



## ORIGINAL ARTICLE

# FAMILY SMOKING STATUS AND PHYSICAL HOUSE CONDITION WITH THE PULMONARY TUBERCULOSIS IN PRE-PROSPEROUS ECONOMIC COMMUNITY

*Status Merokok Keluarga dan Kondisi Fisik Rumah dengan Kejadian Tuberkulosis Paru Kelompok Masyarakat Ekonomi Pra-Sejahtera*

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### ABSTRACT

**Background:** According to the 2019 Indonesian Health Profile, there were 663 tuberculosis cases per 100,000 people, with 1,001 cases in Nganjuk Regency during the pre-prosperous period. Poverty had an impact on densely populated housing as well as bad smoking habits. The purpose of this study is to determine the relationships between family smoking status and tuberculosis in the home in the pre-prosperous group. **Methods:** Case group quantitative research was random, including the incidence of TB from January 2019–December 2020 in the working area of Prambon Public Health Center, Nganjuk Regency; the control group took the closest contact neighbor of the case sample. The category of pre-prosperous was based on the 2011 Central Statistics Agency's Social Protection Program. The study was conducted from October 2020–April 2021. Data collection was done through interviews, observation, and measuring the physical house (rollmeter, luxmeter, and a thermohygrometer). Data analysis used chi-square and multivariate tests. **Results:** The bivariate analysis found the correlations on males ( $p$ : 0.02; OR: 3.17), productive age ( $p$ : 0.01; OR: 0.22), smoker ( $p$ : 0.22; OR: 2.42), humidity <40% and >60% ( $p$ : 0.04; OR: 3.14), lighting <60 lux ( $p$ : 0.00; OR: 4.84), ventilation <40% of floor area ( $p$ : 0.04; OR: 3.40), damp floor ( $p$ : 0.01; OR: 3.50) and damp wall ( $p$ : 0.04; OR: 2.81) with TB. Active smoking was the most influential variable (OR 44.00). **Conclusion:** It is hoped that local health agencies will be able to provide more education about smoking habits through the simple implementation of a healthy house area empowerment program.

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### ABSTRAK

**Latar Belakang:** Profil Kesehatan Indonesia 2019 menyatakan terjadi 663 kasus TB per 100.000 penduduk dengan 1,001 kasus di Kabupaten

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Nganjuk dialami masyarakat ekonomi rendah. Kemiskinan berdampak hunian padat penduduk dan kebiasaan merokok buruk. **Tujuan:** Penelitian ini bertujuan untuk mengetahui hubungan status merokok keluarga dan kondisi fisik rumah dengan kejadian TB paru kelompok masyarakat ekonomi pra-sejahtera. **Metode:** Penelitian kuantitatif kelompok kasus secara acak meliputi kejadian TB Paru Januari 2019-Desember 2020 wilayah kerja Puskesmas Prambon Kabupaten Nganjuk, kelompok kontrol mengambil tetangga kontak terdekat sampel kasus. Kategori masyarakat ekonomi pra-sejahtera berdasar Program Perlindungan Sosial Badan Pusat Statistik 2011. Penelitian dilakukan Oktober 2020-April 2021. Pengumpulan data wawancara, observasi dan pengukuran fisik rumah (rollmeter, luxmeter dan thermohyrometer). Analisis data menggunakan uji bivariat chi-square dan multivariat enter. **Hasil:** Ditemukan signifikansi TB paru pada laki-laki ( $p: 0,02$ ; OR: 3,17), usia produktif ( $p: 0,01$ ; OR: 0,22), perokok aktif ( $p: 0,22$ ; OR: 2,42), kelembaban <40% dan >60% ( $p: 0,04$ ; OR: 3,14), pencahayaan <60 lux ( $p: 0,00$ ; OR: 4,84), ventilasi <10% luas lantai ( $p: 0,04$ ; OR: 3,40), lantai lembab ( $p: 0,01$ ; OR: 3,50) dan dinding lembab ( $p: 0,04$ ; OR: 2,81). Ditemukan perokok aktif merupakan variabel paling berpengaruh (OR 44,00). **Kesimpulan:** Melalui hasil penelitian ini diharapkan instansi kesehatan setempat mampu memberikan edukasi lebih mengenai kebiasaan merokok serta implementasi sederhana program pemberdayaan kawasan rumah sehat.

