



Analysis of Physical Environmental Factors Affecting the Incidence of Pulmonary Tuberculosis in Magelang City

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Abstract

Tuberculosis is a disease caused by *Mycobacterium Tuberculosis* which is transmitted by Tuberculosis patients with BTA (Basil Tahan Asam) (+), namely TB patients whose sputum microscopic examination found BTA bacteria. Magelang is the region with the highest pulmonary TB cases in Central Java Province for 3 consecutive years. In addition, the discovery of new cases of BTA (+) CNR also occupied the highest place for 3 consecutive years in 2015, 2016 and 2017. Even though in 2017 the number of new case finds of BTA (+) decreased drastically from the previous year, which was 284 per year. 100,000 population, but still ranked 1st CNR new cases of BTA (+). The purpose of this study was to analyze physical environmental factors that influence the incidence of pulmonary tuberculosis in Magelang City. This study used a case control research design. The population consisted of all people who had been tested for pulmonary tuberculosis at the puskesmas. The sample consisted of 100 pulmonary tuberculosis patients and 100 non-pulmonary TB patients taken using purposive sampling technique. The instrument uses a questionnaire sheet, checklist, observation, room thermometer, hygrometer, and meter. Data analysis used Chi-square test and logistic regression test. The results of the analysis show that there is a relationship between lighting (p-value 0.043), humidity (p-value 0.045), room temperature (p-value 0.021) with the incidence of pulmonary tuberculosis. Multivariate analysis showed that room temperature was not ideal, with an OR of 0.321 which had the most influence on the incidence of pulmonary TB. The most dominant physical environmental factor is room temperature which is not ideal. From several related physical environmental factors, it is necessary to provide detailed information regarding pulmonary tuberculosis so as to maintain a clean and healthy environment.

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INTRODUCTION

Tuberculosis is a disease caused by *Mycobacterium Tuberculosis* and the infectious source is Tuberculosis patients with positive AFB (Acid-Resistant Basil). BTA positive, namely TB patients whose sputum microscopic examination found BTA bacteria in which the *Mycobacterium Tuberculosis* bacteria are rod-shaped with a size of 1 - 4 microns and 0.3 - 0.6 microns thick, resistant to acid staining so it is known as Acid Resistant Bacteria (BTA). Most of the TB germs attack the lungs, but can also affect other organs (Kemenkes RI, 2011).

Indonesia is the country with the fifth largest number of TB patients in the world after India, China, South Africa and Nigeria (WHO, 2013). It is estimated that the number of TB patients in Indonesia is around 5.8% of the total number of TB patients in the world. It is estimated that every year there are 429,730 new cases and 62,246 deaths and based on the results of the 1995 SKRT survey, TB disease is the number 1 cause of death from the infectious disease class. Pulmonary TB disease, causes a large disease burden globally. In 2015, the number of new and old cases was 10.2 million with a death toll of 1.3 million (GBD Tuberculosis Collaborators, 2018).

In 2012, there were 8.6 million TB incidents and 1.3 million of them died. 1.3 million cases of TB deaths consist of 940,000 people without HIV, and 320,000 people who are HIV positive. Based on Indonesia's 2012 Health Profile, Indonesia ranks 6th in the ASEAN region for TB prevalence, namely 281 per 100,000 population. The highest number of reported TB cases in Indonesia is in the provinces with the highest population, namely West Java, Central Java and East Java.

In 2015 there were an estimated 10.4 million new cases of tuberculosis or 142 cases / 100,000 population, with 480,000 multidrug-resistant cases. Indonesia is the country with the second highest number of new cases in the world after India (WHO, 2016). Based on data from the Health Profile of Central Java Province, Magelang City has the highest rank of CNR new cases of BTA (+) and CNR of all TB cases for 3

consecutive years. The discovery of CNR new cases of BTA (+) in 2015, Magelang City was in the first rank, namely 761.72 per 100,000 population, in 2016 with the number of new case discoveries that increased from the previous year which was 775.32 per 100,000 population, and in In 2017, the number of new cases of BTA (+) found decreased drastically from the previous year, which was 284 per 100,000 population, but still ranked 1st in CNR for new cases of BTA (+).

