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# Environmental factors determine the occurrence of pulmonary tuberculosis

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## 1 Environmental factors determine the occurrence of pulmonary tuberculosis

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### ABSTRAK

**Latar Belakang:** Environment yang terdiri dari kepadatan tempat tinggal, ventilasi rumah, kelembaban ruangan, dan pencahayaan, dianggap sebagai salah satu faktor penyebab penularan tuberculosis (TB) paru. Penelitian saat ini bertujuan untuk mengetahui faktor lingkungan yang menentukan terjadinya TB paru di Kota Surabaya.

**Tujuan:** Tujuan penelitian saat ini adalah untuk mengetahui faktor lingkungan yang menentukan kejadian tuberculosis (TB) paru di Kota Surabaya

**Metode :** Ini adalah penelitian kuantitatif observasional yang dilakukan dengan pendekatan cross sectional. Orang dengan TB paru yang terdaftar untuk berobat di Puskesmas Perak Timur dan Puskesmas Jagir di Kota Surabaya direkrut sebagai populasi penelitian. Sedangkan sampel penelitian adalah pasien dengan TB paru di kedua Puskesmas. Simple random sampling digunakan untuk mengumpulkan 130 pasien sebagai responden. Variabel penelitian meliputi kepadatan hunian, ventilasi rumah, kelembaban ruangan dan pencahayaan. Pengambilan data dilakukan melalui survei dengan melakukan pengukuran suhu ruangan, kelembaban udara dan pencahayaan. Data yang diperoleh kemudian dianalisis univariat dan bivariat. Dan selanjutnya uji statistik menggunakan regresi logistik.

**Hasil:** Uji statistik bivariat melalui regresi linier didapatkan hasil bahwa pada keempat variabel penelitian menunjukkan bahwa kepadatan hunian memiliki OR=0,671, ventilasi rumah memiliki OR=2,874, kelembaban ruangan memiliki OR=1,231, dan pencahayaan rumah memiliki OR=1,170. Keempat, faktor lingkungan bukanlah penyebab penyakit TB, karena hasil uji statistik menunjukkan bahwa nilai OR di atas 0,5

**Kesimpulan:** Dapat disimpulkan bahwa kepadatan perumahan, pencahayaan, dan ventilasi rumah tidak mempengaruhi terjadinya tuberculosis paru. Kemungkinan besar itu disebabkan oleh faktor-faktor yang tidak berasal dari lingkungan tempat tinggal. Saran untuk penelitian ke depan perlu pemeriksaan swab udara di sekitar tempat tinggal pasien TB.

**KATA KUNCI :** penentu; faktor lingkungan; tuberculosis paru-paru; ventilasi; kepadatan hunian

### ABSTRACT

**1 Background:** Environment consisting of residential density, house ventilation, room humidity, and lighting, is regarded as one of the factors causing the transmission of pulmonary tuberculosis (TB). The current research aimed to figure out the environmental factors determining the occurrence of pulmonary TB in Surabaya City.

**Objectives:** the purpose of the current study was to figure out the environmental factor determining the incidents of pulmonary tuberculosis (TB) in Surabaya City

**Methods :** This was observational research carried out by a cross-sectional approach. People with pulmonary TB registered for treatment at the Perak Timur Community Health Center and Jagir Community Health Center in Surabaya City were recruited as the research population. Meanwhile, the research samples were patients with pulmonary TB in both Community Health Centers. Simple random sampling was utilized to collect 130 patients as respondents. The data obtained were then analyzed using univariate and bivariate logistic regression.

**Results:** The bivariate statistical test on the four research variables showed that residential density had OR=0.671, house ventilation had OR=2.874, room humidity had OR=1.231, and house lighting had OR=1.170. Fourth, environmental factors are not the cause of TB disease, because the results of statistical tests show that the OR value is above 0.5

**Conclusions:** It can be concluded that residential density, lighting, and house ventilation did not influence the occurrence of pulmonary tuberculosis. It was more likely that it was caused by factors which do not come from the living environment. Suggestions for future research need to be an air swab examination around the residence of TB patients

**KEYWORD:** determinants; environmental factors; pulmonary tuberculosis; ventilation; residential density

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## INTRODUCTION

Pulmonary tuberculosis (TB) is an infectious disease that considered a global health problem and mostly occurred in developing countries (1). TB is exacerbated by the presence of comorbidities, one of which is Diabetes Mellitus (DM) (2). On the other hand, it also will be able to worsen the condition of people with Diabetes Mellitus (3). Meanwhile, the transmission of pulmonary TB can also occur in families who are not suffering from diabetes mellitus but living in the same house (1). Basic Health Research in 2018 revealed that the prevalence of DM in adults reached 1.3% at the national level (4),(5).