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## INTRODUCTION

The WHO *Global Tuberculosis Report 2020* states that 44% of TB infections occur in Southeast Asia, namely India (26%), Indonesia (8.50%) and China (8.40%). Indonesian humidity is sufficient for the growth of *Mycobacterium tuberculosis* (1). Since 2015, Indonesia's TB infections have reached 331,703 cases with an increase of 562,049 new cases in 2019. This means that, in the last four years, the increase in TB infections has reached 69% (2). The total number of pulmonary TB cases in East Java was 68.84 cases/100,000 populations with Nganjuk Regency being the fourth highest in the residence (3).

Preliminary research studies obtained data from the 2019 Nganjuk TB report, there were 1,001 cases, the highest finding was 8% (90 cases) in the working area of the Prambon Health Center. According to BPS, 2012 underprivileged families occur when they are not able to meet their basic needs so that it has an impact on densely populated housing, bad hygiene and smoking habits (4). TB risk environmental factors include types of walls and floors, humidity, ventilation and residential density (5). Research by Dewi et al. (6) stated that building houses that are not in accordance with health can increase the risk of TB up to 22.15 times. The research of Kakuhes et al. (7) stated

that smoking increases the risk of TB by up to 3.7 times.

Based on this background, the researcher is interested in examining the relationship between family smoking status and physical condition of the house with the incidence of pulmonary TB in economically disadvantaged groups (study in the working area of Prambon Public Health Center, Nganjuk Regency).

## METHODS

This study is a case-control conducted during February-April 2021. The case population was taken based on community medical records data with a history of pulmonary TB January 2019-December 2020 with pre-prosperous economic status in the Prambon Health Center area based on the 2011 Central Statistics Agency Social Protection Program category. Families are declared pre-prosperous when they have not been able to meet the minimum basic needs regarding the physical condition of the house, access to health, education, vehicle ownership and nutritious food (8). The control population includes people who are not economically disadvantaged with pulmonary TB. The sample inclusion criteria included underprivileged residents and a recorded history of pulmonary TB in January 2019-December 2020 in the working area of the

Prambon Public Health Center, Nganjuk Regency and did not carry out any house renovations in the last three months. Sampling theory by Lemeshow et al (9) was used to calculate the proportion of each reference variable from the results of previous studies so that 80 respondents were obtained (40 cases: 40 controls). Case samples were taken randomly from the pulmonary TB medical records data January 2019-December 2020; the control sample took the closest contact neighbors of the case group as well as underprivileged communities.

The dependent variable of this study is the incidence of pulmonary TB, the independent variables are respondents' characteristics (age, gender, education, occupation, income), smoking status (personal and family) and the physical house is appropriate if it meets the requirements (length of stay (< 10 years), temperature (18oC - 30oC), humidity (40% -60%), lighting ( $\geq$  60 lux), occupancy density ( $\geq$  8m<sup>2</sup>/person), ventilation ( $\geq$  10% floor area), type of material floor and wall (watertight without moss or similar fungus found) (10).

Collecting data on respondent characteristics and smoking status used the IFLS questionnaire book 3B point A smoking habits (11). Measurement of the physical house condition Kepmenkes 829/MENKES/SK/VII/1999 used three measuring instruments namely rollmeter (floor and ventilation area), thermohygrometer (humidity and temperature), luxmeter (lighting) measurement at 09.00-14.00 WIB (12). Bivariate analysis was using chi-square test and multivariate analysis multiple logistic regression test. This research was approved by the Health Research Ethics Committee of FKM UNEJ No.03/KEPK/FKM-UNEJ/II/2021.

