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ORIGINAL ARTICLE

EXPOSURE TO THE PHYSICAL CONDITIONS OF THE HOME ENVIRONMENT WITH PULMONARY TB DISEASE IN KALUMATA VILLAGE

Paparan Kondisi Fisik Lingkungan Rumah dengan Penyakit TB Paru di Kelurahan Kalumata

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ABSTRACT

Background: Pulmonary TB is included in the ten highest disease categories yearly in almost all health centers in Ternate City, North Maluku. In certain age groups, pulmonary TB can be a cause of death. Environmental factors, especially the physical environment of the house, can be determinants of pulmonary TB disease. **Purpose:** This study aimed to determine the incidence of pulmonary TB if exposed to the physical environment of the house and the home environment. **Methods:** This research is observational with a case-control study design. She was held in the Coastal Area of Kalumata Village, Ternate City. The number of samples in this study were all pulmonary TB sufferers. Data were collected from observations, interviews, and measurements to determine exposure to the physical environment of the house and the incidence of pulmonary TB. The chi-square test is used to determine the relationship between the variables studied. **Results:** The study's statistical results showed that all the variables did not significantly relate to the incidence of pulmonary tuberculosis associated with the physical condition of the house (p-value = 1.00 (> α = 0.05). **Conclusion:** There is no relationship between the incidence of pulmonary TB and the house's physical condition.

ABSTRAK

Pendahuluan: *Penyakit TB Paru tiap tahunnya masuk dalam Kategori 10 penyakit tertinggi di hampir semua puskesmas di Kota Ternate, Maluku Utara. Pada kelompok umur tertentu (> 60 tahun) TB Paru dapat menjadi salah satu penyebab kematian. Faktor lingkungan terutama lingkungan fisik rumah dapat menjadi determinan penyakit TB Paru.* ***Tujuan:*** *Tujuan penelitian ini untuk mengetahui paparan lingkungan fisik rumah, lingkungan rumah terhadap kejadian TB Paru.* ***Metode:*** *Penelitian ini merupakan penelitian observasional dengan desain case control study yang dilaksanakan*

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di Wilayah Pesisir Kelurahan Kalumata, Kota Ternate. Jumlah sampel pada penelitian ini adalah seluruh penderita TB Paru. Data dikumpulkan pengamatan, wawancara dan pengukuran untuk mengetahui paparan lingkungan fisik rumah dengan kejadian TB Paru. Uji Chi-square digunakan untuk mengetahui hubungan antar variabel yang diteliti. ***Hasil:*** *Hasil penelitian secara statistik semua variabel hasilnya tidak memiliki hubungan yang signifikan, dengan kejadian penyakit TB Paru yang berhubungan dengan kondisi fisik rumah p-value = 1,00 (>a = 0,05).* ***Simpulan:*** *Tidak ada hubungan kejadian TB Paru dengan kondisi fisik rumah.*

INTRODUCTION

Tuberculosis is an infectious disease caused by the Mycobacterium tuberculosis germ. WHO data, in 2018, Indonesia ranks third in the world (8%) with the most people with pulmonary TB after India (27%) and China (9%). In Indonesia, 2021 where the population is 1,284,341, with an estimated number of suspected Tuberculosis of 19,256 cases and a case notification rate (CNR) of 134.0/100,000 population with an estimated incidence of Tuberculosis (in absolute terms) of 4,193 cases, while based on the total number of registered and treated pulmonary TB cases, only 1,485 cases. The number of cases based on female gender was 868 cases, and for male gender was 617 cases (1). Secondary data from the Ternate City Health Office from 2019-2021 shows an increase in TB cases by ≥ 100% per year, namely 102 patients in 2019, 254 in 2020, and 855 in 2021 as of November. All patients were spread out in the Kalumata Health Center working area.

