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DETECTION OF TUBERCULOSIS IN TODDLERS AND ITS RISK FACTOR AT EAST PERAK HEALTH CENTER SURABAYA

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Abstract

Introduction: *Tuberculosis is a contagious disease that can grow fast due to its transmissibility through aerosols. One of the countries with the highest tuberculosis rates is Indonesia with a case fatality rate of 11.59%. This study's objective was to examine the relationship between the physical condition of the house and the immune system and the incidence of tuberculosis in toddlers in Surabaya.* ***Methods:*** *This study used an analytic survey research design with a case control research methodology. The case population consisted of pediatric patients aged 0-5 years who were clinically diagnosed with pulmonary tuberculosis. The Chi-Square test was used to analyze bivariate data with a confidence level of 0.05 (α = 5%).* ***Results and Discussion:*** *The physical condition of the house that influenced the incidence of tuberculosis in toddlers were room temperature (p = 0.009; OR = 8.300; CI = 1.480-46.936) and room humidity (p = 0.000; OR = 7.600; CI = 1.609-35.906) while the immune system that affected the incidence of tuberculosis in toddlers were history of tuberculosis sufferers in the family (p = 0.018; OR = 6.000; CI = 1.266-28.498) and exclusive breastfeeding (p = 0.003; OR = 10.000; CI = 1.998-50.042).* ***Conclusion:*** *Houses with inadequate room temperature and humidity have an increased risk of tuberculosis development. Moreover, tuberculosis risk factors include a history of exclusive breastfeeding and a family history of tuberculosis. Health promotion by community health centers is expected to increase awareness of pediatric tuberculosis.*

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by a bacillus-shaped bacterium called *Mycobacterium tuberculosis*. Tuberculosis is a contagious disease that can grow fast due to its transmissibility through aerosols (1). TB screening is necessary because TB patients with positive smear TB test results have a high risk of being a source of infection for those in their surroundings. Tuberculosis is one of the ten leading causes of death in worldwide. Based on data from WHO, 10 million people worldwide had tuberculosis in 2020, and 1.2 million died each year. One of the countries with the highest tuberculosis rates is Indonesia, with an estimated 845,000 TB cases and a death rate of 98,000 persons, with a case fatality rate of 11.59% (2). India and Indonesia accounted for the bulk of new tuberculosis cases in the world between 2013 and 2018, with increases of 60% and 70%, respectively (3). With 22,585 pulmonary TB case discoveries, East Java province comes in second place to West Java. Surabaya leads all other East Java cities with 2,382 pulmonary TB case findings in 2016 (4). According to the statistical results from the Health Profile of the City of Surabaya in 2019, the percentage of TB cases discovered in children was 10.08%, or 801 out of 7,950 total cases (5). This indicates that the transmission of BTA positive pulmonary TB cases to children is quite large.

There are three elements that contribute to pulmonary tuberculosis in children: predisposing factors, supporting factors, and driving factors. Predisposing factors include nutritional status, prior administration of the BCG vaccine, and knowledge. Supporting factors include

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socio-economic, home environment, and health facilities. While the driving elements include beliefs, practices, smoking habits, alcohol consumption, age, and gender, and direct contact. The history of administering the BCG vaccine significantly impacts the risk of tuberculosis among toddlers, as unvaccinated toddlers have a fourfold increased chance of getting TB infection. Tuberculosis infections are more likely to occur in children aged 0 to 14 years than in adolescents and adults. According to prior studies, children under the age of four with a compromised immune system are at a significant chance of developing tuberculosis (6). In addition, poor nutritional status can lead to secondary immunnodeficiency that increases the host's susceptibility to infection, which is tuberculosis. Children with malnutrition are at significantly higher risk of communicable infections (7). The risk of tuberculosis infection is extremely high for newborns and children who have been exposed to TB sufferers. Most instances arise within a few weeks of the commencement of contact investigations and prophylaxis is ineffective (8).

In 2018, there were six cases of pediatric pulmonary tuberculosis at the East Perak Health Center in Surabaya. In 2019 between January and July, the number of TB cases in toddlers increased to 12 cases. According to these statistics, the incidence of tuberculosis in toddlers requires further attention to prevent a new cases in the future. This study's objective was to examine the relationship between the physical condition of the house and the immune system with the incidence of tuberculosis in toddlers in East Perak Health Center Surabaya.