## RESULTS

### The Correlation between the Characteristics of Respondents and the Incidence of TB

Male sex and unproductive age (15 and >65 years) were found to be associated with TB, with p-values of 0.02, 0.05, and 0.00, respectively. The odds ratio (OR) value shows that men are at risk of being 3,157 more susceptible to TB than women. The productive age variable shows a 95% CI value below 1 (0.08-0.61) including protective factors. The OR value of 0.22 indicates that the productive age group (15–65 years) can reduce the risk of tuberculosis (TB) by 0.2 times when compared to the unproductive age group (15–64 years). Active smokers with the variable status of OR are 3.2

times more susceptible to TB than passive smokers. The characteristics of the respondent can be seen in Table 1.

### The Correlation between Family Smoking Status and TB

Family smoking status in this study consisted of 10 sub-variables. As shown in Table 2, there was no significant relationship between family smoking status and the incidence of pulmonary TB in these ten sub-variables.

### The Correlation between Physical House Condition and TB

This study found the significance of several variables in the physical condition of the house with the incidence of pulmonary TB including humidity <40% and >60% (p: 0.04; OR: 3.14), lighting <60 lux (p: 0.01; OR : 4.84), ventilation area <10% of floor area (p: 0.04; OR: 3.40), damp floor (p: 0.01; OR: 3.50) and damp walls (p: 0.04; OR: 2.81) (Table 3).

### Multivariate Analysis of Family Smoking Status and Physical House Condition and TB

A multiple logistic regression test was carried out in four models, with models 1 and 2 selected. Models 3 and 4 were not selected because there was a change in OR > 10% from the initial OR value, namely the type of floor and family income. It was found that the risk factors for pulmonary TB in economically disadvantaged communities were unproductive age (<15 and >65 years), active smokers, humidity <40% and >60%, lighting <60 lux, ventilation area <10% floor area, and damp walls. It was found that the type of floor and family income were confounding (Table 4).

## DISCUSSION

### The Correlation between the Characteristics of Respondents and the Incidence of TB Gender

The gender significance of this study is in line with Damayanti et al (13) and Marleni et al (14), which stated that the majority of TB are male because of active smokers and high mobility. Most of the men as heads of households in the study sample are also active smokers with high mobility compared to women. Male testosterone inhibits immunity making them susceptible to TB. The female hormone estrogen activates INF-macrophages, enhances immunity and converts BTA(+) to BTA(-).

**Table 1**

The Correlation between the Characteristics of Respondents and the Incidence of TB

Respondents Characteristics	Incidence of TB				<i>p</i>	OR (95% CI)
	TB		Non TB			
	n	%	n	%		
<b>Gender</b>						
Male	23	57.50	12	30.00	0.02*	3.17 (1.25<OR<7.93)
Female	17	42.50	28	70.00		
<b>Age</b>						
Productive	19	47.50	32	80.00	0.01*	0.22 (0.08<OR<0.61)
Not productive	21	52.50	8	20.00		
<b>Education</b>						
< Junior high school	27	67.50	21	52.50	0.25	1.87 (0.75<OR<4.65)
≥ Junior high school	13	32.50	19	47.50		
<b>Employment</b>						
Outdoor	30	75.00	22	55.00	0.10	2.45 (0.95<OR<6.33)
Indoor or not working	10	25.00	18	45.00		
<b>Income</b>						
< UMR Rp. 1.954.705	34	85.00	38	95.00	0.13	0.28 (0.05>OR<1.57)
≥ UMR - Rp. 3.500.000	6	15.00	2	5.00		
Total	40	100.00	40	100.00		

**Age**

There is a significant non-productive age (<15 years and >65 years) with TB. CI<1 and OR values indicate that the productive age group (15-65 years) reduces the risk of TB 0.22 times. The productive age group has more chances of recovery than the unproductive group (<15 years and >65 years). This happens because the elderly group has decreased body functions so they are less able to fight infections, especially pulmonary TB (15).