Home is one of the basic human needs besides clothing and food, so the house must be healthy so that its residents can work productively (2). Home construction and environments that do not meet health requirements are risk factors for transmitting various diseases, especially environment-based diseases. Physical exposures in the home, such as poor ventilation, high humidity, overcrowding, and exposure to smoke from cooking or smoking, have been identified as significant risk factors for the transmission and development of pulmonary TB. These conditions are often found in neighborhoods with low living standards. Research shows that well-ventilated homes can reduce the risk of TB transmission by up to 70%, as well as lighting, floor and wall conditions, humidity, light, and temperature. Based on the Household Health Survey (SKRT) conducted in 1995, Pulmonary TB disease is the second leading cause of death and is closely related to unhealthy housing sanitation conditions (3). Based on the explanation above, this study aims to examine the exposure of the physical condition of the home environment to the incidence of pulmonary tuberculosis disease TB in the Coastal Region of Kalumata Village.

METHODS

This type of research is an analytic observational study with a Case-Control Study design. The case sample criteria were categorized according to the inclusion and exclusion criteria. The inclusion criteria in the case sample were patients with pulmonary TB, recorded in the medical records of the Kalumata Health Center, willing to have their homes used as research samples, whose addresses and contact numbers could be contacted, and patients who were still temporarily undergoing TB treatment. Exclusion criteria in the case sample were patients whose home addresses were not found, unwilling to become respondents, patients declared dead, and the place of residence of patients with pulmonary TB was not evident in the medical record / not found. In control, the inclusion criteria were patients with Pulmonary TB who were not recorded in the medical records of the Kalumata Health Center as patients with Pulmonary TB. The exclusion criteria were those unwilling to become respondents to analyze the Physical Conditions of the Home Environment Against the Incidence of Pulmonary TB Disease in the Coastal Region of Kalumata Village, with 32 respondents and 32 control respondents. The research ethics code issued by the Center for Research and Community Service of the Poltekkes Kemenkes Ternate with (No. UM.02.03/6/286/2023).

The population in this study was the community in the Kalumata Village Coastal Area. The sample in this study included all patients with pulmonary

TB in the Kalumata Village area, and as many as 64 patients were included. Data collection methods, through interviews with respondents about the density of house occupancy, were carried out over 14 days. Observation of the physical condition of the houses of patients with Pulmonary TB (dependent variable), such as floors, and measurement of each independent variable in several ways (4), namely:

1. Ventilation functions as air circulation or air exchange in the house, measured using a rolling meter by comparing the ventilation area with the floor area and qualified if the ventilation area is ≥ 10% of the floor area and unqualified if the ventilation area is < 10%.
2. Humidity can be affected by several things, such as an unqualified home environment or by the weather, measured using a hygrometer, qualified if the result is 40-50%, and unqualified if the result is < 40% and > 60%.
3. Lighting is related to sunlight that can kill pathogenic bacteria in the house, measured using a lux meter, qualified if ≥ 60 lux, and unqualified if < 60 lux.
4. In this study, temperature is the temperature in the patient's house, measured using a Thermo Hygrometer, qualified if the temperature is 180 C-300 C and unqualified if <180 C and >300 C.
5. The type of floor in the house is ceramic coated or tiled, by observation and qualified if watertight and easy to clean and tiled, not qualified if not watertight, and not tiled or plastered.
6. Occupancy density, measured by the number of people living in one dwelling unit (house) per square meter of floor area, was identified through interviews. Not dense if the floor area is at least 8m2 per 2 people and dense if the floor area is <8m2 per 2 people.

Data collection instruments used questionnaires about respondent characteristics, knowledge, attitudes, and actions about pulmonary TB and observation sheets to see the physical construction of respondents' homes. Univariate data analysis was used to determine the frequency distribution of respondent characteristics and research variables, and bivariate data analysis was used to determine the relationship between the independent and dependent variables. The test was Chi-Square, and the data was processed using statistical software.

RESULTS

Based on Table 1, data obtained from respondents with unqualified ventilation in the case group were two houses (50%), and in the control group were two houses (50%). In the case group, respondents with qualified ventilation, namely a ventilation area of at least 10% of the floor area, were 30 houses (50%), and in the control group, were 30 houses (50%).

The results of statistical tests using the Chi-Square method to determine the relationship between ventilation and the incidence of Pulmonary TB in Kalumata Village obtained a p-value = 1.00 (>α = 0.05). This means there is no significant relationship between ventilation and the incidence of Pulmonary TB in Kalumata Village. The results of statistical tests using the Chi-Square method to determine the relationship between ventilation and the incidence of Pulmonary TB in Kalumata Village obtained a p-value = 1.00 (>α = 0.05). This means there is no significant relationship between ventilation and the incidence of Pulmonary TB in Kalumata Village.

