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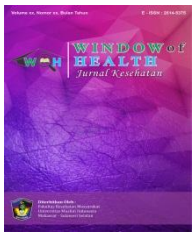

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Behavior and Home Environment Effect on the Air Germs Number in Tuberculosis Patients' Houses

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ABSTRACT

The presence of germs, including Tuberculosis germs, in the house is greatly influenced by home environmental factors and TB sufferers' behavior. This research aim is to determine the influence of home environmental factors and behavior on the number of air germs in the tuberculosis patient's house in Kupang City. This observational research was conducted with purposive sampling in 21 homes with 21 TB patients from 86 patients from 2 Community Health Centers in Kupang City, NTT, Indonesia. The number of air germs with MPN coliform examination is measured based on laboratory examination. The independent variables are the number of people sleeping in the same room, type of walls, type of floor, ventilation conditions, wearing masks in the house, drying mattresses/pillows, place to expel phlegm, type of cooking fuel, smokers, sunlight entering the bedroom, sunlight entering the room. Going out, and passive smoking. The data collected was then analyzed using multiple regression, and result in the equation : Number of Air germs = -203,614 + 59,538Ventilation Conditions + 86,333Drying MattressPillows + 63,841Smoking + 83,515Mthr Light to Room. The model shows that 61% of the number of air germs in the Tuberculosis patient's house is influenced by ventilation conditions, the habit of drying cases and pillows, the ability to smoke, and sunlight entering the rooms of Tuberculosis sufferers. This regression model is suitable for predicting the number of room air germs, where the fewer ventilation conditions, the germ number will increase, so the less frequently drying mattresses and pillows can also impact increasing the number of air germs in the homes of Tuberculosis sufferers. The number of room germs will also increase with smoking behavior and lack of direct sunlight in the bedroom.

Keywords : Air Germ Numbers; Behaviour; Home Environment

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INTRODUCTION

Tuberculosis (TB) is a disease transmitted through the respiratory tract and caused by the bacterium Mycobacterium tuberculosis. Tuberculosis is still a public health problem in the world, including in Indonesia.[1] TB cases and deaths due to TB in Indonesia are still high, namely cases reaching 1,000,000 cases.[2] The number of pulmonary TB cases in Kupang City is still high compared to the number of cases in other districts in East Nusa Tenggara Province.[3]

Tuberculosis (TB) is a disease transmitted through the respiratory tract and caused by the bacterium Mycobacterium tuberculosis. Tuberculosis is still a public health problem in the world, including in Indonesia.[1] TB cases and deaths due to TB in Indonesia are still high, namely cases reaching 1,000,000 cases.[2] The number of pulmonary TB cases in Kupang City is still high compared to the number of cases in other districts in East Nusa Tenggara Province.[3]

TB transmission occurs due to several factors, including TB germs, individual factors, and environmental factors.[4,5] The presence of TB germs in the house greatly determines the occurrence of TB transmission, where the number of germs in the house can be influenced by several factors such as temperature, humidity and lighting. House ventilation conditions, as well as density in the house and other environmental factors.[6–9] Community behavior has also been proven to be related to the incidence of TB transmission, which is no less important than home environmental factors.[10,11]

Wearing a mask or covering your mouth/nose when coughing/sneezing and washing your hands with soap and running water can be done as measures to prevent the incidence and transmission of TB.[2] Case detection and regular and thorough treatment must be carried out to break the chain of TB transmission. Implementing clean and healthy living behavior, improving community nutrition, and administering the BCG vaccine are also needed to increase the body's resistance to TB transmission.

Environmental factors greatly influence the existence of TB germs.[5,7] The general characteristics of germs in the air are similar to those of TB germs, so if TB germs are successfully reduced, the risk of Tuberculosis transmission will also decrease. The general aim of this research is to determine the influence of environmental factors and behavioral factors on the number of air germs in the homes of tuberculosis sufferers.