**Education**

The chi-square study stated that there was no relationship between education level and TB in line with the research of Alnur and Pangestika (5). Most cases of pulmonary TB have been directly controlled by 14 TB cadres in the village of Prambon District. Active TB cadres provide education on six months of TB treatment and prevention efforts. This study states that with limited education and economic status, people still receive appropriate education on prevention and treatment of pulmonary TB.

**Employment**

No significant type of work and TB were found, in line with the research by Namasivayam et al (16). The majority of the research case and control groups worked in the agricultural and trade sectors. The type of work did not have a major

influence on the development of Mycobacterium tuberculosis (16).

**Income**

There is no relationship between family income and TB, in line with research by (17). A tracing (contact investigation) program was carried out by TB cadres in 14 villages in the working area of the Prambon Health Center to find 20-30 suspected close contacts with a history of pulmonary TB. The government's free TB screening program makes people more able to access health so that income in this study is not a risk factor for TB.

**Smoking Status**

The study found 26 (32.50%) heavy smokers of 15 years 18 of whom were infected with pulmonary TB. Smoking habits interfere with the effectiveness of pulmonary respiration. The harmful substances of cigarettes damage the lung mechanism and change the latent TB to the active stage (18).

**Table 2**  
Correlation between Family Smoking Status and TB

Family Smoking Status	Incidence of TB				<i>p</i>	OR (95% CI)
	TB		Non TB			
	n	%	n	%		
<b>Smoking Status</b>						
Active smoker	18	45.00	8	20.00	0.03	3.27
Passive smoker	22	55.00	32	80.00		(1.21<OR<8.84)
<b>Family Smoking Status</b>						
Height (> 84 stems/week)	9	30.00	3	15.00	0.22	2.42
Low (≤ 84 stems/week)	21	70.00	17	85.00		(0.56<OR<10.40)
<b>Family Member Smokers</b>						
2	8	26.66	3	15.00	0.53	2.06
1	22	73.33	17	85.00		(0.47<OR<8.96)
<b>Window State when Smoking</b>						
Closed	19	63.33	15	75.00	0.57	0.57
Open	11	36.66	5	25.00		(0.16<OR<2.02)
<b>Smoking Location</b>						
Inside the house	20	66.66	13	65.00	1.00	1.07
Outside the house	10	33.33	7	35.00		(0.32<OR<3.54)
<b>Smoking Time</b>						
≥ 15 years	27	90.00	20	100.00	0.31	2.25
< 15 years	3	10.00	0	0.00		(0.44<OR<11.36)
<b>Cigarettes Smoked/Day</b>						
11- > 20 stems	27	90.00	20	100.00	0.14	1.74
≤ 10 stems	3	10.00	0	0.00		(1.36<OR<2.22)
<b>Cigarettes Weekly</b>						
7 days/week	26	86.66	16	80.00	0.52	1.62
5 days/week	4	13.33	4	20.00		(0.35<OR<7.42)
<b>Cigarette Fee/Day</b>						
> Rp. 10.000	20	66.66	13	65.00	1.00	1.07
≤ Rp. 10.000	10	33.33	7	35.00		(0.32<OR<3.54)
<b>Smoking when Sick</b>						
Yes	4	13.33	1	5.00	0.33	2.92
Not	26	86.66	19	95.00		(0.30<OR<28.28)
<b>Total</b>	30	100.00	20	100.00		

### Correlation between Family Smoking Status and TB

Hazardous substances in cigarettes cause changes in the structure and function of the lung tract and the host's immunological response so that they are easily infected with bacteria including TB (19).

No significant family smoking status was found with the incidence of pulmonary TB. According to (12)'s research, there is no influence between people who smoke at home and the incidence of pulmonary TB in family members who live together.

In the research interview activities, several prevention efforts were carried out by family members, namely giving warnings and always keeping a distance of 2-5 meters from cigarette smoke in the house. This situation can be a preventive effort in the family scope so that in this study no significant family smoking status was found with the incidence of pulmonary TB.