METHODS

This study used an analytic survey research design with a case-control research methodology. The case population in this study consisted of pediatric patients aged 0-5 years who were clinically diagnosed with pulmonary tuberculosis (through the use of X-rays and tuberculin testing) at the East Perak Health Center in Surabaya, while the control population consisted of pediatric patients aged 0-5 years who received medical treatment in the East Perak Health Center in Surabaya. Purposive sampling was used to obtain a sample of 12 cases and 24 controls by selecting a sample based on the researcher's preferences and the research objectives. Based on the doctor's diagnosis result, 12 case samples were collected at the East Perak Health Center and documented in the medical record.

The study was conducted in the working area of the East Perak Health Center in Surabaya, Pabean Cantikan District. This study was carried out between November 2018 and July 2019. The independent variables included house characteristics (occupancy density, room temperature, and room humidity) and factors that affect the toddler's immune system (nutritional status, family history of tuberculosis, and exclusive breastfeeding). This study's dependent variable was the incidence of tuberculosis in toddlers aged 0 to 5 years with positive smears. A questionnaire was distributed as the data collecting technique to gather details about the house's physical condition and the immune system. The characteristics of occupancy density, history of tuberculosis patients in the household, history of exclusive breastfeeding, and nutritional condition of toddlers were assessed using the interview method. A thermohygrometer was used to measure the humidity and temperature of the room. The Chi-Square test was used to analyze bivariate data with a confidence level of 0.05 (α = 5%).

RESULTS

Analysis of the Relationship between House's Physical Conditions and the Incidence of Tuberculosis in Toddlers

Table 1. Bivariate Analysis of the Relationship Between the Physical Conditions of the House and the Incidence of Tuberculosis in Toddlers at the East Perak Health Center Surabaya

Variable	Tuberculosis Incidence				Total		p	OR	95% CI
	Cases		Controls						
	n	%	n	%	n	%			
Occupancy Density									
Not eligible (<8m²/people)	8	66.7	11	45.8	19	52.8	0.238	2.364	0.558-10.017
Eligible (>8m²/people)	4	33.3	13	54.2	17	47.2			
Room Temperature									
Not eligible (<18°C or >30 °C)	10	83.3	9	37.5	19	52.8	0.009	8.300	1.480-46.936
Eligible (18°C - 30°C)	2	16.7	15	72.5	17	47.2			
Room Humidity									
Not eligible (<40% or >60 %)	8	66.7	5	20.8	13	36.1	0.007	7.600	1.609-35.906
Eligible (40% - 60%)	4	33.3	19	79.2	23	63.9			

Occupancy density

According to Table 1, 4 (33.3%) of the case group's respondents met the requirements for occupancy density, whereas 8 (66.7%) did not. In contrast, in the control group, 13 respondents (54.2%) of those with occupancy density met the requirements, while 11 respondents (45.8%) did not.

The results of statistical analysis showed p=0.238 (p > α). This indicated that there was no relationship

between occupancy density and the incidence of tuberculosis in toddlers at East Perak Health Center Surabaya.

Room Temperature

As can be seen in Table 1, 2 (16.7%) of the case group's respondents met the requirements for room temperature, while 10 (83.3%) did not. Comparatively, in the control group, 15 respondents (72.5%) with room temperature met the requirements, but 9 respondents (37.5%) did not.

The statistical analysis results showed p = 0.009 (p <α). This indicated that room temperature has an effect on the incidence of tuberculosis in toddlres in the service area of the East Perak Health Center in Surabaya. However, given the Contingency Coefficient is 0.397. The odds ratio (OR) was 8.333, indicating that the probability of acquiring tuberculosis in toddlers was 8.333 times higher among respondents whose homes did not fulfill the room temperature requirements compared to those who did

Room Humidity

Table 1 shows that 4 respondents (33.3%) from the case group had an adequate room humidity's requirements, while 8 respondents (66.7%) did not. In the control group, 19 respondents (79.2%) met the requirements for room humidity, while 5 respondents (20.0%) did not.

The statistical analysis revealed that p = 0.007 (p < α). This indicates that there is a relationship between humidity levels and the occurrence of tuberculosis in toddlers in the service area of the East Perak Health Center Surabaya. With a Contingency Coefficient value of 0.410. The odds ratio (OR) was 7.600, indicating that the incidence of tuberculosis (TB) in toddlers was 7.6 times higher among respondents whose homes did not fulfill the humidity requirements compared to those who did.

