

## RELATIONSHIP BETWEEN PHYSICAL REQUIREMENTS OF HOUSES AND RESIDENTIAL DENSITY WITH THE INCIDENCE OF PULMONARY TUBERCULOSIS ON THE BANKS OF THE BARITO RIVER

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### ABSTRACT

**Relationship Between Physical Requirements Of Houses And Residential Density With The Incidence Of Pulmonary Tuberculosis On The Banks Of The Barito River.** Tuberculosis is an infectious disease and one of the world's 20 leading causes of death. Marabahan Health Centre for TB's working area consistently records the highest cases in the Barito Kuala district, with most of the population residing along the densely populated river. The study's goal was to determine the relationship between the physical requirements of the house, occupancy density, and the incidence of pulmonary tuberculosis on the banks of the Barito River. This research was an analytical observational study using a case-control method. The sample size in this study was 1:2, with 15 cases and 30 controls, for a total of 45 samples. The sampling technique used was purposive sampling. Statistical analysis used the chi-square test and the odds ratio test for risk factors. The results of the chi-square statistical test showed a relationship between the physical requirements of the house and the incidence of pulmonary tuberculosis in the Barito riverbanks, Barito Kuala Regency, in 2023. Results Odd's ratio analysis showed that the variable temperature is 20 times, the humidity is 13 times, the lighting is 18 times, and the occupancy density is 11 times the risk of developing pulmonary tuberculosis. People can get used to opening windows in the morning and not accumulate unused items in their rooms.

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### INTRODUCTION

Health problems are very complex problems that are interconnected with other problems outside of health itself. Many factors influence health, both individual and public [1]. The environment is made up of physical and non-physical elements. The physical environment includes geographic conditions, air humidity, temperature, and the living environment [2]. The home environment encompasses both the interior and exterior requirements of the house. Inside the house, physical requirements relate to temperature, humidity, lighting, etc. Besides that, the house's physical requirements are related to the presence of microorganisms, viruses, and bacteria.

Tuberculosis is an infectious disease caused by the bacterium *Mycobacterium tuberculosis*. After HIV/AIDS, tuberculosis remains the leading cause of death.

One of the 20 leading causes of death worldwide is pulmonary tuberculosis [3]. It shows that the variables temperature, humidity, residential density, and lighting are related to the incidence of pulmonary tuberculosis, and the variable residential density is the most dominant [4].

In the research results, there is a relationship between humidity, lighting, and residential density and the incidence of pulmonary TB. Residential density is a risk factor for pulmonary TB incidence, as it increases the risk of pulmonary TB by 6.2 times [5]. Research results show a significant relationship between housing density and the incidence of tuberculosis [6].

Barito Kuala district was in second place out of 13 districts and cities in 2019; in 2021, it experienced another increase of 248 cases [7]. In 2021, the Marabahan Community Health Centre, particularly the area on the banks of the Barito River, had the highest number of TB cases in the Barito Kuala district [8]. In addition, most people live on the Barito River in densely populated settlements.

Based on the description above, this research aims to determine the relationship between the physical requirements of houses and residential density, as well as the incidence of pulmonary tuberculosis on the banks of the Barito River in Barito Kuala Regency in 2023.

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## **MATERIALS AND RESEARCH METHODS**

This analytical observational research aims to prove whether there is a relationship between the physical requirements of houses and residential density and the incidence of pulmonary tuberculosis on the banks of the Barito River in Barito Kuala Regency [9]. The research design used a case-control method to test specific hypotheses about the relationship between exposure to risk factors in the past and the onset of disease [10]. The study included independent variables such as temperature, humidity, lighting, and residential density, while the dependent variable was the incidence of pulmonary tuberculosis. The research was carried out in the working area of the Marabahan Community Health Centre, especially on the banks of the Barito River, from January to March 2023, with a total population of 15 people who were responding to pulmonary tuberculosis sufferers registered at the Marabahan Community Health Centre as new cases in 2022. Meanwhile, the sample size examined had a case-control ratio of 1:2. Because there were fewer than 100 cases, 15 people were taken as samples, along with 30 control samples for a total of 45 samples.

The sampling technique used in the research is purposive sampling, which is based on certain considerations with the control sample [11]. In this case, the respondent is not a pulmonary tuberculosis sufferer whose house is located either to the right or left of the case sample house, or who is still in the same area. This is because they have a higher risk of contracting or being exposed to the disease, share the same age and gender characteristics, and are willing to participate as respondents. Data was collected using measuring instruments and measurement sheets. Measurements were carried out in the bedroom in the house on a sunny day from 09.00 to 14.00 WITA.

Based on Republic of Indonesia Minister of Health Decree No. 1077/Menkes/Per/V/2011's guidelines for indoor air health, the collected data were analysed in a descriptive way. For example, the temperature meets the requirements if the readings are between 18°C and 30°C, but not if they are below 18°C or above 30°C. Humidity meets the requirements if the measurement results range between 40% and 60%, and does not meet the requirements if they range between <40% and >60%. Lighting meets requirements if it ranges between 60 and 100 lux, and does not meet requirements if it is <60 or >100 lux [12].

