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Risk Factors for Primary and Secondary Tuberculosis in the Warung Jambu Health Center Area, 2026

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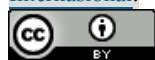
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ABSTRACT

Tuberculosis (TB) remains a major public health problem in Indonesia, particularly in West Java, which has a high disease burden. This study aimed to identify factors associated with pulmonary TB in the working area of Puskesmas Warung Jambu, Bogor City, in 2026. An observational analytic study with a cross-sectional design was conducted among 100 respondents selected from patients treated at the health center. Primary data were collected using a Google Forms questionnaire, while secondary data were obtained from the Tuberculosis Information System. Associations were analyzed using the Chi-square test. Pulmonary TB was significantly associated with sex (PR=8.77; 95% CI: 3.51–21.88; p<0.001), permanent ventilation (PR=1.53; 95% CI: 0.64–3.69; p<0.001), house window size (p<0.001), active smoking (PR=6.50; p<0.001), and nutritional status (PR=1.70; 95% CI: 1.36–2.11; p<0.001). Age, education, occupation, income, HIV status, diabetes mellitus, bedroom window size, lighting, and passive smoking showed no significant associations. Male sex, inadequate home ventilation, active smoking, and undernutrition were important risk factors. Health promotion, active screening, smoking cessation, nutritional improvement, and healthier housing should be strengthened to support TB elimination

INTRODUCTION

Mycobacterium tuberculosis is the primary causative agent of tuberculosis (TB), an infectious disease transmitted through the air that mainly affects the lung parenchyma. The World Health Organization (WHO) reported approximately 10 million TB cases worldwide in both 2017 and 2018, with 1.5 million deaths recorded in 2018. According to the WHO Global Tuberculosis Report 2025, Indonesia was classified as a highly endemic country, with an estimated incidence of 300–499 cases per 100,000 population in 2024. Indonesia accounted for approximately 10% of all TB cases globally, placing it second worldwide after India.

West Java is one of the provinces with the highest TB burden, recording 224,798 cases in 2024.

TB cases were unevenly distributed across districts and cities due to population density, economic activity, geographical characteristics, access to healthcare services, and community socioeconomic conditions. Data from the West Java Provincial Health Office in 2025 recorded 224,650 TB cases, with a treatment success rate of 86%. Meanwhile, Bogor City recorded 28,035 cases, with a treatment success rate of 88.2%.

TB incidence is influenced by individual factors, including smoking, poor nutritional status, a history of close contact, and HIV coinfection. Environmental and social factors also contribute, including household overcrowding, inadequate ventilation, insufficient lighting, high humidity, and poverty. Puskesmas Warung Jambu achieved 108%

of its standard target for presumptive TB cases, equivalent to 1,372 individuals, from January to December 2025. The treatment success rate for drug-susceptible TB reached 85% among 117 patients, while the achievement for childhood TB cases was 74%, representing 28 children. Based on these findings, research on pulmonary TB risk factors in the working area of Puskesmas Warung Jambu is necessary to support the development of TB control programs and the achievement of Indonesia's TB elimination target.

This study generally aimed to identify demographic factors, clinical conditions, healthy housing components, and behavioral factors associated with pulmonary TB at Puskesmas Warung Jambu in 2026. The factors examined included patient demographic characteristics, such as age, sex, and education level; home environmental conditions, such as household overcrowding, ventilation, windows, and lighting; behavioral factors, including active and passive smoking; and clinical conditions, including diabetes mellitus, HIV status, and nutritional status.

METHODS

This study employed a cross-sectional design with an observational analytic approach. It was conducted from June to July 2026 at Puskesmas Warung Jambu, Bogor City, West Java. The study population comprised 28,486 patients who had received healthcare services at Puskesmas Warung Jambu. The study sample consisted of 100 respondents selected from the records of patients with TB who had received treatment at the health center.

The inclusion criteria were patients with primary or secondary pulmonary TB who received treatment at Puskesmas Warung Jambu and agreed to participate in the study. The exclusion criteria included patients with multidrug-resistant or extensively drug-resistant TB (MDR/XDR-TB), extrapulmonary TB, and patients who could not be contacted. Primary data were collected using a Google Forms questionnaire after the respondents provided informed consent, while secondary data were obtained from the Tuberculosis Information System (SITB) website. The independent variables included age, sex, education level, occupation, income, history of HIV infection, history of diabetes mellitus, body mass index, household overcrowding, ventilation, window area, lighting, humidity, and active and passive smoking status. The dependent variable was the occurrence of pulmonary TB.

