The Relationship Between Residential Density and Ventilation Area and The Incidence of Pulmonary TB in The Work Area of The Temindung Community Health Center

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Abstract

Background: Tuberculosis (TB) is an infectious disease that remains a major health problem in Indonesia. One of the important risk factors in its transmission is the condition of the residential environment, including residential density and the area of house ventilation. Objective: This study aims to analyze the relationship between residential density and ventilation area with the incidence of pulmonary TB in the working area of Temindung Community Health Center, Samarinda City. Research Methods: This study used a quantitative approach with a case-control design. The study sample consisted of 90 respondents, namely 45 pulmonary TB cases and 45 non-TB controls taken from the working area of Temindung Community Health Center. Data were collected through direct observation, interviews, and measurements using a rollmeter. Analysis was carried out bivariately using the Chi-Square test and Odds Ratio (OR). Results: The results of the analysis showed a significant relationship between ventilation area and the incidence of pulmonary TB (p = 0.001; OR = 5.091; 95% CI: 2.052–12.628). In contrast, no significant association was found between residential density and the incidence of pulmonary TB (p = 1.000; OR = 0.780; 95% CI: 0.195–3.118). Conclusion: Inadequate ventilation is a significant risk factor for the incidence of pulmonary TB. Meanwhile, residential density was not statistically proven to be associated with the incidence of pulmonary TB in the study area. Environmental health interventions that emphasize improving home ventilation are recommended to reduce the incidence of pulmonary TB.

Keywords: *Pulmonary tuberculosis; Residential density; ventilation and Case control.*

I. INTRODUCTION

Tuberculosis (TB) is currently a priority health problem in several countries in the world. In Indonesia, tuberculosis is still a disease with high cases in several regions in Indonesia. Tuberculosis is an infectious disease caused by the bacteria Mycobacterium Tuberculosis which can attack the lungs. In addition to attacking the lungs, Mycobacterium Tuberculosis can also attack other organs such as the meninges, lymph nodes, lymph nodes, kidneys, pleura, middle ear, intestines, spine, throat, eyes and skin (Mellyana et al., 2021).Geographically, the WHO regions with the highest TB burden in 2018 were Southeast Asia (44%), Africa (24%), the Western Pacific (18%), the Eastern Mediterranean (8%), the Americas (3%), and Europe (3%). Eight countries accounted for two-thirds of the global total: India (27%), China (9%), Indonesia (8%), the Philippines (6%), Pakistan (6%), Nigeria (4%), Bangladesh (4%), and South Africa (3%). Another 22 countries accounted for 87% of the cases in the WHO's list of 30 countries with a high TB burden. Drug-resistant TB continues to be a major public health threat. In 2018, there were approximately half a million new cases of rifampicin-resistant TB (of which 78% had multidrug-resistant TB). The three countries with the largest share of the global burden were India (27%), China (14%), and the Russian Federation (9%). Globally, 3.4% of new TB cases were reported (World Health Organization, 2020). The prevalence of pulmonary tuberculosis in Samarinda City in 2021 was 4,939 per 100,000 population. Meanwhile, in 2022, pulmonary tuberculosis cases increased, as seen from the CNR rate of new cases of 10,289 per 100,000 population.

In 2023, pulmonary tuberculosis cases in Samarinda City increased by 18,323 per 100,000 population. According to the Samarinda City Health Office report, the number of pulmonary tuberculosis cases in Samarinda City in 2022 was 10,289, compared to 18,323 in 2023, so the increase from 2022 to 2023 was 8,034. Then, the location of the highest TB cases was found in the Temindung Community Health

Center area with 299 cases of pulmonary TB in 2022, while in 2023 there were 1,773 cases of Pulmonary Tuberculosis so that in the last 2 years there was an increase, and the highest burden was in adult men (56.2%) adult women (43.8%) (East Kalimantan Health Office, 2022).Pulmonary TB can be triggered by various factors, including environmental conditions. The home environment greatly determines the health status of its occupants. Residential density is one of the triggering factors for Tuberculosis where if the area of the residence is not proportional to the number of occupants it will cause crowding or overcrowding, this can cause a lack of oxygen consumption, if one member is infected with Tuberculosis it will easily infect other members. The ventilation area is used in this study because ventilation is useful for maintaining air flow in the house to remain cool, meaning O2 balance is very important, because insufficient ventilation can increase humidity, humidity can be a breeding ground for pathogenic bacteria such as Mycrobacterium Tuberculosis bacteria.

II. METHODS

This study used a case-control study method and was conducted in the Temindung Community Health Center (Puskesmas) area of Samarinda City. The study sample consisted of 90 respondents: 45 pulmonary TB cases and 45 non-TB controls, drawn from the Temindung Community Health Center area. Data were collected through direct observation, interviews, and measurements using a roll meter. Bivariate analysis was performed using the Chi-Square test and the Odds Ratio (OR) test.