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## **RESEARCH RESULTS AND DISCUSSION**

The following table displays the results of measurements taken on the banks of the Barito River:

Table 1 Frequency distribution of house temperatures on the banks of the Barito River

|   | Temperature  | Frequency | %    |
|---|--------------|-----------|------|
| 1 | Qualify      | 28        | 62.2 |
| 2 | Not eligible | 17        | 37.7 |
|   | Total        | 45        | 100  |

Table 1 reveals that of the 45 respondent houses, 28 (62.22%) met the requirements for house temperature, while 17 houses (37.78%) did not, with a minimum measurement of 18°C and a maximum of 30°C. In the results of the measurements carried out, there were several respondent houses that did not meet the requirements with temperature values above 30 °C. This is also influenced by disturbing variables such as floor type, wall type, and the presence of ceilings, which can result in the temperature in the house not meeting the requirements.

Table 2 Frequency distribution of humidity in houses on the edge of the riverI barito

| No. | Humidity     | Frequency | %     |
|-----|--------------|-----------|-------|
| 1   | Qualify      | 26        | 57.77 |
| 2   | Not eligible | 19        | 42.23 |
|     | Total        | 45        | 100   |

Table 2 shows that of the 45 respondent houses that met the requirements for house humidity, 26 (57.77%) did not meet the requirements for house humidity, namely 19 houses (42.23%) with a minimum measurement of 40% and a maximum of 60%. In the results of the measurements carried out, there were several respondent houses that did not meet the requirements with humidity values above 60%. This is also influenced by the respondent's house; if the room they live in is not cleaned every day, it will become damp, and unused items will pile up in the room.

Table 3 Frequency distribution of house lighting on the banks of the Barito River

| No. | Humidity     | Frequency | %   |
|-----|--------------|-----------|-----|
| 1   | Qualify      | 18        | 40  |
| 2   | Not eligible | 27        | 60  |
|     | Total        | 45        | 100 |

Table 3 reveals that of the 45 respondent houses that met the requirements for home lighting, 27 (60%) did not, and 18 houses (40%) did not meet these requirements. The minimum measurement for home lighting was 60 lux, while the maximum was 100 lux. The majority of the measurement results had lighting values below 60 lux. This is due to a lack of lighting in the house; there are no windows or ventilation.

Table 4 frequency distribution of residential density on the banks of the Barito river

| No. | Humidity     | Frequency | %     |
|-----|--------------|-----------|-------|
| 1   | Qualify      | 21        | 46.67 |
| 2   | Not eligible | 24        | 53.33 |
|     | Total        | 45        | 100   |

Table 4 shows that of the 45 respondent houses that met the requirements for residential density, 21 (46.67%) and those that did not meet the requirements for residential density

were 24 houses (53.33%). There are more respondents who do not meet the requirements than those who do. This also means that in one house, there are several heads of families.

**Table 5 Analysis of the Incidence of Pulmonary Tuberculosis Based on House Temperature**

| No | house temperature | Pulmonary tuberculosis |      |         |       |
|----|-------------------|------------------------|------|---------|-------|
|    |                   | case                   |      | Control |       |
| 1  | Not eligible      | 12                     | 80%  | 5       | 16.7% |
| 2  | Qualify           | 3                      | 20%  | 25      | 83.3% |
|    | Amount            | 15                     | 100% | 30      | 100%  |

Table 5 displays the results of the chis square test, which revealed that  $p = 0.000 < \alpha = 0$ . Therefore, we reject the null hypothesis; we have statistically proven a correlation between the physical temperature requirements of houses and the incidence of pulmonary tuberculosis on the banks of the Barito River, Barito Kuala Regency in 2023. The results of the analysis using the Odd Ratio test show that houses with temperatures that do not meet the requirements have a 20-fold increased risk of contracting pulmonary tuberculosis. The incidence of pulmonary tuberculosis is negatively impacted by temperatures that do not meet the requirements, as many windows in the house remain closed during the day, with only a small percentage, such as those in the living room and kitchen, opening for ventilation. In addition, apart from that, the houses of pulmonary TB cases with measurement results did not meet the requirements because most of the respondents' houses did not have ceilings and used tin roofs, which also affected the temperature inside the house. *Mycobacterium tuberculosis* cannot survive in a hot room or in direct sunlight [12].