Based on data from the Central Java Province Health Profile, the highest total number of TB cases in 2015 was also occupied by the City of Magelang with a total of 777.45 per 100,000 population, while the number increased in 2016 to 791 per 100,000 population, and continued to increase in 2017 to 845, 4 per 100,000 population. Magelang City became the first rank for 3 consecutive years for the highest number of total TB cases and the highest number of new BTA (+) cases.

The success rate of treatment for patients with BTA (+) Lung TB has also not reached the target. According to data from the Central Java Province Health Profile in 2015, the target of successful treatment for patients with BTA (+) Pulmonary TB only reached 79.49%, this figure decreased in 2016 to 68.69%, and increased in 2017 to 82.36% of the target. set by the government is 90%.

Environmental factors are a factor in the incidence of pulmonary tuberculosis. Among them are the density of the occupants of the house, the type of floor of the house, the area of ventilation, lighting, humidity and room temperature. The condition of the residence / house is closely related to the incidence of pulmonary tuberculosis. With unfavorable environmental conditions, it can help the growth of the *Mycobacterium tuberculosis* bacteria. Occupancy has a requirement for a member density of 9 m² per person. Shelter that does not meet the requirements in density has a 7,841 greater risk of pulmonary tuberculosis than housing that meets the requirements (Wulandari et al., 2015). This means, the denser the occupancy, the lower the circulation quality, humidity, and air temperature. Not only occupancy density, population density also has a

significant contribution as a risk factor for pulmonary tuberculosis (Kajal et al., 2015). The aim of this study was to analyze physical environmental factors that influence the incidence of pulmonary tuberculosis in Magelang City.

METHOD

This research is a quantitative study using a case control design. The population in the research were patients who were found by the Puskesmas starting in January 2019 and were new case findings of 145 patients who were selected using purposive sampling technique. The minimum number of samples obtained was 100 for the case group and 100 for the control group. The criteria for the case group were positive for pulmonary tuberculosis on examination and contained in medical records, at least 15 years old when tested positive for pulmonary tuberculosis, and had complete medical record data at the

Puskesmas Kota Magelang. The exclusion criteria for the case group were not willing to be research respondents. Meanwhile, the control group criteria were negative for pulmonary TB on examination; have sex and come from the same Puskesmas area as the case group respondents; have an age difference that is not much different from the case group respondents; have complete medical record data at the Puskesmas Kota Magelang. The exclusion criteria for the control group were not willing to be respondents in the study, moved, or died. Data analysis used the Chi-square test, as well as jiregresilogistics. Data processing used the SPSS v.20 application.

RESULTS AND DISCUSSION

The results of research that have been carried out related to the physical environmental factors of pulmonary tuberculosis in Magelang City are listed in table 1 below.

Table 1. The Frequency of distribution on physical environment factors

Factors of physical environment	n	%
The density of house companions		
Not comply the requisite	32	16
Comply the requisite	168	84
Kind of house floor		
Not comply the requisite	9	4.5
Comply the requisite	191	95.5
Kind of house wall		
Not comply the requisite	12	6
Comply the requisite	188	94
Ventilation existence		
Available	11	5.5
Not available	189	94.5
Illumination		
Not comply the requisite	36	18
Comply the requisite	164	82
The air dampness		
Not comply the requisite	29	14.5
Comply the requisite	171	85.5
Temperature		
Not ideal	26	13
Ideal	174	87
Total	200	100

Based on table 1., the results of research findings related to physical environmental factors for pulmonary tuberculosis in Magelang City have been presented. Physical environmental factors studied include the density of the occupants of the house, the type of floor of the house, the type of house walls, the presence of ventilation, lighting, humidity, and room temperature. Occupant density is the ratio between the floor area of a house and the number of family members in one house. The occupancy density requirements for all ordinary housing are expressed in m² per person. For this reason, the Ministry of Health has made regulations on healthy houses with the formula for the number of residents/ building area. According to KEPMENKES RI Number 1202/MENKES/SK/VIII/2003, the condition for a house to be considered healthy is 9 m² per person.

According to table 1. the results of this study found that 84% of respondents had met the requirements in the resident density variable. Only 16% of respondents did not meet the requirements in the resident density variable. These findings prove that most of the people of Magelang City have paid attention to the government's recommendation for the number of residents in one house. This action is in accordance with the knowledge and behavior of respondents who are already good, so that when living in one house pay attention to health aspects and can prevent pulmonary tuberculosis disease transmission.