Analysis of the Relationship between Immune System Factors and the Incidence of Tuberculosis in Toddlers

Table 2. Bivariate Analysis of the Relationship Between the Immune System and the Incidence of Tuberculosis in Toddlers at the East Perak Health Center Surabaya

Variable	Tuberculosis Incidence				Total		p	OR	95% CI
	Cases		Controls						
	n	%	n	%	n	%			
Nutritional Status									
Below the Red Line (<80%)	3	25	4	16.7	7	19.4			
Above the Red Line (>80%)	9	75	20	83.3	29	80.6	0.551	1.667	0.307-9.042
History of Tuberculosis in the Family									
Yes	9	75	8	33.3	8	22.2			
No	3	25	16	66.7	28	77.8	0.018	6.000	1.263-28.498
Exclusive Breastfeeding									
No	10	83.3	4	16.7	14	38.9			
Yes	2	16.7	20	83.3	22	61.1	0.003	10.000	1.998-50.042

Nutritional Status

In accordance with Table 2, the majority of the nutritional status of the case group and the control group classified into the category above the red line or weight/age >80%, with 9 respondents (75%) in the case group and 20 respondents (83.3%) in the control group. Nonetheless, there were still respondents with nutritional status according to the lower red line category or weight/age 80%, with 3 (25%) in the case group and 4 (16.7%) in the control group.

The statistical analysis yielded the value p = 0.551 (p > α). This indicated that there was no relationship between nutritional status and the incidence of tuberculosis in toddlers in the service area of East Perak Health Center Surabaya.

History of Tuberculosis in the Family

As shown in Table 2, the majority of respondents in the case group, as many as 9 respondents (75.0%) and 3 respondents (25.0%) had no history of TB sufferers in their families, but the majority of respondents in the control group did not have a history of TB sufferers. There was a family history of tuberculosis in 16 (66.7%) and 8 (33.3%) of the respondents' families.

The statistical analysis revealed that p = 0.018 (p < α). This indicates that there is a correlation between the family history of tuberculosis and the prevalence of TB in toddlers in the service area of East Perak Health Center Surabaya. With a Contingency Coefficient value of 0.366. The odds ratio (OR) was obtained to be 6.000, indicating that the chance of contracting tuberculosis in toddlers was 6 times higher among those with a family history of TB than among those without such a history.

Exclusive Breastfeeding

According to Table 2, the majority of the respondents from the case group did not receive exclusive breastfeeding, with only two respondents (16.7%) receiving exclusive breastfeeding. This was inversely related to the majority of the control group,

in which 20 respondents (83.3%) got exclusive breastfeeding and 4 respondents (16.7%) did not.

The statistical analysis revealed that p = 0.003 (p < α). This indicated that there was a relationship between exclusive breastfeeding and the occurrence of tuberculosis in toddlers within the service area of the East Perak Health Center Surabaya. With a Contingency Coefficient value of 0.447. The odds ratio (OR) was determined to be 10.000, indicating that the chance of contracting tuberculosis in toddlers was 10 times higher among those who were not exclusively breastfed compared to those who were exclusively breastfed.

DISCUSSION

The majority of Surabaya City's cases of pulmonary tuberculosis in children ages 0 to 14 occurred at the East Perak Health Center with a total of 12 cases for the period June 2018 - July 2019. The distribution of TB cases was separated into two categories: 11 cases were found within the East Perak Health Center and one case was found outside of it. This study involved 36 respondents consisting of toddlers, yet the mother of toddlers were used as research respondents.

The fact that most respondents were immigrants who lived in boarding houses or rented houses accounts for the large number of households that did not fulfill the occupancy density requirements. Boarding houses often have an area that is not too large because one house building can be divided into four to six boarding houses. Occupancy density can be defined as ratio of the number of people that are present in the usable area. A high occupancy density is indicated by a small occupancy density value and a low occupancy density by a big occupancy density value (9).

According to the study, 66.7% of the case group respondents had occupancy density that did not fulfill the requirements. In contrast, the majority of the control group met the requirements. The results of statistical analysis showed p = 0.238 (p > α). This indicated that there was no relationship between occupancy density and the prevalence of tuberculosis in toddlers in the service area of the East Perak Health Center Surabaya. However, this contradicts prior research conducted in Bukittinggi that found that occupancy density affects the risk of tuberculosis with a p-value 0.032 (10). Similar research conducted in Batam stated that there was significant correlation between occupancy density and tuberculosis incidence with p = 0.000 (11). The imbalance between the number of occupants and the size of the building is considered unhealthy because it can lead to a deficiency in oxygen (O_2) consumption, and *Mycobacterium tuberculosis* spreads rapidly if there are enough pulmonary tuberculosis patients in the houses for the disease to be transmitted through the air.

