

Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia

Wiwit Aditama¹, Frans Yosep Sitepu², Rahmat Saputra¹

¹Department of Environmental Health, Banda Aceh Polytechnic of Health of The Ministry of Health, Indonesia, Jl. Soekarno-Hatta Kampus Terpadu Poltekkes Aceh, Aceh Besar 23352, Indonesia

²Provincial Health Office of North Sumatera

Jl. Prof.HM Yamin, SH No.41 AA Medan, Indonesia

Corresponding Author: Wiwit Aditama

ABSTRACT

Background: Tuberculosis (TB) is a direct infectious disease caused by *Mycobacterium tuberculosis*. Most of the TB germs attack the lungs, but they can also affect other organs. From the health profile data in Lhoong Community Health Center (CHC) in 2015 there were 5 pulmonary tuberculosis cases, while in 2016 there were 13 pulmonary TB cases.

Aim: This study aims to determine the correlation between ventilation, lighting, humidity, occupancy density, type of floor and house temperature with the incidence of pulmonary tuberculosis in the work area of Lhoong CHC Aceh Besar District in 2018.

Methods: This was an observational study with case control design. The total samples were 39 people including 13 case samples plus 26 control samples during 2018. Data for the independent variables were obtained by questionnaire, observation and measurement. Data analysis used chi square.

Results: Bivariate analysis resulted that ventilation, lighting, occupancy density, humidity, and type of floor were related to the incidence of pulmonary TB in the work Area of Lhoong CHC, Aceh Besar District. The multivariate analysis resulted that occupancy density (OR= 30.8; 95%CI= 2.8-336.4) and ventilation (OR= 17.2; 95%CI= 1.6-178.9) were the most risk factors of pulmonary TB.

Conclusions: Occupancy density and ventilation were the most risk factors of pulmonary TB in the work area of Lhoong CHC Aceh Besar District in 2018.

Keywords: Pulmonary TB, occupancy density, ventilation, Aceh.

INTRODUCTION

According to Law of the Republic of Indonesia No. 36 of 2009 on Health article 1 paragraph 1, Health is a state of complete physical, mental, spiritual and social well-being which enables everyone to live productively socially and economically. [1] A poor environmental sanitation can become a way for disease transmission. The occurrence of environmental-based diseases is caused by the interaction between humans and the environment, especially for people who spend a lot of time at home. If the sanitation of the house environment is not well maintained, it has the potential to cause an illness. Some environmental-based diseases include Acute Respiratory Tract Infection (ARI), diarrhea, malaria, Dengue Hemorrhagic Fever (DHF), Tuberculosis (TB), helminthiasis, and skin diseases. [2]

Tuberculosis is a disease that becomes a global concern. [2,3] Globally, TB is one of the top 10 causes of death and the leading cause from a single infectious agent. Millions of people were infected with TB each year. In 2017, TB caused an estimated 1.3 million deaths. It is estimated that 10 million people infected TB in 2017. There were cases in all countries and age groups, but overall 90% were adults (aged ≥ 15 years) and two thirds were in eight countries: India (27%), China (9%), Indonesia (8%), the Philippines (6%), Pakistan (5%), Nigeria (4%), Bangladesh (4%) and South Africa (3%). [2]

Tuberculosis is still a major public health problem. [4] The disease is often associated with a slum environment. [5] House environmental factors that can affect the incidence of pulmonary TB include ventilation of the room, humidity, temperature, lighting, type of floor, and occupancy density. [6,7]

Based on health profile of Aceh Besar District Health Office, the incidence of tuberculosis in Aceh Besar District in 2013 was 73.23 per 100,000 people with a total of 272 cases with the highest cases in Subulimum Subdistrict (26 cases), followed by Darul Imarah Subdistrict (23 cases) and Kuta Baro Subdistrict (18 cases) and Seulawah Valley Subdistrict (18 cases). [8]

From the health profile data in Lhoong Community Health Center (CHC) in 2015 the number of suspected tuberculosis screening had not been able to reach the target of 70% of the population; however the prevalence of pulmonary TB cases had increased. In 2015 pulmonary TB cases were 5 people, whereas in 2016 pulmonary TB cases were 13 people from an estimated 16 new cases. [9] From the results of a study conducted by Rosiana it was found that there was a significant correlation between the type of floor, type of wall, lighting intensity and humidity with the incidence of pulmonary TB. There was no correlation between bedroom occupancy density and ventilation area with the incidence of pulmonary tuberculosis. [6] Research conducted by Mayangsari and Korneliani, it was found that the mean of age of respondents was 40-45 years, there were 38% of male respondents and 62% of female respondents. The study showed that there were correlations between occupancy density, bedroom occupancy density, there is a relationship between bedroom windows and ventilation with the incidence of pulmonary TB. [10]

This study aims to determine the correlation between physical condition of house environment and the incidence of pulmonary TB in the work area of Lhoong CHC Aceh Besar District.