Based on Table 1, data obtained from respondents with unqualified temperature in the case group were eight houses (40%), and in the control group were 12 houses (60%). Respondents with eligible temperature in the case group were 24 houses (54.45%), and in the control group were 20 houses (45.55%).

The results of statistical tests using the Chi-Square method to determine the relationship between temperature and the incidence of Pulmonary TB in Kalumata Village obtained a p-value = 0.41 (>α = 0.05). This means there is no significant relationship between temperature and the incidence of Pulmonary TB in Kalumata Village.

Based on Table 1, data obtained from respondents with unqualified humidity in the case group were five houses (55.60%) and four houses (44.40%). Respondents with qualified humidity in the case group were 27 houses (49.10%) and 28 houses (50.90%).

Table 1

Analysis of Physical Conditions with the Incidence of Pulmonary TB in Kalumata Village

Variable	Pulmonary TB Status				Total		*p-value*
	Case		Control				
	n	%	n	%	n	%	
Ventilation							
Qualified	30	50	30	50	60	100	1.00
Unqualified	2	50	2	50	4	100	
Humidity							
Qualified	24	54.45	20	45.54	44	100	0.41
Unqualified	8	40	12	60	20	100	
Lighting							
Qualified	24	49	25	51	49	100	1.00
Unqualified	8	53.30	7	46.70	15	100	
Temperature							
Qualified	27	49.10	28	50.90	55	100	1.00
Unqualified	5	55.60	4	44.40	9	100	
Type of floor							
Qualified	21	41.20	30	58.80	51	100	0.01
Unqualified	11	84.60	2	15.40	13	100	
Occupancy density							
Qualified	21	48.80	22	51.20	43	100	1.00
Unqualified	11	52.40	10	47.60	21	100	

The results of statistical tests using the Chi-Square method to determine the relationship between humidity and the incidence of pulmonary TB in Kalumata Village obtained a p-value = 1.00 (>α = 0.05). This means there is no significant relationship between humidity and the incidence of pulmonary TB in Kalumata Village.

Based on Table 1, data obtained from respondents with unqualified lighting in the case group were eight houses (53.30%), and in the control group were seven houses (46.70%). While respondents with qualified lighting in the case group were 24 houses (49%), and in the control group were 25 houses (51%).

The results of statistical tests using the Chi-Square method to determine the relationship between lighting and the incidence of pulmonary TB in Kalumata Village obtained a p-value = 1.00 (>α = 0.05). This means there is no significant relationship between lighting and the incidence of pulmonary TB in Kalumata Village.

Based on Table 1, data obtained from respondents with unqualified floor types in the case group were 11 houses (84.60%), and in the control group were two houses (15.40%). Respondents with qualified lighting in the case group were 21 houses (41.20%), and in the control group were 30 houses (58.80%).

The results of statistical tests using the Chi-Square method to determine the relationship between floor type and the incidence of pulmonary TB in Kalumata Village obtained a p-value = 0.01 (<α = 0.05). This means there is no significant relationship between lighting and the incidence of pulmonary TB in Kalumata Village.

Based on Table 1, data obtained from respondents with unqualified residential density in the case group comprised 11 houses (52.40%) and ten (47.60%) in the control group. Respondents with eligible residential density in the case group were 21 houses (48.80%), and in the control group, there were 22 houses (51.20%).

The results of statistical tests using the Chi-Square method to determine the relationship between residential density and the incidence of pulmonary TB in Kalumata Village obtained a p-value = 1.00 (>α = 0.05). This means there is no significant relationship between residential density and the incidence of pulmonary TB in Kalumata Village.

In the variable type of wall, it is known that all have met the requirements in the case and control groups, so the chi-square test cannot be carried out.