Based on the study, room temperature measurements showed that the majority of the case group (83.3%) did not meet the standards for room temperature. In accordance with Regulation of Minister of Health of Republic Indonesia No.1077/Menkes/Per/V/2011, the room temperature levels in a living room must be between 18 ºC – 30 ºC. The results of statistical analysis showed p = 0.009 (p < α). This indicated that room temperature had an effect on the prevalence of tuberculosis in toddlers in the service area of the East Perak Health Center in Surabaya. The odds ratio (OR) was 8.333, indicating that the probability of acquiring tuberculosis in toddlers was 8.333 times higher among respondents whose homes did not fulfill the room temperature requirements compared to those who did. This measurement took place in the living room or family room because this room is the most often occupied space. In this study, the room temperatures of the respondents' houses varied. A room's temperature was affected by a number of factors, including ventilation and closed windows. Observations indicate that the types of ventilation include incident ventilation (can be opened and closed). During the observation, the majority of respondents' vents were closed, making the air in the room stuffy and dark due to the lack of sunlight.

Mycobacterium TB transmission or growth was affected by the air temperature. Bacteria proliferate most effectively at the appropriate air temperature for their survival (12). This is consistent with prior research conducted in Kampar Pekanbaru which found that respondents whose room temperature did not reach the requirements had a 3.53 fold greater likelihood of contracting pulmonary tuberculosis than respondents whose room temperature did exceed the requirements (13). According to several studies, regions with low temperatures have a greater risk of contracting tuberculosis (14). This result is in line with a study conducted in Hong Kong which stated that lower temperatures were associated with increased risk of tuberculosis infections (15).

The findings of room humidity measurements revealed that the majority of the case group (66.7%) did not fulfill the requirements for room humidity, whereas the control group did. In accordance with Regulation of Minister of Health of Republic Indonesia No.1077/Menkes/Per/V/2011, the humidity levels in a living room must be between 40% - 60%. The statistical analysis revealed that p = 0.007 (p < α). This indicated that there

was a relationship between humidity levels and the occurrence of tuberculosis in toddlers in the service area of the East Perak Health Center Surabaya. The odds ratio (OR) was 7.600, indicating that the incidence of tuberculosis (TB) in toddlers was 7.6 times higher among respondents whose homes did not fulfill the humidity requirements compared to those who did. In the case group and the control group, humidity levels that did not meet the requirements were probably caused by a combination of factors, including the density of residents, ventilation, and the intensity of sunlight. In addition, the majority of the respondent's houses are located in densely populated regions and boarding houses.

A research conducted in Lampung stated that inadequate humidity conditions can make susceptible viruses or bacteria to grow easier in indoor environments with high humidity levels. It's proved by valuable bivariate analysis with p = 0.000 (16). Hence, according to a study conducted in Central Mamuju, insufficient room humidity is a risk factor for the development of pulmonary TB, which is promoted by poor environmental circumstances, with p = 0.022 (17). Other researchers revealed that there was a correlation beween room humidity and tuberculosis incidence. Inadequate room humidity was 6.667 times higher risk for *Mycobacterium tuberculosis* transmission (18). A humid environment may also increase bacterial growth.

An individual's health status as it is influenced by their food intake and utilization is referred to as their nutritional status. By consuming enough essential nutrients, one can achieve optimal nutritional status. Based on the study's findings, both the case group and the control group were classified as having a nutritional status over the red line or weight/age >80%. This nutritional status is not a risk factor for the occurrence of pulmonary tuberculosis in toddlers in the East Perak Health Center. The statistical analysis yielded the value p = 0.551 (p > α). This indicates that there isn't any relationship between nutritional status and the prevalence of tuberculosis. Unlike the findings of Siregar's research, which found a link between nutritional status and the incidence of pulmonary TB, Siregar agreed that the risk of TB in children with low nutritional condition was 3.31 times greater than in children with adequate nutritional status (19). Poor nutritional status is a health problem mostly caused by a lack of nutrients to meet the body's physical needs (20). Inadequate nutrition can weaken the body's immunity, hence increasing the likelihood of contracting pulmonary tuberculosis. This is due to the fact that antibodies and lymphocytes require protein and carbs for their production. Malnutrition in children can also lead to immune problems and impair disease recovery. Another research showed some risk factors of tuberculosis in children, including malnutrition. A child with malnutrition was at 18.5 times higher risk of tuberculosis infection (21).