METHOD

This research is an observational study with a cross-sectional study design conducted in 2 community health centers in Kupang City, NTT Province, Indonesia. This research explains the factors that influence the number of airborne germs in the homes of tuberculosis sufferers. This research was conducted using a purposive sampling technique to get the research samples on a research sample of 21 houses from 21 TB patients in 2 Community Health Centers in Kupang City, NTT Province, Indonesia. The respondent requirements are stated as still being a tuberculosis sufferer, being willing to voluntarily become a respondent, and being willing for their house to be observed and air samples taken in their room. The obstacle in selecting samples was the large number of Tuberculosis patients who did not want

to be involved in this research, besides that at the time of the research there were already cases that were declared cured and had completed treatment, so that from a total of 86 tuberculosis cases in 2 health center areas, in the end only 21 people were willing to be research samples. The dependent variable is the number of air germs with MPN coliform examination, which is measured based on laboratory examination. The independent variables are behavioral factors, which include the number of people sleeping in the same room, wearing masks in the house, drying mattresses/pillows, places to expel phlegm, types of cooking fuel, smoking, and passive smoking. Meanwhile, independent variables for home environmental factors include wall type, floor type, ventilation conditions, sunlight entering the bedroom, and sunlight entering the outside room. The independent variables were obtained by interview using a questionnaire. Primary data from independent and dependent variables, were collected and then analyzed using multiple regression tests in SPSS 23 and presented in table form. The research has received ethical approval from Poltekkes Kemenkes Kupang with Number LB.02.03/1/0008/2022 dated March 4, 2022. During the research, the researcher pays attention to the ethical principles of information to concentrate, respect for human rights, benefits and non-maleficence

RESULTS

Table 1 shows that the average number of air germs in the home of Tuberculosis sufferers is 240.29, while the average number of people sleeping with Tuberculosis sufferers is 1.62, or not all the TB patients sleep with other people in the same room. Table 1 also shows that the Pearson correlation value is 0.217 with a p value of 0.345, which means there is no relationship between the number of people sleeping in the room with Tuberculosis sufferers and the average number of germs in the room with Tuberculosis sufferers.

Table 1. Relationship between the number of people sleeping and the number of air germs in the tuberculosis patient's room

Variabel	N	Mean	Min – Max	SD	Pearson Correlation	Nilai p
Average Air Germ Rate	21	240.29	85 – 468	103.83	0.217	0.345
Number of Sleeping in the Patient Room	21	1.62	1 - 3	0.74		

Table 2 show that 81% TB patients have a permanent wall's house or their house made from brick wall, with 66.7% with ceramics as floor. Most of the TB patients (61.9%) have houses ventilation and mostly open it in the day, and almost of the TB patient are rarely or never drying mattresses/pillow. Table 2 also show that most of the TB patients never wearing a mask when they are at home, and as many 95.2% don't have special place to get rid of their phlegm. Around 71.4% of the TB patients are using kerosene or firewood, and almost half of the TB patients are smoker. Sunlight can enter the bed room just for 23.8% houses of TB patients, even though as many 76.2% the sunlight can enter the living room, as seen as in Table 2.

Table 2. Correlation between Home Conditions and Behavior with the Average Number of Air Germs in Houses of Tuberculosis patients in Kupang City

Variable		Number (%)	Mean air germ	SD air germ	SE air germ	p value
Wall Type	Permanen (1)	17 (81.0)	223.88	98.586	23.911	0.139
	Semi/Not Permanent (2)	4 (19)	310.00	109.681	54.841	
Floor Type	Ceramics (1)	14 (66.7)	208.29	101.588	27.150	0.042
	Cement/Soil/Plywood (2)	7 (33.3)	304.29	80.045	30.254	
Ventilation Conditions	Available and Open (1)	13 (61.9)	211.62	83.023	23.026	0.108
	Not Open/None (2)	8 (38.1)	286.88	122.386	43.270	
Wear a mask at home	Yes (1)	5 (23.8)	230.60	142.928	63.919	0.818
	No (2)	16 (76.2)	243.31	94.263	23.566	
Drying Mattresses/ Pillows	Less than a month (1)	12 (57.1)	186.42	73.998	21.361	0.003
	Rarely / Never (2)	9 (42.9)	312.11	96.259	32.086	
Place to Get Rid of Phlegm	special can (1)	1 (4.8)	284.00	-	-	0.677
	Floor/Outside of the House (2)	20 (95.2)	238.10	106.030	23.709	
Types of Cooking Fuel	LPG/Electricity (1)	6 (28.6)	209.50	73.932	30.183	0.404
	Kerosene, Firewood (2)	15 (71.4)	252.60	113.491	29.303	
Smoker	Not Smoker (1)	12 (57.1)	207.83	77.221	22.292	0.099
	Smoker (2)	9 (42.9)	283.56	122.745	40.915	
Sunlight in the bed Room	Can Enter (1)	5 (23.8))	169.00	79.000	35.330	0.078
	Can not enter (2)	16 (76.2)	262.56	102.404	25.601	
Sunlight in the family room	Can Enter (1)	16 (76.2)	218.31	99.116	24.779	0.082
	Can not enter (2)	5 (23.8	310.60	94.614	42.313	