In Indonesia, the discovery of new tuberculosis patients frequently occurs in family members of patients who suffered from pulmonary TB (6). However, new cases were also found in people with no one suffering from this disease (7). Cases of pulmonary TB in people with diabetes mellitus comorbidity have never been found (8). Pulmonary TB is transmitted through the air (9) when the patient sprinkles mucus or phlegm when coughing or sneezing (10). During this time, the tuberculosis-causing bacteria,

mycobacterium tuberculosis, also come out through the mucus and were carried into the air (11).

In order to figure out whether the environmental condition is one of the factors which influence the transmission of pulmonary TB (12), this study focuses to examine the environmental conditions including residential density (13), house ventilation, room humidity, and house lighting (10). The purpose of the current study was to figure out the environmental factor determining the incidents of pulmonary TB in Surabaya City.

## MATERIALS AND METHODS

The current research was conducted in the working area of Perak Timur Community Health Center and Jagir Community Health Center, Surabaya City. It was carried out from May 2022 to August 2022. Analytical observational research with a cross-sectional design was employed in this research.

Patients who visited the Perak Timur Community Health Center and Jagir Community Health Center in Surabaya were determined as the research population. The

samples were collected using simple random sampling. It was performed by drawing a lottery to patients' registration numbers from both of the Community Health Centers. The number drawn were selected as respondents. In total, there were 130 people involved in this research. The primary data were obtained through direct interviews and the measurement of humidity and lighting using a hygrometer and a lux meter.

Meanwhile, the secondary data were obtained from the medical records of pulmonary TB patients who visited the Perak Timur Community Health Center and Jagir Community Health Center in Surabaya.

The data were then processed electronically by utilizing the SPSS program. The data analysis was carried out by employing univariate and bivariate analysis with odd ratio tests. Then, the analysis results were presented in the form of tables and narratives.

## RESULTS AND DISCUSSION

### RESULTS

There was a change in the number of research samples from 152 to 130 people because 10 respondents dropped out (DO); Of these, 3 people died, 2 people moved their residence, 3 people lived in the same house, and 4 people had an unknown address and did not visit East Perak Community Health Center and Jagir Health Center, Surabaya, for treatment.

There were 70 (53.8%) male respondents found in this research, which was higher than that of female respondents with 60 people (46.2%). Among people with pulmonary TB interviewed, 20 people (15.4%) were aged 40-44 years and 3 people (2.3%)

were aged 15-19 years. Meanwhile, according to their education level, 58 people (44.6%) graduated from high school and 4 people (3.1%) did not graduate from elementary school (Table 1).

4 Table 1. Distribution of respondents' characteristics (N = 130)

Characteristics	N	%
Age:		
Median (IQR), (range), y		
56 (48-76), 74 (12-62)		
Gender:		
Male	70	53.8
Female	60	46.2
Education Level:		
Did not graduate from elementary school	4	3.1
Elementary school	14	10.8
Middle school	34	26.2
High school	58	44.4
Higher education	20	15.6
Occupation:		
Civil Servant	16	12.3
Private employees	14	10.8
Self-employed	21	16.2
Retiree	15	11.5
Students	7	5.4
Farmer	2	1.5
Laborer	3	2.3
Unemployed	51	39.2
Others	1	0.8
Types of housing:		
Permanent	124	95.2
Semi-permanent	6	4.8
Length of stay:		
< 5 years	8	6.2
5 – 10 years	24	22.6
> 10 years	97	71.2
The number of rooms:		
None	4	6.2
One	6	4.8
Two	82	64.2
Three	32	27.4
Four	6	4.6

The statistical regression test analysis conducted on residential density on the incidence of pulmonary tuberculosis at 95% confidence interval (CI) obtained a lower limit of 0.425, an upper limit of 1.862 (0.425<OR<1.862), and OR value of 0.671.