III. RESULT AND DISCUSSION

Respondent Characteristics

Table 1. Distribution of Respondent Characteristics

	Case		Control		Total	Total Percentage
	n	%	n	%		
Man	27	60.0	22	48.9	49	54.4%
Woman	18	40.0	23	51.1	41	45.6%
Total	45	100	45	100	90	100
Last education						
No school	1	2.2	0	0.0	1	1.1%
Elementary School	5	11.1	3	6.7	8	8.9%
Junior High School	13	28.9	14	31.1	27	30.0%
High School	18	40.0	21	46.7	39	43.3%
D3/S1	8	17.8	7	15.6	15	16.7%
Total	45	100	45	100	90	100
Work						
Work	3	51.1	32	71.1	55	
Doesn't work	22	48.9	13	28.9	35	38.9
Total	45	100	45	100	90	100

Table 2. Frequency Distribution of Case Age

	Case	
Age	n	%
18 – 27 Years	11	24.4
28 – 37 Years	12	26.7
38 – 47 Years	9	20.0
48 – 57 Years	2	4.4
58 – 67 Years	7	15.6
68 – 77 Years	4	8.9
Total	45	100%

Table 3. Frequency Distribution of Control Age

	Control	
Age	n	%
23 – 31 Years	8	17.8
32 – 40 Years	10	22.2

41 – 49 Years	8	17.8
50 – 58 Years	10	22.2
59 – 67 Years	6	13.3
68 – 76 Years	3	6.7
Total	45	100%

Univariate Analysis

1. Distribution based on Residential Density

Table 4. Frequency Distribution of Residential Density

Density Residence	Case		control		Total	Total percentage
	n	%	n	%		
Not eligible	4	8.9	5	11.1	9	10.0%
Qualify	41	91.1	40	88.9	81	90.0%
Total	45	100	45	100	90	100

2. Distribution Based on Ventilation Area

Table 5. Frequency Distribution of Ventilation Area

Density Residence	Case		control		Total	Total percentage
	n	%	n	%		
Not eligible	4	8.9	5	11.1	9	10.0%
Qualify	41	91.1	40	88.9	81	90.0%
Total	45	100	45	100	90	100

Bivariate Analysis

1. Relationship between Residential Density and TB

Table 6. Frequency of Residential Density Against TB

Residential Density	Case		control		OR 95%CI	P
	n	%	n	%		
Not eligible	4	8.9	5	11.1	0.780 (0.195-3.118)	1,000
Qualify	41	91.1	40	88.9		
Total	45	100	45	100		

The results of the housing density that did not meet the requirements in the case group were 4 (8.9%) and the control group were 5 (11.1%). Based on the chi-square test that has been done, seen from the (Fisher's exact test)) on the sig value. 1,000 > 0.05 can be interpreted that there is no relationship between housing density and the incidence of tuberculosis in the Temindung Community Health Center work area. So, the case group that does not meet the requirements has a risk of 0.780 times this is comparable to the control group to experience tuberculosis incidents with a 95% CI value (0.195-3.118).

2. Relationship between Ventilation Area and TB

Table 1. Wide Frequency of Ventilation Against TB

Ventilation Area	Case		control		OR 95%CI	P
	n	%	n	%		
Not eligible	34	75.6	17	37.8	5,091 (2,052-12,628)	0.001
Qualify	11	24.4	28	62.2		
Total	45	100	45	100		

The area of ventilation that did not meet the requirements was more in the Tuberculosis group (75.6%) than in the non-Tuberculosis group (37.8%). The Chi-Square test results showed a significant relationship between the area of ventilation and the incidence of Tuberculosis in the Temindung Community Health Center work area (P-value 0.001). The OR calculation results showed that the area of ventilation that did not meet the requirements was 5.091 times more likely to experience Tuberculosis compared to the area of ventilation that met the requirements (95% CI 2.052-12.628).

Discussion

1. Respondent Characteristics

a. Age

The research shows that respondents based on 45 case respondents and 45 control respondents obtained an age category with the most respondents in the case age category, namely 28 – 37 years old as many

as 12 respondents (26.7%), while in the control age category, namely 32 – 40 years old and 50 – 58 years old as many as 10 respondents (22.2%).This is consistent with research conducted by Clarita et al. (2020) which states that pulmonary tuberculosis is most often found in young or productive age groups, namely 15-50 years. Nowadays, with the demographic transition, the life expectancy of the elderly is increasing. At the age of 55 years and above, a person's immunological system declines, making them highly susceptible to various diseases, including pulmonary tuberculosis (Paladan et al., 2020).