Based on Table 2, what can be included in the multivariate test are variables that have a relationship with germ numbers with a p value <0.25, namely wall type, floor type, ventilation conditions, mattress and pillow drying habits, smoking, sunlight entering the room, and sunlight entering the family room. Meanwhile, variables that have a significance value <0.25 cannot be included in the multivariate test, namely the number of people sleeping in the same room as someone with tuberculosis, wearing a mask at home, a place to expel phlegm, type of cooking fuel, and passive smoking.

Multivariate tests using multiple linear regression with the backward method found that the variables that influenced the average number of germs in the air of a room with tuberculosis sufferers were the light entering the family room, the type of walls and ventilation conditions. The Summary model shows a value of 0.615, which means that 61% of the number of air germs in the homes of Tuberculosis sufferers is influenced by the light entering the family room, the type of walls and ventilation conditions. Based on the resulting regression model, the F value is 0.003, it is stated that this regression model is fit (suitable) with the existing data or it is stated that the model can significantly predict the variable number of room air germs. The resulting regression equation is: Air Germ Rate = -203.614 + 59.538 Ventilation Conditions + 86.333 Drying Pillow Mattress + 63.841smoker + 83.515 Sunlight into the room.

DISCUSSION

Tuberculosis are still a major disease in the world, Indonesia and also in the Province of East Nusa Tenggara (NTT). The role of the environment in the spread of Tuberculosis is very large, so this disease is grouped under Environmental Based Diseases. Many people still have poor knowledge regarding Tuberculosis and how it is transmitted and prevented[12], so this is also the reason why Tuberculosis cases remain high and even tend to increase.

This study also found that there are still many TB sufferers who behave poorly in preventing TB transmission. This is also likely due to the lack of public knowledge in preventing TB. This research found that most of the TB patients (61.9%) have houses ventilation and mostly open it in the day. In another condition, even though the ventilation is open in the day bu the sunlight can enter the bed room just for 23.8% houses of TB patients. It means that 76.2% bed room is dark without sunlight and this condition is good for the breeding of germs in the room including TB germs. So, it is necessary to make efforts to increase the ventilation area or place ventilation in the direction of sunlight so that it can enter the bedroom directly and can kill germs in the room and prevent the transmission of TB to family members who also sleep or often do activities in the room.

This research also found that most of the TB patient are rarely or never drying mattresses/pillow. Drying bedding regularly needs to be done, especially for equipment belonging to TB sufferers. This aims to keep the bedding dry and not damp so that germs that are still attached to the bedding with phlegm can also die. However, if the bedding can be washed, then wash it as soon as possible after use.

This research also found that most of the TB patients never wearing a mask when they are at home, and most of them also don't have special place to get rid of their phlegm. Tuberculosis is transmitted through droplets containing TB germs that come out when coughing, sneezing and talking. So, if TB sufferers do not wear masks either inside or outside the home, the risk of transmitting to family members and people with close contact is very high. So it is necessary for TB sufferers to get used to always wearing masks wherever they are. The use of this mask is not only important to prevent the transmission of TB but also to prevent the transmission of other respiratory infections. Likewise, the preparation of a special place to dispose of phlegm for TB patients is very necessary. If phlegm is disposed of carelessly, the germs that are still alive in the phlegm are at risk of being transmitted to people around them. The use of masks must also be considered, namely choosing a mask with small pores so that it can filter viruses, germs and other small particles that will enter the respiratory tract. In addition, masks must be replaced every 4 hours and washed immediately after use.[13]

Tuberculosis requires a long time for treatment, so there are still negative behaviors in treatment and non-compliance with this treatment [14]. This causes Tuberculosis treatment to be incomplete and can cause resistance to anti tuberculosis drug so that Mycobacterium tuberculosis germs in the body can no longer be killed with anti-tuberculosis drug.[15] Therefore, it is better to prevent the transmission of TB

because once you are sick, it will take a long time to heal and will also have an impact on decreasing productivity for TB sufferers.