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Kristen Indonesia, under approval number 14/Etik Penelitian/FKUKI/2026. Data processing involved editing, coding, data entry using SPSS for Windows version 24.0, and data cleaning. Data analysis consisted of univariate analysis to describe the frequency distribution of each variable and bivariate analysis using the Chi-square test to assess the associations between the risk factors and pulmonary TB occurrence.

RESULTS AND DISCUSSION

Respondent Characteristics

The distribution of respondent characteristics based on demographic factors, home environmental conditions, cigarette smoke exposure, and nutritional status is presented in Table 1.

Tabel 1 Distribution of Respondent Characteristics (n=100)

Variable	n	%
Age <15 years	5	5.0
Age 15–64 years	83	83.0
Age >64 years	12	12.0
Male	41	41.0
Female	59	59.0
Did not complete senior high school	33	33.0
Completed senior high school	52	52.0
University graduate	15	15.0
Unemployed	49	49.0

Employed	51	51.0
Income below the regional minimum wage	77	77.0
Income above the regional minimum wage	23	23.0
HIV-positive	4	4.0
Diabetes mellitus-positive	7	7.0
Ventilation area <1 m ²	54	54.0
Window area <1 m ²	50	50.0
Bedroom area <8 m ²	78	78.0
Active smoker	38	38.0
Passive smoker	72	72.0
Undernutrition	27	27.0
Normal nutritional status	49	49.0
Overweight or obesity	24	24.0
Primary pulmonary TB	44	44.0
Secondary pulmonary TB	30	30.0

Source: Primary and secondary data, 2026.

Associations Between Risk Factors and Pulmonary TB

The results of the bivariate analysis using the Chi-square test showed that sex, permanent ventilation, house window size, active smoking status, and nutritional status were significantly associated with pulmonary TB ($p < 0.05$). In contrast,

age, education level, occupation, income, history of HIV infection, history of diabetes mellitus, bedroom window area, lighting, and passive smoking status showed no significant associations ($p > 0.05$). A summary of the bivariate analysis is presented in Table 2.

Table 1 Associations Between Risk Factors and Pulmonary TB

Variable	TB-positive, n (%)	TB-negative, n (%)	PR (95% CI)	p-value
Age ≤64 years	41 (46.6)	3 (5.1)	2.62	0.31
Age >64 years	47 (53.4)	9 (94.9)	(0.66–10.3)	
Male	30 (73.1)	14 (23.7)	8.77	<0.001
Female	11 (27.0)	45 (76.4)	(3.51–21.9)	
Lower education	14 (42.4)	30 (44.8)	0.90	0.82
Higher education	19 (57.6)	37 (55.2)	(0.39–2.11)	
Unemployed	24 (48.9)	20 (39.2)	1.49	0.33
Employed	25 (51.2)	21 (60.9)	(0.67–3.29)	
Income below the regional minimum wage	35 (45.5)	9 (39.1)	1.30	0.59
Income above the regional minimum wage	42 (54.6)	14 (60.9)	(0.50–3.35)	
HIV-positive	53 (55.2)	3 (75.0)	2.43	0.59
HIV-negative	43 (44.8)	1 (25.0)	(0.22–2.42)	
Diabetes mellitus-positive	53 (55.2)	3 (75.0)	2.43	0.59

Diabetes mellitus-negative	43 (44.8)	1 (25.0)	(0.22–2.42)	
Ventilation area <1 m ²	13 (24.1)	31 (67.4)	1.53	<0.001
Ventilation area >1 m ²	41 (75.9)	15 (32.6)	(0.64–3.69)	
House window area <1 m ²	13 (31.7)	31 (67.4)	1.53	<0.001
House window area >1 m ²	41 (68.3)	15 (32.6)	(0.64–3.69)	
Bedroom window area <1 m ²	41 (46.6)	3 (25.0)	2.68	0.107
Bedroom window area >1 m ²	47 (53.4)	9 (75.0)	(0.64–2.03)	
Inadequate lighting	18 (48.6)	26 (41.3)	1.35	0.47
Adequate lighting	19 (51.4)	37 (58.7)	(0.59–3.05)	
Active smoker	25 (40.3)	31 (54.3)	6.50	<0.001
Non-active smoker	37 (59.7)	7 (18.4)	(0.25–1.72)	
Passive smoker	16 (57.2)	40 (55.6)	9.38	0.88
Non-passive smoker	12 (42.9)	32 (44.4)	(0.38–2.26)	
Undernutrition	44 (57.1)	0 (0.0)	1.70	<0.001
Normal nutritional status	33 (42.9)	23 (100)	(1.36–2.11)	

PR: prevalence ratio; CI: confidence interval; Chi-square test, considered statistically significant at $p < 0.05$.