MATERIAL AND METHODS

The type of study design used here was a case-control study. The population of this study were AFB positive pulmonary TB patients who were treated at Lhoong CHC in Lhoong Subdistrict for the past year. In 2017 there were 13 positive pulmonary TB sufferers with a comparison between cases: control = 1:2, which consisted of 13 respondents in the case group and 26 respondents in the control group, thus the total number of samples was 39 people. Cases were respondents who had AFB positive pulmonary TB with a history of clinical symptoms recorded at the Lhoong CHC, became the part of the pulmonary TB management. Controls were people who lived around the cases, usually the closest neighbors who did not have pulmonary TB.

The study location was in Lhoong Subdistrict in the work area of Lhoong Community Health Center in Aceh Besar District. The study was conducted in February 2018. The instruments used in this study were questionnaires, observation sheets, hygrometers used to measure air humidity and lux meters. Data analysis was conducted with statistical tests used Chi Square test.

RESULTS

The number of respondents was 39 respondents, consisting of 13 case respondents, and 26 control respondents. The characteristics of respondents are presented in Table 1 below:

Table 1. Characteristics of cases (n=13) and controls (n=26) of respondents of Pulmonary TB, in the work area of Lhoong CHC, 2018

Variables	Number of Case (%)	Number of Control (%)
Gender		
Male	8 (61.5)	18 (69.2)
Female	5 (38.5)	8 (30.8)
Age (year)		
8-18	1 (7.70)	0 (0)
19-50	6 (46.15)	16 (61.54)
>50	6 (46.15)	10 (38.46)

Table 1 showed that 61.5% of respondents infected by pulmonary TB were male and mostly were in the age group of 19-50 and >50 years (46.15%). The study

results on the physical condition of the house related to the incidence of pulmonary TB in the Work Area of Lhoong CHC in 2018 are presented in Table 2 below:

Table 2. Results of bivariate analysis of physical condition of the house and the incidence of Pulmonary TB in the work area of Lhoong CHC, 2018

Variables	Cases (%)	Controls (%)	P value	OR (95% CI)
Ventilation				
Not eligible	11 (84.6)	7 (26.9)	0.002	14.9 (2.6-84.9)
Eligible	2 (15.4)	19 (73.1)		
Lighting				
Not eligible	8 (61.5)	7 (26.9)	0.04	4.3 (1.1-17.9)
Eligible	5 (38.5)	19 (73.1)		
Occupancy density				
Not eligible	9 (69.2)	2 (7.7)	0.000	27 (4.2-173.8)
Eligible	4 (30.8)	24 (92.3)		
Humidity				
Not eligible	13 (100)	7 (26.9)	0.000	-
Eligible	0 (0)	19 (73.1)		
Type of floor				
Not eligible	8 (61.5)	0 (0)	0.000	-
Eligible	5 (38.5)	26 (100)		
Temperature				
Not eligible	10 (76.9)	23 (88.5)	0.310	0.4 (0.1-2.5)
Eligible	3 (23.1)	3 (11.5)		

Table 2 showed that the physical condition of the house: ventilation, lighting, occupancy density, humidity and type of floor were related to the incidence of pulmonary TB in the work area of Lhoong CHC in Aceh Besar District (p value <0.05) while there was no significant correlation between temperature and the incidence of Pulmonary TB (p value >0.05).

Table 3. Results of multivariate analysis of physical condition of the house and the incidence of Pulmonary TB in the work area of Lhoong CHC, 2018

Variables	P value	OR	95% CI
Occupancy density	0.005	30.8	2.8 – 336.4
Ventilation	0.017	17.2	1.6 – 178.9
Constant	0.004	0.00	

The multivariate analysis showed that the most related factor of pulmonary TB in the work area of Lhoong CHC was occupancy density (P value: 0.005).

DISCUSSION

House ventilation is related to pulmonary TB because in general the houses of people with pulmonary TB have ventilation in the form of windows but the windows are not opened because they are ashamed to open them since it will be visible to outsiders. [6] There was a correlation between ventilation and the incidence of pulmonary TB in accordance with the results of a study conducted by Toni Lumban Tobing on the Effect of

Behaviors of the Patients with Pulmonary TB and Sanitary Conditions on the Prevention of Potential Transmission of Pulmonary TB. [8] The similar result was also found in the study conducted by Helda Suarni on the risk factors associated with the incidence of pulmonary TB in Pancoran Mas District Depok in 2009. [11]

From the study results it can be seen that the most of the lighting condition in case and control was the eligible lighting condition of 53.8%, while not eligible lighting condition was 46.2%. In non eligible lighting condition, there were 61.1% of respondents in case and 38.9% of respondents in control. The results of the statistical test obtained a value of p <0.05 (p=0.036), then there was a significant correlation between the lighting condition and the incidence of pulmonary TB in the work area of Lhoong CHC in Aceh Besar District. Odds ratio of 1.056 indicated that respondents who had poor lighting condition were at risk of 1,056 times infected with pulmonary TB than respondents who had good lighting.