The floor is the wall covering the lower part of the room. According to KEPMENKES RI No. 829/MENKES/SK/VII/1999, the construction of a healthy house floor must be water tight and always dry so that it is easy to clean from dirt and dust. The condition of the floor of the house needs to be made of materials that are impermeable to water so that the floor does not become damp and always wet, such as tiles, cement, and tiles. Whereas for the types of house floors that are not waterproof, such as soil, boards and wood (Pradita et al., 2018). Referring to table 1., the findings in this study are that 95.5% of respondents already have a type of house floor that meets the requirements, namely

waterproof. Only 4.5% of respondents who have a house floor do not meet the requirements. This data shows that the community already knows the importance of a healthy home environment. The type of floor in the house is not waterproof (does not meet the requirements) can interfere with health. In addition, aesthetic reasons were used to improve the condition of the floor in the house. Types of house floors that do not meet the requirements can increase the risk of transmitting pulmonary tuberculosis. The risk is 16.67 times the infection of pulmonary tuberculosis (Oktavia et al., 2016).

The type of material used in the walls of the house can affect the incidence of pulmonary tuberculosis. If what is used is made of wood, it will be difficult to clean which can cause a buildup of dust. Conversely, if the walls of the house are made of concrete, it is easier to clean so that they do not become a medium for germs to reproduce. Based on table 1, the results of the study found that the average respondent had the type of house wall that met the requirements, which was 94%. Only 6% of respondents that house walls do not meet the requirements. These results prove that the people of Magelang City have paid attention to health aspects in building houses. The type of house wall in the form of concrete can help in preventing the transmission of pulmonary tuberculosis, because concrete walls are easy to clean so that the proliferation of bacteria will decrease.

Table 1 show that the presence of ventilation in the respondent's houses is 94.5%. Meanwhile, the remaining 5.5% did not have ventilation in their houses. Generally, a house built with health aspects in mind will have adequate ventilation. This is useful for air circulation. In addition, with good air circulation, the growth of bacteria will decrease. Several previous studies have found that the area of ventilation has a relationship with the incidence of pulmonary tuberculosis (Oktavia et al., 2016; Prihartanti et al., 2017; Wulandari et al., 2015). In addition, the area of ventilation that does not meet the requirements has an effect of 27.12 times greater than the area of ventilation that meets the requirements for the incidence of pulmonary tuberculosis (Oktavia et al., 2016).

The results refer to table 1. That is found 82% of the respondents' houses have met the requirements in lighting. It is said that they meet the requirements if there are windows and glass tiles in the house. The light that comes from windows and glass tiles is included in natural light, namely light from sun. This light is very important, because it can kill pathogenic bacteria in the house, such as TB germs. This finding was proven by research in Kendal, that the intensity of natural lighting had a significant relationship with the incidence of pulmonary tuberculosis (Wulandari et al., 2015).

In general, the assessment of humidity in the house using a hygrometer. According to the housing supervision indicator (KEPMENKES RI Number 829/MENKES/SK/VII/1999), the humidity that meets the health requirements in the house is 40-70% and the humidity that does not meet the health requirements is <40% or >70%. Table 1 shows that most of the

respondent's houses have met the requirements in terms of humidity, which is 85.5%. Humidity is important because it is a factor in the breeding ground for TB bacteria. If the humidity in the room does not meet the requirements, there is a 4.705 times greater risk of pulmonary TB (Wulandari et al., 2015).

The room temperature in the average respondent's house is ideal, which is 87% of the total 200 respondents. This condition shows that most of the houses of the people of Magelang City have met the standards of the Ministry of Health. Room temperature plays a major role in the growth of mycobacterium tuberculosis, where the rate the growth of these bacilli is determined by the ambient air temperature. In addition, a house with a room temperature that does not meet the requirements has a risk of 8.5 times greater than a house with a temperature that meets the requirements for the incidence of pulmonary tuberculosis (Prihartanti et al., 2017).