**Table 3**

Correlation of Physical House Condition and TB

Physical House Condition	Incidence of TB				<i>p</i>	OR (95% CI)
	TB		Non TB			
	n	%	n	%		
<b>Length of Stay (years)</b>						
> 10 years	4	10.00	8	20.00	0.34	2.25 (0.61<OR<8.18)
≤ 10 years	36	90.00	32	80.00		
<b>Temperature</b>						
Not in accordance	25	62.50	27	67.50	0.81	1.24 (0.49<OR<3.12)
In accordance	15	37.50	13	32.50		
<b>Humidity</b>						
Not in accordance	16	40.00	7	17.50	0.04	3.14 (1.12<OR<8.82)
In accordance	24	60.00	33	82.50		
<b>Lighting</b>						
Not in accordance	28	70.00	13	32.50	0.01	4.84 (1.88<OR<12.48)
In accordance	12	30.00	27	67.50		
<b>Occupancy Density</b>						
Not in accordance	30	75.00	23	57.50	0.15	2.21 (0.85<OR<5.74)
In accordance	10	25.00	17	42.50		
<b>Ventilation Area</b>						
Not in accordance	15	37.50	6	15.00	0.04	3.40 (1.15<OR<9.99)
In accordance	25	62.50	34	85.00		
<b>Floor Type</b>						
Not in accordance	28	70.00	16	40.0	0.01	3.50 (1.38<OR<8.83)
In accordance	12	30.00	24	60.0		
<b>Wall Type</b>						
Not in accordance	30	75.00	13	32.50	0.04	2.81 (1.12<OR<6.99)
In accordance	10	25.00	27	67.50		
Total	40	100.00	40	100.00		

**Temperature**

House temperature with the incidence of pulmonary TB in this study did not find a significant relationship. This situation caused statistically 62.50% of TB cases and 67.50% of non-pulmonary TB occurred in occupancies with house temperatures that did not meet the requirements (<18°C and >30°C), so they were unable to cause a significant relationship. This is in line with the research of Dewi et al. (6) (p 0.19 0.05) which stated that there was no significant relationship between house room temperature and the incidence of pulmonary.

**Humidity**

The chi-square of this study stated that there was a significant relationship between house humidity and the incidence of pulmonary TB. A total of 23 (28.75%) respondents lived with inappropriate humidity (<40% and >60%) with 16 of them having pulmonary TB infection. This situation raises the significance of humidity with pulmonary TB. Similar research was conducted by

Indriyani et al (20) (p 0.00 0.05 OR 4.72). Moisture is an important factor for the growth of *Mycobacterium tuberculosis*. Humidity in the house that occurs due to the lack of sunlight intake and exchange of air circulation will make the atmosphere of the house dark and humid so that microorganisms can survive for a long time (6).

**Lighting**

There is a significant relationship between home lighting and the incidence of pulmonary TB. In line with research by (21), it is stated that there is a significance of house lighting with the incidence of pulmonary TB. The Ministry of Health of the Republic of Indonesia states that a minimum of 60 lux circulation of solar lighting to the house through windows, ventilation or glass roofs can prevent the growth of microorganisms (10). Research observations stated that the majority of pulmonary TB cases (28.70%) occurred in people who lived in low-light housing. One of the influencing factors is the condition of windows that are rarely opened (22).

**Table 4**

Multivariate Analysis of Family Smoking Status and Physical House Condition and TB