This is in accordance with the results of a study on the correlation between house environmental factors and the incidence of pulmonary TB transmission in households. [3,6] The study found that poor lighting condition was at risk of being exposed to

pulmonary TB when compared to houses with sufficient sunlight. [12,13]

Lighting condition was a significant risk factor. It can be seen from the study results above. With poor lighting, the development of pulmonary TB germs will increase because sunlight is one of the factors that can kill the pulmonary TB germs. Thus, if the lighting is good then germs transmission and proliferation can be prevented. This had a significant correlation because air humidity is one of the factors that cause the growth of bacteria especially tuberculosis bacteria which can thrive and multiply well. Respondents with AFB Positive Pulmonary Tuberculosis living in houses with high humidity were correlated to the incidence of AFB positive pulmonary tuberculosis because it is a good medium for the growth and proliferation of tuberculosis germs. The higher the air temperature, the lower the humidity will be. This will increase body heat loss and the body will try to balance the temperature of the environment through the evaporation process. This loss of body heat will reduce the body's vitality and is a predisposition factor to infection by an infectious agent. [14]

In the study conducted by Toni Lumban Tobing on the Effect of Behaviors of the Patients with Pulmonary TB and Sanitary Conditions on the Prevention of Potential Transmission of Pulmonary TB among Families in North Tapanuli District, it was found that occupancy density condition had a significant correlation with TB disease. It can be seen from the Odds Ratio of 3.3 which meant that people living in environment with poor occupancy density were at risk of pulmonary TB transmission by 3.3 times more than those living in environment with good occupancy density condition. [12] The occupancy density greatly influenced the transmission of pulmonary TB disease, because the pulmonary TB can be transmitted through air media so that these germs are easily transmitted when the house is located in a dense area. [3] If the house is not in a dense area, the circulation becomes smooth so that patients and other

family members can be prevented from the transmission of pulmonary TB. [15,16]

There was a significant correlation between the condition of the floor type and the incidence of pulmonary tuberculosis in the work area of Lhong CHC in Aceh Besar District. Odds ratio of 0.000 indicated that respondents who had poor type of floor had the same risk with those who had good type of floor to be infected with pulmonary TB. This is in accordance with the results of a study conducted by Toni Lumban Tobing on the Effect of Behaviors of the Patients with Pulmonary TB and Sanitary Conditions on the Prevention of Potential Transmission of Pulmonary TB. The study found that the floor had an effect on the transmission of TB. [12] However, there was also a study conducted by Rustono on the factors related to the incidence of pulmonary TB which found that dirty floors and dust can be a vehicle for transmission of TB if the patient removes saliva or phlegm on the floor.

The study results found that the total of not eligible temperature condition in case and control was 85.6% and eligible temperature condition was 15.4%. It can be seen that not eligible temperature condition was more than eligible temperature condition. Although in this study the temperature did not have a correlation ($p=0.3$) with the incidence of pulmonary TB, the temperature still had a role in the transmission of pulmonary TB. Mycobacterium tuberculosis bacteria have a preferred temperature range, but in this temperature range there is an optimum temperature that allows them to grow tightly. Mycobacterium tuberculosis is a mesophilic bacteria that thrives in a range of 25-40° C, but will grow optimally at the temperatures of 31-37° C. [17]

CONCLUSIONS

There were correlations between ventilation, lighting, humidity, occupancy density, type of floor with the incidence of pulmonary tuberculosis and there was no correlation between temperature and the incidence of pulmonary tuberculosis in the

Work Area of Lhoong CHC, Aceh Besar District

Recommendations

There is an importance of counseling about the negative implications of pulmonary TB disease to patients related to the cause of pulmonary TB infection, how to prevent pulmonary TB disease and appropriate treatment methods for pulmonary TB disease, counseling about healthy house environment, especially in pulmonary TB patients who live in high density houses, as well as temperature, ventilation, humidity, types of floors that do not meet the requirements to prevent the severity of pulmonary TB disease. Community empowerment should be increased by training cadres to improve surveillance of case finding and help prevent transmission of pulmonary TB disease.

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