Table 2. Chi Square Test Analysis in Psychological Relation Environmental Factors with Pulmonary Tuberculosis Case

Factor	Group		p-value	OR	95% CI
	Case	Control			
The density of house companions	18 (9%)	14 (7%)	0.563	-	-
Not comply the requisite	82 (41%)	86 (43%)			
Comply the requisite					
Kind of house floor			0.170	-	-
Not comply the requisite	7 (3.5%)	2 (1%)			
Comply the requisite	93 (46.5%)	98 (49%)			
Kind of house wall			0.372	-	-
Not comply the requisite	8 (4%)	4 (2%)			
Comply the requisite	92 (46%)	96 (49%)			
Ventilation existence			0.215	-	-
Available	8 (4%)	3 (1.5%)			
Not available	92 (46%)	97 (48.5%)			
Illumination			0.43	2.316	1.085-4.941
Not comply the requisite	24 (12%)	12 (6%)			
Comply the requisite	76 (38%)	88 (44%)			
The air dampness			0.045	2.528	1.089-5.868
Not comply the requisite	20 (10%)	9 (4.5%)			
Comply the requisite	80 (40%)	91 (45.5%)			
Temperature			0.021	3.116	1.246-7.791
Not ideal	19 (9.5%)	7 (3.5%)			
Ideal	81 (40.5%)	93 (46.5%)			

The results of the Chi-square test analysis in Table 2. That is found that lighting, air humidity, and room temperature were significantly related to the incidence of pulmonary tuberculosis. The results of this study are in accordance with previous studies which found a close correlation between lighting, humidity and room temperature with the incidence of tuberculosis (Dewi & Yulianti, 2019).

Based on table 2, it was found that 84% of the respondents had met the requirements in the resident density variable. Only 16% of respondents did not meet the requirements in the resident density variable. These findings prove that most of the people of Magelang City have paid attention to the government's recommendation for the number of residents in one house. This action is in accordance with the knowledge and behavior of respondents who are already good, so that when living permanently in one house pay attention to health aspects and can prevent TB disease transmission. Research in Aceh found that the number of family members in one house with pulmonary tuberculosis is mostly >4 people (Hadifah et al., 2017). In addition, the condition of the number of house residents who do not meet these requirements can increase the risk of pulmonary TB disease (Supriyono, 2003; Wulandari et al., 2015).

The findings in this study are that 95.5% of respondents already have the type of floor of the house that meets the requirements, namely watertight. Only 4.5% of respondents who have a house floor do not meet the requirements. This data shows that the community already knows the importance of a healthy home environment. The type of floor in the house is not waterproof (does not meet the requirements) can interfere with health. In addition, aesthetic reasons were used to improve the condition of the floor in the house. Types of house floors that do not meet the requirements can increase the risk of transmitting pulmonary tuberculosis. The risk is 16.67 times the infection of pulmonary tuberculosis (Oktavia et al., 2016).

The type of material used in the walls of the house can affect the incidence of pulmonary tuberculosis. If what is used is made of wood, it will be difficult to clean which can cause a buildup of dust. The results of the study found that the average respondent has the type of wall of the house that meets the requirements, which is 94%. Only 6% of respondents whose house walls do not meet the requirements. These results prove that the people of Magelang City have paid attention to health aspects in building houses. The type of house wall in the form of concrete can help in preventing the transmission of pulmonary tuberculosis, because concrete walls are easy to clean so that the proliferation of bacteria will decrease. Azzahra (2017) in his research also found that there was a significant relationship between the type of house wall and the incidence of pulmonary tuberculosis in Deli Serdang (Azzahra, 2017).

The presence of ventilation in the respondents' houses was 94.5%. Meanwhile, the remaining 5.5% did not have ventilation in their houses. Generally, a house built with health aspects in mind will have adequate ventilation. This is useful for air circulation. In addition, with good air circulation, the growth of bacteria will decrease. Several previous studies found that the area of ventilation has a relationship with the incidence of pulmonary tuberculosis (Oktavia et al., 2016; Prihartanti et al., 2017; Wulandari et al., 2015). In addition, the area of ventilation that does not meet the requirements has an effect of 27.12 times greater than the area of ventilation that meets the requirements for the incidence of pulmonary tuberculosis (Oktavia et al., 2016).

Ventilation is useful as air circulation in the house, especially if family members smoke. Pollutants and household fuel fumes as well as fumes from vehicle fuels (houses close to main roads) can pollute the air in the house. As well as research conducted in India found that the number of smokers in the household, household fuels and houses close to major highways have a weak positive correlation with pulmonary TB (Jafta et al., 2017).