According to the study, 75% of TB patients in the case group had a family history of tuberculosis. The statistical analysis revealed that p = 0.018 (p < α). This suggest a correlation between the prevalence of tuberculosis in toddlers and family history of the disease at East Perak Health Center Surabaya. The odds ratio (OR) was obtained to be 6.000, indicating that the chance of contracting tuberculosis in toddlers is 6 times higher among those with a family history of TB than among those without such a history. Contact history is a key indicator of tuberculosis transmission because toddlers immune system still weak, *Mycobacterium tuberculosis* can enter the body easily. Contact is defined as living in the same house, doing activities together, or spending time in the room with tuberculosis sufferer. The greater the frequency of child interacting with a family member affected with tuberculosis, the greater the risk of exposure to the disease. The rate of tuberculosis transmission among families is relatively high. An average TB patient can infect two to three others in their house (16). The transmission danger will increase if multiple TB patients are in a house. The greater the number of TB patients in a house, the greater frequency and intensity of contact with tuberculosis germs.

Mycobacterium tuberculosis spreads easily through the air, increasing the chance of exposure to TB bacteria in the house environment of smear-positive patients and the risk of infection among children. Other studies by several researchers also revealed that there was a correlation between family history of tuberculosis and tuberculosis incidence, those stated that a history of interaction with tuberculosis patients increased the probability of contracting the disease by 5.429% (22). TB microorganisms are released into the air when a TB patient coughs, speaks, or sings. Those in its surroundings are in danger of contracting the tuberculosis bacterium (23). A research conducted in Pati showed that there was a correlation between familial tuberculosis sufferers contact and tuberculosis in children with a p-value = 0.007 (24).

Immunity is an important factor in determining an individual's health status. Immunity protects the body from bacteria, including *Mycobacterium tuberculosis*. Breastfeeding is one of the ways to ensure child health because it provides optimal nutrition that the infants need. The World Health Organization (WHO) recommends an exclusive breastfeeding until two years old. In accordance with Regulation of Government of Republic Indonesia

No. 33/2012 exclusive breastfeeding is defined as breast milk given to babies since birth for six months without adding or replace with another food or beverage. According to the study the majority of respondents in the case group were not exclusively breastfed for six months, 83.3% of case group respondents did not receive exclusive breastfeeding. The statistical analysis results showed p = 0.003 (p < α), indicating that exclusive breastfeeding affects the prevalence of tuberculosis in toddlers in the service area of the East Perak Health Center in Surabaya.

Exclusive breastfeeding protects babies from contracting infectious diseases. A history of exclusive breastfeeding has an effect on the nutritional status of children, which in turn impacts the child's immunity to infectious diseases, such as tuberculosis. Breast milk contains immunological components, such as lysozyme and immunoglobulin A (Ig A), which can break down the cell walls of Enterobacter and gram-positive bacteria, including Mycobacterium TB. A research conducted by in Jepara showed that the significance of exclusive breastfeeding for infants aged 0 to 1 year is significant, particularly in terms of nutritional needs and the immune system against disease (25). Based on a study conducted at the Children's Polyclinic of A. Yani Metro Hospital, the risk factor for pulmonary tuberculosis in children who did not receive exclusive breastfeeding was 9.198 times higher than in those who did (26). Similar research demonstrates that children who are not exclusively breastfed are 2.25 times more likely to develop tuberculosis than those who are exclusively breastfed (27). The result is in line with a study in Garut which stated that there was a significant correlation between exclusive breastfeeding and tuberculosis (28).

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CONCLUSION

In patients who went to the East Perak Health Center Surabaya, we found pediatric patients aged 0-5 years who were clinically diagnosed with pulmonary tuberculosis was 12. In the spread of tuberculosis bacteria, the physical condition of the house and the immune system played significant roles. The physical condition of the house that affected the incidence of tuberculosis in toddlers were room temperature (p = 0.009; OR = 8.333) and room humidity (p = 0.007; OR = 7.600). While the immune system, history of TB sufferers in the family (p = 0.018; OR = 6.000) and exclusive breastfeeding (p = 0.003; OR = 10.000) affected the likelihood of tuberculosis in toddlers.

It would be preferable if the community could improve the physical condition of the house environment, particularly by installing ventilation in each room so that air circulation flows smoothly and the house receives adequate sunlight so that the room temperature and humidity meet the needs. In addition, Posyandu (Integrated Healthcare Center) cadres must educate moms and prospective brides on the significance of exclusive breastfeeding so that they are more aware of the health of their infants and future infants.

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