Because the lower limit and upper limit include 1, then  $H_0$  was accepted. Thus, the value of  $OR = 0.671$  was considered insignificant. It indicates that, in this study, a house with dense occupancy was not considered a risk factor for pulmonary tuberculosis. The results of statistical regression test analysis on the variable lighting on the incidence of pulmonary TB at the 95% CI obtained a lower

limit of 0.610, an upper limit of 2.305 ( $0.610 < OR < 2.205$ ), and OR value of 1.170. The lower limit and upper limit include 1, so  $H_0$  was accepted. Therefore, the OR value of 1.170 was considered insignificant. In other words, in this study, a house with inadequate lighting was not a risk factor for pulmonary TB (Table 2).

**Table 2. Environmental factors determining the incidence of pulmonary**

Environmental Determinants	Incidents of pulmonary tuberculosis		Statistical test
	n	%	
Residential density:			
High density	99	40	OR 0.671 (0.425-1.862)
Low density	31	60	
House humidity:			
Has met the requirement	35	26.7	OR 2.874 (1.264-3.531)
Has not met the requirement	95	73.3	
House lighting:			
Has met the requirement	85	65.4	OR 1,170 (0.610-2.205)
Has not met the requirement	45	34.6	
Air ventilation:			
Insufficient	119	91.5	OR 1.231 (0.651-2.345)
Sufficient	11	8.5	

## DISCUSSION

The results showed that the residential density did not lead to the risk of pulmonary TB transmission (14), (10). It can be seen from the statistical test which showed insignificant results because the lower limit and upper limit include 1 (15). This indicates that other factors cause the risk of pulmonary tuberculosis to occur (2). The risk factors may come from other environmental factors (16) including a clean and healthy lifestyle as well as the nutritional intake that has been carried out by pulmonary TB patients (17). The increasing residential density had a significant relationship with the potential for pulmonary TB transmission (18), (13). The current study

found that pulmonary TB patients mostly live in houses with humidity that have met the requirements for a healthy home (19). This is because the house size and the number of rooms were made according to the needs and number of occupants (20); hence, it did not induce tuberculosis transmission in family members who live under the same roof (21).

Besides the house humidity which was regarded as a risk factor for pulmonary TB transmission (22), it was also revealed that house lighting also plays a part as a risk factor for this disease to occur (23). However, it was statistically not significant because the lower limit and upper limit include 1 (24). The results of this study were influenced by the frequency

of measurement which was performed only at 3 points in each room measuring 90 x 90 cm<sup>2</sup> (8). This is intended to eliminate the saturation of respondents when the house was being measured (25). Furthermore, residents who live in houses with lighting that does not meet the health requirements had 2.5 times the risk of being infected with pulmonary TB (26). This study exhibited that in general, patients with pulmonary tuberculosis who seek treatment at the Perak Timur Community Health Center and Jagir Community Health Center in Surabaya showed sufficient air ventilation. The statistical regression test found that there was no significant relationship between air ventilation and the occurrence of pulmonary tuberculosis. However, air ventilation was considered a risk factor since the result showed OR value = 1.220 or > 1. When home visits were conducted to carry out the observation, the windows of each respondent's houses were closed, rarely opened, and some were closed with curtains. Therefore, the air vent was blocked from entering even though the ventilation size has met the requirements. The current result is not in accordance with another research which showed that there was a significant association between home ventilation and the incidence of pulmonary tuberculosis (OR=6.176, p=0.003)–(27).

Sanitation of the living environment is closely related to disease transmission (28), particularly pulmonary TB transmission (29). Houses with good lighting and ventilation will be able to inhibit the growth of mycobacterium tuberculosis(30). Ultraviolet rays from sunlight can kill mycobacterium tuberculosis germs and ventilation that has met the health requirements can help the exchange of air in

the room, thereby reducing the spread of germs(31).

## CONCLUSION AND RECOMMENDATION

Pulmonary TB transmission to family members who live in the same house as pulmonary TB patients were not influenced by residential density, lighting, and air ventilation. It was more likely to be affected by other factors outside the living environment. Therefore, it is necessary to provide health education for the people who live around pulmonary TB patients so that they can carry out a clean and healthy lifestyle. The education given includes wearing masks inside and outside the house, washing hands with running water and using hand sanitizer frequently, and maintaining a safe distance from other people.

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