DISCUSSION

The above research variables are closely related to the incidence of Respiratory TB disease associated with exposure to the house's physical conditions, namely Ventilation, Humidity, Temperature, Lighting, Floor Type, Occupancy Density, and Wall Type. This study aligns with research (5), which states that the house's physical condition dramatically affects TB disease transmission. These include roof, floor, walls, window availability, ventilation, lighting, and occupancy density. The incidence of Pulmonary TB in the coastal area of Kalumata Village is most likely from the high mobility of sufferers, who are primarily male and of productive age, so that mobilization outside the home is quite intense; this is a possible cause of TB because TB transmission is through airborne transmission sources, with the intensity of outside activities that allow sufferers to get or be exposed to bacteria outside of the physical condition of the house or the patient's environment.

Air ventilation is part of the building that functions as an airflow channel. The airflow through ventilation can be from inside to outside the building or vice versa. The existence of air vents allows for continuous air exchange inside and outside the building. From the results of this study, it was found that the function of ventilation itself did not function because the ventilation in the respondent's house was not used properly, including windows that were permanently closed and were not accustomed to opening every morning, causing poor air circulation. In addition, it was found that the ventilation of the TB patient's house did not function properly because the ventilation was covered by the wall of the neighbor's house due to the densely populated location (6). Poor indoor ventilation plays a vital role in the spread of pulmonary TB; when a person with pulmonary TB is in a room with inadequate ventilation, Mycobacterium tuberculosis bacteria that they expel through coughing or sneezing can stay in the air longer. This is in line with Nurhanifah's research (7), which states that there are houses with windows of disproportionate size and rarely opened, causing air exchange not to take place properly.

Mycobacterium tuberculosis is spread mainly through droplet nuclei produced when an infected person coughs or sneezes. Droplet nuclei are tiny and can float in the air for several hours, especially in rooms with poor air circulation and without good ventilation. The concentration of droplet nuclei containing these bacteria will increase, so the risk of transmission to other people is higher. This explanation does not align with research conducted by Romadhon (8), which found a relationship between the ventilation area and the incidence of pulmonary TB in the Babana Health Center working area.

Humidity is an essential environmental factor in pulmonary TB control. Uncontrolled humidity, either too high or too low, can increase the risk of pulmonary TB infection by affecting the duration of droplet nuclei containing bacteria that remain in the air and affect the respiratory system. Humidity is an essential environmental factor in pulmonary TB control. Uncontrolled humidity, either too high or too low, can increase the risk of pulmonary TB infection by affecting the duration that droplet nuclei containing bacteria remain in the air and the respiratory system. Other studies have shown a strong positive correlation between coverage of healthy homes and TB case finding ($p = 0.01 < 0.05$; $r = 0.68$) (9).

This study is not in line with other research conducted by Siregar (10), which says that there is a relationship between humidity and the incidence of pulmonary TB, which means that respondents who live in homes with unqualified humidity can suffer from pulmonary TB with a risk of 4.8 cases of TB. Inappropriate humidity can affect the immune system. Air that is too humid or dry can irritate the airway and weaken the mucosal layer, the body's first defense against respiratory infections that can increase a person's susceptibility to infection by Mycobacterium tuberculosis. The relationship between humidity and the incidence of pulmonary Tuberculosis is due to the high humidity in the houses studied (11).

Based on the Decision of the Minister of Health of The Republic of Indonesia Number 2 of 2023, the ideal room temperature in the house is in the range of 18-30°C. At the time of the research in the respondents' homes, the temperature varied; this was also influenced by several things, such as the humidity in the house, the ventilation was closed, and the windows were not opened. A parallel study stating that there was no statistical relationship between the physical conditions of the house and the room temperature was carried out. There was a temperature range favored by Mycobacterium tuberculosis bacteria; namely, in that temperature range, there was an optimum temperature that allowed the bacteria to proliferate (12).

There was a temperature range favored by Mycobacterium tuberculosis bacteria; namely, in that temperature range, there was an optimum temperature that allowed the bacteria to proliferate. Mycobacterium tuberculosis is a mesophilic bacterium that proliferates in the range of 25°C-40°C, but the bacteria will grow optimally at 31°C-37°C (13). The chi-square test showed no significant relationship between house temperature and the incidence of Tuberculosis (p=0.35) (14).

