TB compared to casual contacts (not in the same house) [18].

A patient with BTA (+) with a high positive degree has the potential to transmit the disease. On the other hand, sufferers with BTA (-) are considered not contagious. In Indonesia, this figure is 1-3%, which means that among 100 residents, there are 1-3 people infected with pulmonary TB. half had BTA positive (0.5%) [18]. This condition is further exacerbated if family members in the same house have bad habits such as throwing phlegm anywhere and coughing/sneezing without covering their mouths. Based on research in Kendal Regency [4], the habit of expelling phlegm in any place ($p = 0.016$; OR = 4.402) and the practice of coughing/sneezing without covering the mouth ($p < 0.001$; OR = 9.137) are related. Significant impact on the incidence of pulmonary TB. The results of his research also prove the theory that sufferers of BTA (+) pulmonary tuberculosis have the potential to infect other people.

The source of tuberculosis transmission is BTA (+) pulmonary tuberculosis sufferers [4]. The method of transmission is through saliva splashes when BTA (+) pulmonary TB sufferers talk, sing, cough, or sneeze [19]. n this condition, thousands of M. tuberculosis bacteria scatter with the sufferer's breath "droplets." Air contaminated with Mycobacterium tuberculosis bacteria is sufficient as a medium for transmitting tuberculosis to other people. BTA (+) pulmonary tuberculosis patients can infect around ten people per year [4]. Considering that the transmission of this disease is due to contact with phlegm or inhaling water droplets from sneezing or coughing from people infected with TB germs, people in Indonesia need to be aware that if they are diagnosed with TB, they need to be careful when interacting with other people so as not to cough carelessly. Throwing saliva carelessly and it is highly recommended to be willing to wear a mask or at least a handkerchief or tissue [20].

The bivariate analysis results showed no significant relationship between residential density and the incidence of pulmonary TB in the working area of the Pamarican Health Center in 2021. Research in the Sindang District area showed different results because a relationship was found between residential density and the incidence of pulmonary TB, with a p-value = 0.000; OR = 0.179 [21].

Residential density is the ratio of the floor area of a house to the residents inside. The floor area of the building must be adjusted to the number of occupants to avoid overload. Besides obstructing air circulation, namely the exchange between oxygen and carbon dioxide, overload can also cause the easy transmission of infectious diseases to other family members [14].

According to the Decree of the Minister of Human Settlements and Regional Infrastructure Number 403/KPTS/M/2002, the space requirement per person is 9 m2/person. Residential density is calculated by dividing the floor area of the house by the number of family members. The dense number of residents allows for more frequent contact between pulmonary TB sufferers and other family members, thus accelerating the transmission of the disease. [22].

In the results of this study, no relationship was found between residential density and the incidence of pulmonary TB. This is because the research results show that more respondents with residential densities meet the requirements in both the case and control groups than respondents with residential densities that do not meet the criteria. This was supported when researchers conducted observations of the respondents' houses; generally, they found that the condition of the houses was relatively large, and the number of residents in the houses was only small. Most residential densities have met the requirements based on research in the field. Most houses in villages are relatively large, and only a few people live in them, which is different from the size of the houses. Based on the results of interviews in the field, most respondents already have separate residences from their parents and children.
Other factors may be more influential, so even though you have a residential density that meets the requirements, it is still possible to get pulmonary TB disease. Based on the epidemiological triangle theory (host, agent, environmental), apart from environmental conditions, host and agent factors can also influence the incidence of pulmonary TB. Host factors that can affect are the condition of the respondent's immunity and living habits. Meanwhile, the influencing agent factor is the presence of household contacts [23].

This research is in line with a study conducted at the Depok 3 Community Health Center, Sleman Regency [14], and research in Wori Village, Wori District [24], which stated that residential density has no relationship with the incidence of pulmonary TB with a value of ($p > 0.05$). So, residential density is not the main factor in the incidence of pulmonary TB. A combination of other environmental factors and good human factors is needed to prevent transmission of pulmonary TB disease.

From the results of the bivariate analysis, it can be seen that there is no significant relationship between the floor of the house and the incidence of pulmonary TB in the working area of the Pamarican Health Center in 2021. The results of this study are not in line with research in Kendal Regency, which found that the condition of the floor of the house that did not meet the requirements was a risk factor for the occurrence of TB. Lung, with a p-value of 0.016 and OR=5.266 (95% CI=1.356 to 20.446) [4].

According to the Decree of the Minister of Health of the Republic of Indonesia Number 829/Menkes/SK/VII/1999 concerning Housing Health Requirements, the type of floor that meets health requirements is a floor that is waterproof and easy to clean, such as ceramics, plaster and tiles, a minimum height of 10 cm from the yard and 25 cm from the road, for stilt houses it can be made of planks or woven bamboo. The floor is made of non-slip material, so the danger of falls and mechanical accidents can be avoided. The type of dirt floor plays a role in the incidence of pulmonary TB because it produces damp conditions. In summer, the floor becomes dry, creating dangerous dust for the occupants [25].

The study's results did not find a significant relationship between the type of floor of the house and the incidence of pulmonary TB. This is because the study results showed that more house floors met the requirements in the case and control groups than those that did not meet the criteria. This was supported when the researcher made observations of the respondents' houses regarding the types of floors in the respondents' houses; on average, they met the requirements, such as ceramic, plaster, and tile.
Based on research in the field, most of the floor types in respondents' houses met the requirements. Several respondents have realized the importance of installing tiles or ceramics or plastering the house floor to prevent dust buildup in the house and make it easy to clean. Therefore, the condition of the house floor is not the main factor in this study's incidence of pulmonary TB. A combination of other environmental factors and good human factors is needed to prevent transmission of pulmonary TB disease.
This research is in line with a study conducted in the Pekalongan Health Center Work Area, East Lampung Regency [26], and research in the Bandarharjo Health Center, Semarang City [27], which said that there was no relationship between types floor with TB incidence with a p-value> 0.05.

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