The germ numbers in this study generally still meet the requirements because they are still below the threshold, namely <700 CFU/m^3, but in this study it is not possible to identify whether the existing germs are pathogenic or non-pathogenic, where the requirement for biological pathogenic germs in the air at home is 0 CFU/m^3.[16] Research in 2 areas, Oebobo Community Health Center and Oesapa Community Health Center, Kupang City, found a risk factor regression equation for the number of air germs, where the equation was able to predict the number of germs by 61%.

The equation produced in this research is: Number of Air Germs = -203,614 + 59,538 Ventilation Conditions + 86,333 Drying Mattress Pillows + 63,841 Smoker + 83,515 Sun Light to Room. This equation explains that with increasingly poor ventilation conditions, the number of germs will increase, so the less frequent drying of mattresses and pillows can also have the impact of increasing the number of air germs in the homes of Tuberculosis sufferers. The number of room germs will also increase with smoking behavior and lack of direct sunlight into the bedroom. The number of indoor air germs has been proven to be related to the incidence of Tuberculosis ($p < 0.05$).[17]

The relationship between ventilation and the number of air germs in this study is that the worse the ventilation, or in other words, the absence of ventilation in a house or the ventilation being there but not open, it will result in an increase in the chances of the occupants of the house contracting TB. The relationship between ventilation conditions and the incidence of pulmonary tuberculosis has also been proven in research at the Aceh Besar Community Health Center with an Odds Ratio (OR) value of 14.9 or the risk of people with houses whose ventilation does not meet the requirements has a risk of 14.9 times greater than the risk of people with houses whose ventilation does not meet the requirements. Condition.[18] Likewise, previous research in Kupang City found that poor house ventilation conditions caused house occupants to have a 16.3 times higher risk of contracting tuberculosis compared to those in houses whose ventilation did not meet the requirements.[9] The existence of ventilation here is needed, not just whether it is present or not, but in previous research it was stated that the wider the ventilation, the lower the chance of the occupants of the house getting Tuberculosis and conversely, the bigger the ventilation area, the greater the risk of getting Tuberculosis.[19]

The importance of ventilation in maintaining air health for TB patients is with ventilation that meets the requirements, namely a minimum area of 10% of the floor area of the room and is open so that it allows for the exchange of indoor air with outside air which has an impact on reducing the density of germs in the room. In addition, good ventilation is what allows sunlight to enter the house so that it can kill germs in the house.[15] Good ventilation should be allows air to flow from indoors to outdoors and cleaner outdoor air to flow into the room. When a patient coughs, they can emit air droplets (droplet nuclei) containing Mycobacterium tuberculosis. Once a patient coughs, he can produce around 3,000 droplets of phlegm. If these germs stay in the room air for too long without ventilation that can move them outside, this will increase the risk of transmitting tuberculosis in the room. Apart from being useful

for circulating air, ventilation is also useful as a way for sunlight to enter the room, especially ultra violet rays in the morning. Sunlight is useful in killing germs that cause Tuberculosis, so dark rooms without sunlight, rooms that have no or lack of ventilation are at risk of having a high number of germs in the room and are at risk of increasing the transmission of Tuberculosis.

The benefits of ventilation will be maximized if it is located, paying attention to several aspects such as location and area. Placing ventilation (the way for sunlight and air to enter) needs to be in the right position, considering that the heat generated by solar radiation can damage and cause discomfort.[20] Rooms that need ventilation are bedrooms, family rooms, kitchens and bathrooms. Ventilation is expected to be able to filter light waves entering the house, so that the lighting entering the house is sufficient but does not cause an excessive increase in room temperature. These four rooms need to be ventilated because people often do activities in these rooms and the whole family also often enters and does activities in these rooms, so the ventilation here is expected to be able to circulate air containing infectious droplets and other sources of pollutants to the outside of the room and also let in sunlight to kill germs in the room.