Homes with sufficient natural lighting allow more UV light to enter, which can reduce the presence of bacteria in the air and on surfaces, thus reducing the risk of TB infection. The results showed no significant relationship between lighting and the incidence of pulmonary TB. This study is not in line with Hidayatullah et al (12), which states a relationship between lighting intensity and the incidence of pulmonary TB. The p-value = 0.00 <0.05 and OR = 6.2 means that respondents with unqualified house lighting intensity have a 6.2 more significant risk than those whose lighting intensity meets the requirements. Based on the results of research in the field, it was found that most of the respondents' house lighting met the requirements. Research that was not in line with this study was also conducted by Nopita et al (15) on the proportion of cases who had houses with unqualified lighting / (120 Lux); thus it was stated that house lighting was a risk factor for the incidence of Pulmonary Tuberculosis or there was a relationship between lighting and the incidence of Pulmonary Tuberculosis and the homes of respondents with BTA (+) Pulmonary Tuberculosis who had unqualified lighting conditions had a risk of 3.455 times contracting Pulmonary Tuberculosis compared to respondents' homes that had good lighting (16).

Floors made of soil or other natural materials that do not have a covering layer, such as cement or ceramics, tend to be more dusty and can be a place for bacteria and other microorganisms to grow, which can affect respiratory health. The study found no relationship between the type of floor and the incidence of pulmonary TB because all respondents' houses covered the floors with ceramics/tiles, which were easy to clean and had a lower risk of spreading dust and microorganisms. This is in line with research conducted by Prakosa's research (17), who stated that there is no relationship between the type of floor and the incidence of pulmonary TB disease in the Pegirian Health Center working area. Based on the results of this study in the field, it was found that most of the respondents' houses met the requirements because most of the patients' families used a type of floor that was not damp and had tile floors. This study does not align with research by Septidwina et al (18) and Rosyid (19), which stated that there is a relationship between the type of floor and the incidence of pulmonary TB.

High residential density is associated with an increased risk of pulmonary TB transmission due to closer and more frequent interactions between residents. This can facilitate the spread of bacteria through droplets when coughing or sneezing. The results showed no significant relationship between occupancy density and the incidence of pulmonary Tuberculosis in Kalumata Village. This study is not in line with research by Rokot et al (20) and Wahyuningtyas research (21), whose statistical data analysis results prove that there is a significant relationship between unqualified residential density and the incidence of Pulmonary Tuberculosis in Sindulang 1 Village, Tuminting District obtained a p-value = 0.01. When viewed from the OR value = 3.608, unqualified residential density is a risk factor for the incidence of Pulmonary Tuberculosis and has a risk of 4 times compared to qualified residential density (17). People who live in houses with a floor area of <8 m2/org are more likely to develop pulmonary Tuberculosis than people who live in houses with a floor area of >8 m2/org (22).

Based on the results of research conducted in Tanjung Pinang City it shows that the proportion of houses that have non-permanent walls (do not meet the requirements) is higher in the case group compared to the control group with a value of p = 0.10 and OR = 6.96, because p > 0.05, meaning that there is no significant relationship between walls and the incidence of Tuberculosis. However, it can be stated that people who live in houses that have non-permanent walls have a 6.969 times greater risk of pulmonary Tuberculosis than people who live in houses that have permanent walls (23). The proportion of permanent or qualified house walls with plastered brickwork or wall materials does not affect the incidence of Pulmonary Tuberculosis (24).

CONCLUSION

Based on the results of the study above, which can be seen from the statistical results of all variables, the results do not have a significant relationship with the incidence of Pulmonary TB disease related to the physical condition of the house (Ventation p-value = 1.00 (>α = 0.05), Temperature p-value = 0.41 (>α = 0.05), Humidity p-value = 1.00 (>α = 0.05). Lighting p-value = 1.00 (>α = 0.05), Floor Type p-value = 0.01 (<α = 0.05), Residential Density p-value = 1.00 (>α = 0.05). Moreover, Wall Type In the wall type variable, it is known that all have met the requirements in the case and control groups so that the chi-square test cannot be carried out) which means that statistically, it is not related to the incidence of Pulmonary TB.

AUTHOR CONTRIBUTIONS

In compiling this research article, the two authors whose names are listed, namely SW as the first author and PS as the second author, played an active role in implementing the research, starting with compiling the proposal, searching for literature and initial data, collecting primary data, interviewing respondents, analyzing research data up to preparing the research report and compiling the article.

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