Variable	Model 1		Model 2		Model 3		Model 4	
	<i>p</i>	OR (CI 95%)	<i>p</i>	OR (CI 95%)	<i>p</i>	OR (CI 95%)	<i>p</i>	OR (CI 95%)
Gender	0.06	0.108 (0.01-1.15)	0.06	0.11 (0.01-1.14)	0.06	0.11 (0.01-1.17)	0.06	0.11 (0.01-1.16)
Age	0.03*	0.16 (0.03-0.87)	0.03*	0.17 (0.03-0.85)	0.03*	0.16 (0.03-0.84)	0.03*	0.17 (0.03-0.90)
Employment	0.17	3.26 (0.59-17.88)	0.16	3.31 (0.60-18.06)	0.18	3.13 (0.59-16.64)	0.18	3.13 (0.58-16.72)
Income	0.57	0.50 (0.04-5.67)	0.56	0.48 (0.04-5.48)	0.52	0.46 (0.04-5.01)	-	-
Individual Smoking Status	0.01*	44.73 (2.66- 749.83)	0.01*	40.32 (2.95- 550.96)	0.01*	42.10 (2.57-688- 06)	0.01*	51.41 (3.12-845.35)
Family Smoking Status	0.83	0.78 (0.07-7.81)	-	-	0.78	0.73 (0.07-7.08)	0.79	0.73 (0.07-7.25)
Humidity	0.05	7.04 (0.97-50.92)	0.04*	6.45 (1.07-38.73)	0.04*	7.38 (1.04-52.41)	0.04*	7.44 (1.04-52.05)
Lighting	0.03*	4.64 (1.08-19.98)	0.03*	4.62 (1.07-19.81)	0.03*	4.67 (1.09-20.06)	0.03*	4.99 (1.16-21.34)
Occupancy Density	0.54	0.62 (0.13-2.85)	0.53	0.62 (0.13-2.81)	0.58	0.66 (0.15-2.89)	0.47	0.58 (0.13-2.55)
Ventilation Area	0.01*	10.65 (1.57-71.98)	0.01*	10.35 (1.57-68.08)	0.01*	10.33 (1.53-68.73)	0.01*	10.86 (1.61-72.95)
Floor Type	0.75	0.71 (0.09-5.70)	0.71	0.68 (0.08-5.29)	-	-	0.65	0.62 (0.08-4.91)
Wall Type	0.01*	17.23 (1.66- 178.06)	0.01*	17.57 (1.71- 180.22)	0.01*	13.48 (2.31-78.44)	0.01*	18.34 (1.75-191.99)

\*Significance  $\leq 0.02$ **Occupancy Density**

Results of this study stated that occupancy density did not have a significant effect on the incidence of pulmonary TB. In line with the research of Amaliah et al (23), there is no significant relationship between residential density and the incidence of pulmonary TB. The more the number of occupants in the house, the lower the oxygen levels, increasing CO<sup>2</sup> and facilitating the growth of microorganisms (7).

Research observations show that the majority of a community house is inhabited by three to six family members with each room occupied by up to three people, making the dwelling unable to meet health requirements (8m<sup>2</sup>/person), but still has an appropriate ventilation area ( $\geq 10\%$  floor area). It can be interpreted that the house has a good air circulation so that it can reduce the risk of pulmonary TB incidence (24).

**Ventilation Area**

Primary data of the study stated that out of 21 (26.25%) people who lived in housing with less ventilation area (<10% floor area), 15 of them had pulmonary TB infection. Statistical analysis of this study stated that there was a significant relationship between ventilation area and the incidence of pulmonary TB. In line with the research by Ernirita et al (24), it showed the significance of ventilation area with the incidence of pulmonary TB. The ventilation area that does not meet health requirements will reduce oxygen circulation and increase the concentration of carbon dioxide with toxic properties and become a growth medium for *Mycobacterium tuberculosis*. Bacteria can survive for a long time if the house is in a humid state with minimal ventilation due to evaporation (25).

### Wall Type

There is a significance between the type of house wall and the incidence of pulmonary TB. Similar research was conducted by Budi et al (26) who found there was a significance of wall type with the incidence of pulmonary TB ( $p$  0.01, 0.05, respectively). The best wall instruments that meet health requirements are masonry or permanent walls and are non-flammable and impermeable to water so that they are easy to clean. Research observations found that the majority of the walls were in the form of walls, but the residential walls were not properly cared for and kept clean, so many were found in a fragile, cracked, perforated and green condition due to the growth of moss and fungus. The growth of moss and fungus on the walls of the house is an indication that the house is in a humid state and becomes a medium for the growth of microorganisms including the bacterium *Mycobacterium tuberculosis* (27).