DISCUSSION

Respondent Characteristics

Most respondents were in the productive age group of 15–64 years (83.0%), consistent with the WHO report that TB is most commonly found among individuals of productive age because of their high mobility and frequent social contact. The proportion of female respondents (59.0%) was higher than that of male respondents. This finding differs from the global pattern, which generally shows a predominance of male patients. Local population characteristics and women's use of healthcare services may have influenced this finding. Most respondents had completed senior high school (52.0%) and earned an income below the regional minimum wage (77.0%), indicating the association between TB and socioeconomic determinants that has been widely reported in previous studies.

Sex

This study found a significant association between sex and pulmonary TB (PR=8.77; 95% CI:

3.51–21.88; $p < 0.001$). This finding is consistent with the study by Haddase et al., which reported that men had a 3.5-fold higher risk of TB than women. Men's high levels of activity and mobility outside the home, smoking habits, and exposure to unhealthy working environments may contribute to this increased risk.

Home Ventilation and Windows

Permanent ventilation and house window sizes that did not meet the required standard (<1 m²) were significantly associated with pulmonary TB ($p < 0.001$). Adequate ventilation helps maintain air circulation and reduce the concentration of infectious droplets. Therefore, inadequate home ventilation may increase the risk of TB transmission. This finding is consistent with the study by Monintja et al., which reported that residents of houses with inadequate ventilation had a 3.35-fold higher risk of TB. In contrast, bedroom window area and household lighting were not significantly associated with pulmonary TB. This finding may be influenced

by residents' infrequent practice of opening windows or the availability of other ventilation sources.

Smoking Behavior

Active smoking status was significantly associated with pulmonary TB (PR=6.5; $p<0.001$). Exposure to cigarette smoke impairs mucociliary function and alveolar macrophage activity, thereby weakening the respiratory tract's defense mechanisms against *Mycobacterium tuberculosis*. This finding is consistent with Martanto's study, which reported that active smokers had a ninefold higher risk of TB. However, passive smoking status was not significantly associated with pulmonary TB in this study, possibly because the intensity of cigarette smoke exposure was not measured in detail.

Nutritional Status

Nutritional status based on body mass index was significantly associated with pulmonary TB (PR=1.7; 95% CI: 1.36–2.11; $p<0.001$). Malnutrition can impair immune system function, particularly macrophage and lymphocyte activity, thereby increasing susceptibility to TB infection.¹² This finding is consistent with an analysis of the Basic Health Research data, which showed that individuals with a BMI below 18.5 kg/m² had a 7.67-fold higher risk of TB than individuals who were overweight or obese.

Other Non-Significant Factors

Age, education level, occupation, income, history of HIV infection, and history of diabetes mellitus were not significantly associated with pulmonary TB in this study ($p>0.05$). This finding may have been influenced by the limited sample sizes in certain subgroups, such as the small numbers of respondents with HIV and diabetes mellitus, the availability of free TB diagnostic and treatment services through the national program, and the presence of other more dominant risk factors. These findings confirm that TB is multifactorial and cannot be explained by a single determinant.

CONCLUSION

The distribution of pulmonary TB patients at Puskesmas Warung Jambu in 2026 showed that 44.0% had primary pulmonary TB and 30.0% had secondary pulmonary TB. Pulmonary TB was significantly associated with male sex (PR=8.77; 95% CI: 3.51–21.88), permanent ventilation (PR=1.53; 95% CI: 0.64–3.69), house window size, active smoking status (PR=6.5), and undernutrition (PR=1.7; 95% CI: 1.36–2.11). No significant associations were found between pulmonary TB and age, education level, occupation, income, history of HIV infection, history of diabetes mellitus, bedroom window area, lighting, or passive smoking status in the working area of Puskesmas Warung Jambu in 2026.

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