**Table 6 Analysis of the Incidence of Pulmonary Tuberculosis Based on House Humidity**

| No | home humidity | Pulmonary tuberculosis |      |         |       |
|----|---------------|------------------------|------|---------|-------|
|    |               | case                   |      | Control |       |
| 1  | Not eligible  | 12                     | 80%  | 5       | 16.7% |
| 2  | Qualify       | 3                      | 20%  | 25      | 83.3% |
|    | Amount        | 15                     | 100% | 30      | 100%  |

Table 6 displays the results of the chis square test, which revealed that  $p = 0.000 < \alpha = 0$ . Therefore, we reject  $H_0$  because statistical evidence demonstrates a correlation between the physical humidity requirements of houses and the incidence of pulmonary tuberculosis in the Barito Kuala Regency in 2023. According to the results of the analysis using the Odd Ratio test reveals that houses with humidity levels below the required levels have a 13-fold higher risk. Many of the respondent's houses on the banks of the Barito River lack ventilation or ventilation holes, resulting in poor air flow, untidy rooms, and abnormally damp air due to the accumulation of unused items. In addition, high humidity can cause the skin mucous membranes to become dry, making them less effective at blocking microorganisms [13].

**Table 7 Analysis of the Incidence of Pulmonary Tuberculosis Based on House Lighting**

| No | Home lighting | Pulmonary tuberculosis |       |         |       |
|----|---------------|------------------------|-------|---------|-------|
|    |               | Case                   |       | Control |       |
| 1  | Not eligible  | 14                     | 93.3% | 13      | 43.3% |
| 2  | Qualify       | 1                      | 6.7%  | 17      | 56.7% |
|    | Amount        | 15                     | 100%  | 30      | 100%  |

Table 7 displays the results of the chis square test, which revealed that  $p = 0.001 < \alpha = 0$ . Therefore, we reject  $H_0$  because statistical evidence demonstrates a correlation between the physical lighting requirements of houses and the incidence of pulmonary tuberculosis in the Barito Kuala Regency in 2023. According to the results of the analysis using the Odd Ratio test reveals that houses with inadequate lighting have an 18-fold higher risk. Densely populated houses also have an impact on the intensity of incoming light. Closely spaced houses restrict the amount of natural light that can enter the house due to their limited distance from one another. The distance between adjacent houses also causes residential roofs to block each other, which in turn results in insufficient natural lighting in the home. The distance between adjacent buildings increases the opportunity for additional roofs, designed for the upper layers of residences, to block each other's sources of incoming light. So it influences home lighting and contributes to the incidence of pulmonary tuberculosis [14].

Table 8 Analysis of the Incidence of Pulmonary Tuberculosis Based on House Occupancy Density

| No | residential density |    | Pulmonary tuberculosis |         |       |
|----|---------------------|----|------------------------|---------|-------|
|    |                     |    | case                   | Control |       |
| 1  | Not eligible        | 13 | 86.7%                  | 11      | 36.7% |
| 2  | Qualify             | 2  | 13.3%                  | 19      | 63.3% |
|    | Amount              | 15 | 100%                   | 30      | 100%  |

Table 8 displays the results of the chis square test, which revealed that  $p = 0.002 < \alpha = 0$ . Therefore, we reject  $H_0$ , as statistical evidence demonstrates a correlation between residential density and the incidence of pulmonary tuberculosis on the banks of the Barito River in Barito Kuala Regency in 2023. According to the Odd Ratio test results, houses with a residential density that does not meet the requirements have an 11-fold increased risk of contracting pulmonary tuberculosis. Houses with densely populated environmental requirements, located on the edge of a river or above a swamp, have a high housing density due to their limited size, numerous occupants, and an abundance of piled-up items that are not cleaned. These factors contribute to the ease with which bacteria can spread disease and breed, thereby increasing the risk of pulmonary tuberculosis. The number of people in one room, the higher the humidity caused by human sweat and when humans inhale water vapour [15].

## CONCLUSIONS AND RECOMMENDATIONS

The conclusion drawn from this research is that the results of house temperature measurements are mostly 62.2%, which meets the requirements. Home humidity is mostly 57.7% qualified. Most of the house lighting, 40%, meets the requirements. The majority of residential density is 46.7%, which meets the requirements. It has been statistically proven that there is a relationship between house temperature and the incidence of pulmonary tuberculosis, with an OR value of 20 times the risk of developing pulmonary tuberculosis. It has been statistically proven that there is a relationship between house humidity and the incidence of pulmonary tuberculosis, with an OR value of 13 times the risk of developing pulmonary tuberculosis. It has been statistically proven that there is a relationship between home lighting and the incidence of pulmonary tuberculosis, with an OR value of 18 times the risk of developing pulmonary tuberculosis. It has been statistically proven that there is a relationship between residential density and the incidence of pulmonary tuberculosis, with an OR value of 11 times the risk of developing pulmonary tuberculosis. It has been statistically proven that there is a relationship between the physical requirements of houses, residential density, and the incidence of pulmonary tuberculosis on the banks of the Barito River. People should get into the habit of opening doors and windows in the morning so that

sunlight can enter the house and air changes can be maximised, thereby reducing the risk of pulmonary tuberculosis.

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