### Multivariate Analysis of Family Smoking Status and Physical House Condition and TB

Personal smoking status was the most influential factor in this study (OR 44.73). In line with the research of Kakuhes et al (7) which states that there is a significance of smoking history with the incidence of TB. The more number of cigarettes smoked per day for a long period of time will damage the pulmonary alveolar macrophages so that it affects the immunity of T cells (lymphocytes) which are unable to distinguish the types of pathogens and reduce the body's immunity. This smoking habit makes the respiratory system more susceptible to infections including pulmonary TB infection.

### CONCLUSION

This study found risk factors for the incidence of pulmonary TB in men, unproductive age (<15 years and >65 years) and active smokers. In addition, the physical condition of the house was found to be significant between humidity <40% and >60%, lighting <60 lux, ventilation area <10% floor area, type of floor and damp walls with the incidence of pulmonary TB in economically disadvantaged groups in the region of Prambon Public Health Center, Nganjuk Regency. It is hoped that the Puskesmas and the local Health Service will be able to provide more education about smoking habits as well as a simple implementation of the program for empowering healthy home areas according to the target group.

### CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this study.

### AUTHOR CONTRIBUTIONS

SA contributed in determining the research concept, introduction, methods, data collection to analysis and draft writing. YA and AME contributed in reviewing, providing feedback and revising.

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### REFERENCES

1. Chakaya J, Khan M, Ntumi F, Aklillu E, Fatima R, Mwaba P, et al. Global tuberculosis report 2020–Reflections on the global TB burden, treatment and prevention efforts. *Int J Infect Dis*. 2021;113:S7–12.
2. Organization WH. Global tuberculosis report 2020. World Health Organization; 2020.
3. Kemenkes RI. Hasil utama riset kesehatan dasar (Riskesdas) tahun 2018. Jakarta; 2018.
4. Syukur SB, Pakaya AW. Faktor-faktor yang berhubungan dengan kejadian TBC paru di wilayah kerja Puskesmas Bolangitang. *Zaitun (Jurnal Ilmu Kesehatan)*. 2021;4(1).
5. Alnur RD, Pangestika R. Faktor risiko tuberculosis paru pada masyarakat di wilayah kerja Puskesmas Bambu Apus Kota Tangerang Selatan. *ARKESMAS (Arsip Kesehat Masyarakat)*. 2018;3(2):112–7.
6. Dewi EF, Suhartono S, Adi MS. Hubungan faktor lingkungan rumah dengan kejadian TB paru di Kota Magelang. *J Kesehat Masy*. 2015;4(2):149–59.
7. Kakuhes H, Sekeon SAS, Ratag BT. Hubungan antara merokok dan kepadatan hunian dengan status tuberculosis paru di wilayah kerja Puskesmas Tuminting Kota