The regression equation in this study also explains that the number of air germs is influenced by the habit of drying mattresses, pillows and other sleeping equipment. This is in accordance with previous research where it was said that the habit of drying mattresses had a risk of being infected with Tuberculosis 3,535 times higher than those who had the habit of regularly drying mattresses.[21] This is because by regularly cleaning the room, including drying the mattress and pillow, you can clean and kill germs in the room and reduce the number of germs in the room, including in the air in the room, as has been proven in previous research that the habit of cleaning a room is related to incidents ARI (acute Respiratory Infection) (p 0.001).[22] ARI and Tuberculosis are both environmental-based diseases which are transmitted in the same way, namely through droplets from sufferers containing the germs of the disease, so that if the room is rarely cleaned, including rarely drying mattresses and pillows, the risk of transmission of ARI and Tuberculosis will be high. This habit of cleaning the room requires the role of the family because usually there is a division of roles and responsibilities within the family for cleaning the room, and in many areas there are still many opinions that the responsibility for cleaning the house is the responsibility of the housewife, so that even if her husband is sick, he is responsible for cleaning. is his wife. This is in accordance with previous systematic review research where the influence of culture and family behavior in the transmission of tuberculosis.[23]The equation in this study found that smoking behavior also influences the increase in the number of airborne germs. The direct impact of smoking is air pollution in the house, and this has the effect of increasing the risk of Tuberculosis for the occupants of the house and also worsening the health conditions for Tuberculosis sufferers in the house. So, to reduce air pollution in the house, it is best not to smoke in the house.[16] The relationship between smoking behavior, duration of smoking and number of cigarettes per day has also been proven to be related to the incidence of tuberculosis ($p < 0.05$).[24] Smoking behavior often triggers a person to suffer from coughing or coughing more frequently for someone with a cough who is still smoking. Likewise, if a

Tuberculosis sufferer continues to actively smoke, it will stimulate him to cough more frequently. The more frequently you cough, the more droplets you emit, and in Tuberculosis sufferers the more Mycobacterium germs they expel through these droplets. The more Tuberculosis germs in the air in the house, the higher the risk of Tuberculosis transmission in the house. This condition can explain why in this study the number of air germs in the homes of Tuberculosis sufferers is related to smoking behavior, that is, the more often you smoke, the worse the sufferer's condition is, which results in more frequent coughing and more droplets containing Tuberculosis germs in the room of the house. According to Zainal (2010), it is stated that continuous smoking habits lead to damage to the lung defense mechanism, so that vibrating books and other parts of the lung organs will also be damaged due to continuous inhalation of cigarette smoke.[24] Seeing this condition, it is best for people who are already suffering from Tuberculosis not to smoke anymore, so that the respiratory organs do not become more problematic.

The number of germs in this study is also influenced by the presence of sunlight, where the more sunlight that enters the house, the more germs in the room will be reduced. On the other hand, if less sunlight enters the room, the number of germs in the house will increase. Sunlight, especially ultra violet light, can kill germs, including tuberculosis germs. If direct sunlight can enter the house, the growth of germs in the house can be inhibited and can even die, thereby reducing the risk of Tuberculosis transmission in the house. Previous research has proven that room lighting is related to with the number of germs in the treatment room in the hospital.[25]

Previous research has proven that room lighting is related to the number of germs in hospital treatment rooms[25] and apart from that lighting has been proven to be related to the incidence of Tuberculosis.[26] The source of room lighting can be sunlight or light from ultra violet (UV) lamps, where this light must always be present so that the room is bright and does not become an optimal place for germs to breed. To increase the amount of sunlight entering the house, it is necessary to increase the number of entry points such as windows, vents and glass tiles or by providing room lighting using UV lamps.[27]

Many types of germs and viruses can have their growth inhibited or even killed by sunlight, for example tuberculosis germs and viruses SARS-CoV-2.[28] so this will be useful in preventing the transmission of Tuberculosis.[27] By producing this research equation, it can provide information to the public about the importance of preventing the transmission of Tuberculosis, especially by improving or increasing the ventilation of the house so that it allows sunlight to enter the rooms and also other family rooms. This aims to prevent killing germs in the room, including tuberculosis germs. Apart from that, providing information to the public that drying cases/pillows regularly is very important in preventing the transmission of Tuberculosis because it can maintain the humidity of mattresses and pillows and kill germs that might stick to them. The weakness of this research is that it was only conducted on a group of Tuberculosis sufferers and only used samples of Tuberculosis sufferers.

CONCLUSIONS AND RECOMMENDATIONS

This regression model is suitable for predicting the number of room air germs, where the less ventilation conditions, the germ number will increase, so the less often you dry the mattress and pillow, it can also have an impact on increasing the number of air germs in the home of Tuberculosis sufferers. The number of room germs will also increase with smoking behavior and lack of direct sunlight into the bedroom.

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