b. Gender

The research shows that respondents based on gender found that the majority (54.4%) of 49 respondents were male and 41 (45.6%) of respondents were female.This aligns with the WHO theory in Naga (2014), which states that the disease is more common in men because smoking and alcohol can weaken the immune system. Therefore, it's natural that smokers and alcoholics are often cited as agents of pulmonary tuberculosis (Farhanisa, 2015).

c. Last education

This study shows that respondents based on their last education of 90 respondents found that the majority (43.3%) of 39 respondents had a high school/vocational school education and a small portion (1.1%) of 1 person had no education.This aligns with the theory proposed by Naga (2014), which states that a person's education level influences their knowledge of health-saving housing and pulmonary tuberculosis. Therefore, with sufficient knowledge, a person will strive to maintain a clean and healthy lifestyle. Furthermore, a person's education level influences their type of work and economic situation (Ahmad Zakiudin & Nurhastati Rakhmatillah, 2021).

d. Work

This study shows that respondents based on their occupations, out of 90 respondents, almost half, namely 55 respondents (61.1%) were working and a small portion, namely (38.9%), 35 respondents were not working.Based on the research results of Surakhmi Oktavia et al (2016) which has been conducted, the average respondent's work comes from the non-formal sector, 63.7% of whom have an unstable income per month, which has a direct impact on food/nutrition as well as the health of the housing environment which does not meet health requirements, which has an impact on their own health.

2. The Relationship Between Residential Density and Tuberculosis Incidence in the Temindung Community Health Center Work Area

Based on the bivariate analysis conducted using the Chi-square test, a P value of 1,000 > 0.05 was obtained. From this value, it can be stated that there is no relationship between residential density and the incidence of tuberculosis in the Temindung Community Health Center work area. This is also supported when researchers conducted observations by measuring the area of respondents' houses, it was found that many respondents' houses were large and the number of occupants living in the house was not too large. This can also be seen from the frequency distribution, namely 81 (90.0%) residential densities have met the requirements. Residential density that meets the requirements in a house is if ≥ 8m2/person, while residential density that does not meet the requirements is if <8m2/person. This study is in line with research conducted by S. Rahmawati et al., 2021 which stated that there is no relationship between residential density and the incidence of tuberculosis with a P Value = 0.743 > 0.05 and an OR value of 0.633 with a 95% CI value (1.380-2.899).(Rahmawati et al., 2021).

3. The Relationship between Ventilation Area and Tuberculosis Incidence in the Temindung Community Health Center Work Area

Based on bivariate analysis using the Chi-square test to determine the relationship between the ventilation area variable and the incidence of tuberculosis, the results obtained were P Value = 0.001 < 0.05, which means that there is a relationship between the ventilation area and the incidence of tuberculosis in the Temindung Community Health Center work area.The relationship between ventilation area and tuberculosis incidence in the Temindung Community Health Center work area was supported when researchers conducted direct observations and measurements using a Roll meter. Many houses have ventilation areas that are still less than 10% of the floor area, and the area of ventilation holes that are not proportional to the area of the respondents' houses studied. From the frequency results obtained for ventilation areas that do not meet the

requirements, there are 51 respondents with a percentage of (56.7%). To determine the ventilation area that meets the requirements, the ventilation area is ≥ 10% of the floor area, while those that do not meet the requirements are <10% of the floor area.This research is supported by research conducted by Nike Monintja et al., 2020, which stated that ventilation area is one of the factors that can cause tuberculosis. The analysis results obtained were P Value = 0.001 < 0.05. The OR result = 3.354, this occurs because many houses have ventilation areas that do not meet the requirements (Monintja N, Warouw F, 2020). The same study was also conducted by S. Rahmawati et al., 2021, which found a relationship between ventilation area and the incidence of tuberculosis. The results of the P Value = 0.000 < 0.05 with an OR value of 0.036 (Rahmawati et al., 2021).

IV. CONCLUSION

Respondent characteristics based on the highest age of the case are in the age category of 28-37 years as many as 12 respondents (26.7%), while in the highest age category of control, namely 32-40 years and 50-58 years have the same number, namely 10 respondents (22.2%). In the gender variable, the largest percentage is male as many as 49 (54.4%) respondents. In the employment variable, it can be seen that the highest percentage of respondents' work is against the unemployed category as many as 55 (61.1%) respondents. For the education category, the highest percentage is high school education as many as 39 (43.3%).There was no relationship between residential density and tuberculosis incidence in the Temindung Community Health Center work area. P-value = 1.000 > 0.05, with an OR of 0.78 and a 95% CI of 0.195 – 3.118.There is a relationship between the ventilation area variable and the incidence of tuberculosis in the Temindung Community Health Center work area. The P value = 0.001 < 0.05, with an OR value of 5.09 and a 95% CI value of 2.05-12.62.

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