- Manado. KESMAS. 2020;9(1).
8. Badan Pusat Statistik. Pendataan program perlindungan sosial (PPLS) 2011 [Internet]. Jakarta; 2012. Available from: <https://www.bps.go.id/publication/download.html?nrbvfeve=MzYwMzk3YWRIN2Q2MDIkMWMxN2JlODY2&xzmn=aHR0cHM6Ly93d3cuYnBzLmdvLmlkL3B1YmxpY2F0aW9uLzIwMTIvMTEvMjEvMzYwMzk3YWRIN2Q2MDIkMWMxN2JlODY2L3BlbmRhdGFhbi1wcm9ncmFtLXB1cmxpbmR1bmdhbi1zbnNpYWwtLXBwbHMtLTIwMTEt>
  9. Lemeshow S, Klar J, Lwanga SK, Pramono D, Hosmer DW. Besar sampel dalam penelitian kesehatan. Yogyakarta: Gadjah Mada University Press; 1997.
  10. Kementerian Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan RI No. 829/Menkes. SK/VII/1999 tentang Persyaratan Kesehatan Perumahan; 1999.
  11. Strauss J, Witoelar F, Sikoki B. The fifth wave of the Indonesia family life survey: overview and field report. Santa Monica; 2016. (1st Volume).
  12. Endah A. Hubungan kondisi fisik rumah terhadap kejadian tuberkulosis di wilayah kerja Puskesmas Gantrung Kabupaten Madiun. 2018;
  13. Damayati DS, Susilawaty A, Maqfirah M. Risiko kejadian TB paru di wilayah kerja puskesmas Liukang Tupabbiring Kabupaten Pangkep. *Hig J Kesehat Lingkung*. 2018;4(2):121–30.
  14. Marleni L, Syafei A, Saputra AD. Hubungan antara faktor pejamu (host) dan faktor lingkungan (environment) dengan kejadian tuberkulosis paru kambuh (relaps) di Puskesmas Kota Semarang. *Babul Ilmi J Ilm Multi Sci Kesehat*. 2020;12(1).
  15. Aminah NS, Djuwita R. Trend dan faktor yang berhubungan dengan keberhasilan pengobatan pasien TB MDR paduan jangka pendek di Indonesia 2017-2019. *Pro Heal J Ilm Kesehat*. 2021;3(1).
  16. Namasivayam S, Kauffman KD, McCulloch JA, Yuan W, Thovarai V, Mittereder LR, et al. Correlation between disease severity and the intestinal microbiome in Mycobacterium tuberculosis-infected rhesus macaques. *MBio*. 2019;10(3):e01018-19.
  17. Rahmah PM. Hubungan tingkat pendapatan terhadap keberhasilan pengobatan pada pasien Tuberkulosis di Puskesmas Kecamatan Johar Baru Jakarta Pusat Tahun 2016. *J Profesi Med J Kedokt dan Kesehat*. 2018;12(1).
  19. Rosdiana R. Faktor yang berhubungan dengan kejadian tuberkulosis paru di Rumah Sakit Umum Daerah Labuang Baji Makassar. *Promot J Kesehat Masy*. 2018;8(1):78–82.
  20. Indriyani N, Istiqomah N, Anwar MC. Hubungan tingkat kelembaban rumah tinggal dengan kejadian tuberkulosis paru di wilayah Kecamatan Tulis Kabupaten Batang. *Unnes J Public Heal*. 2016;5(3):214–20.
  21. Mariana D, Hairuddin MC. Kepadatan hunian, ventilasi dan pencahayaan terhadap kejadian Tb paru di wilayah kerja Puskesmas Binanga Kabupaten Mamuju Sulawesi Barat. *J Kesehat Manarang*. 2018;3(2):75–80.
  22. Sahadewa S. Hubungan tingkat pencahayaan, kelembaban udara, dan ventilasi udara dengan faktor risiko kejadian tb paru bta positif Di Desa Jaticalang Kecamatan Krian Kabupaten Sidoarjo. 2019;
  23. Amaliah L, Rufaedah AA, Nurcahyati S, Abdurakhman RN, Hidayat A. The relationship between the physical home environment and the event of tuberculosis. *World J Adv Res Rev*. 2022;14(3):623–8.
  24. Ernirita E, Fitria PA, Widakdo G, Permatasari TAE, Kurniaty I. Karakteristik skrining terhadap kejadian tuberkulosis (TB) paru pada anak di Puskesmas Kecamatan Cakung, Jakarta Timur. In: *Prosiding Seminar Nasional Penelitian LPPM UMJ*. 2020.
  25. Firdausi NL, Artanti KD, Li C-Y. Analysis of risk factors affecting the occurrence of chronic obstructive pulmonary disease in Indonesia. *J Berk Epidemiol*. 2021 Jan 29;9(1).
  26. Budi IS, Ardillah Y, Sari IP, Septiawati D. Analisis faktor risiko kejadian penyakit tuberkulosis bagi masyarakat daerah kumuh Kota Palembang. *J Kesehat Lingkung Indones*. 2018;17(2):87–94.
  27. Nurwanti N, Wahyono B. Hubungan antara faktor penjamu (host) dan faktor lingkungan (environment) dengan kejadian

tuberkulosis paru kambuh (relaps) di puskesmas se-kota Semarang. *Public Heal Perspect J.* 2016;1(1).