According to KEPMENKES RI No. 829/MENKES/SK/VII/1999, a healthy home requires sufficient light, especially natural light in the form of sunlight which contains, among others, ultra violet. Sunlight enters at least 60 lux on condition that it is not dazzling. The results of the study found that 82% of the respondents' houses met the requirements in lighting. It is said that they meet the requirements if there are windows and glass tiles in the house.

In general, the assessment of humidity in the house using a hygrometer. According to the housing surveillance indicator (KEPMENKES RI Number 829/MENKES/SK/VII/1999), the humidity that meets the health requirements in the house is 40-70% and the humidity that does not meet the health requirements is <40% or >70%. Research shows that most of the respondent's houses have met the requirements in terms of humidity, which is 85.5%. Humidity is important because it is a factor in the breeding ground for TB bacteria. According to Sun (2015), altitude and climate have an important

role in the prevalence of pulmonary tuberculosis (Sun et al., 2015). If the humidity of the room does not meet the requirements then has a 4.705 times greater risk of developing pulmonary TB (Wulandari et al., 2015).

The average room temperature in the respondents' houses is ideal, which is 87% of the total 200 respondents. This condition shows that most of the houses of the people of Magelang City have met the standards of the Ministry of Health. Room temperature plays a major role in the growth of mycobacterium tuberculosis, where the growth rate of the bacillus is determined by the ambient air temperature. It is proven that in a country that has 4 seasons, temperature significantly affects patients with new pulmonary TB infection in the hospital (Alvaro-Meca et al., 2016). In addition, a house with a room temperature that does not meet the requirements has a risk of 8.5 times greater than a house with a temperature that meets the requirements for the incidence of pulmonary tuberculosis (Prihartanti et al., 2017).

Table 3. Multivariate Logistic Regression of Physical Environmental Factors that Most Influence the Case of Pulmonary Tuberculosis

	Coefficient	S.E.	Wald	df	<i>p-value</i>	OR	95% CI	
							Min	Mix
Room Temperature	-1.137	0.468	5.011	1	0.015	0.321	0.128	0.802
Constanta	0.999	0.442	5.100	1	0.024	2.714		

Table 3 shows the logistic regression test results for the physical environment factors that influence the incidence of pulmonary tuberculosis in Magelang City, which is the room temperature is not ideal, with an OR of 0.321. So, it can be concluded that the factor of room temperature that is not ideal has an effect of 0.321 times greater than the ideal room temperature on the incidence of pulmonary tuberculosis in Magelang City. The risk of room temperature that is not ideal is at least 0.128 times and the highest is 0.802 times the incidence of pulmonary tuberculosis in Magelang City.

Room temperature is a risk factor for the physical environment of pulmonary tuberculosis. Room temperature that is not ideal

affects the incidence of pulmonary tuberculosis with a risk of 6,548 times greater than the room that has the ideal temperature. This study is in line with research by Zulaikhah et al (2019), that room temperature affects the incidence of pulmonary tuberculosis and has a risk of 3.60 times (Zulaikhah et al., 2019). In addition, research conducted in Pekalongan City found that room temperature had a risk of 2.298 times the incidence of pulmonary TB in children (Mudiyono et al., 2015).

Room temperature is not ideal or above 30°C could be lower by adding natural or artificial ventilation. Conversely, if the temperature is less than 18 ° C, a heating device can be added so that the room temperature returns to ideal or added ventilation so that

sunlight can enter directly into the house. Room temperature regulation in the house is very important because with an ideal temperature the bacteria that cause pulmonary tuberculosis will not survive (Zulaikhah et al., 2019). Factors from the physical environment of the house describe the physical quality of the house. Fahreza (2012) found that the physical quality of the house is related to the incidence of pulmonary tuberculosis in the Semarang community (Fahreza et al., 2012). High temperature has a big impact on pulmonary tuberculosis (Giri et al., 2019).

CONCLUSION

The risk factor that related to pulmonary tuberculosis case is illumination, air dampness, and the temperature (p-value <0.05). The risk factor that most influence to a pulmonary tuberculosis case is temperature of the room. Hence, this research is hope that can be useful to the government of Magelang City in execute spreading prevention of pulmonary tuberculosis in it region and the respondent that already know the risk factor influenced through pulmonary tuberculosis case can doing an individual spreading prevention of pulmonary tuberculosis.

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