

Risk Factors Associated with Leprosy Incidence in the Endemic Area of Pekalongan City: A Case-Control Study 2025

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ABSTRACT

Leprosy is one of the Neglected Tropical Diseases (NTDs) that remains a public health problem in Indonesia. Pekalongan City is one of the endemic areas, reporting 75 new cases in 2025. Leprosy transmission is influenced by individual characteristics, history of close contact, household environmental conditions, and personal hygiene practices. This study aimed to analyze the risk factors associated with leprosy incidence in the endemic area of Pekalongan City. An observational analytic study with a 1:1 case-control design was conducted from October 2025 to April 2026 involving 76 respondents. Data were collected through structured questionnaire-based interviews and observations and analyzed using univariate analysis, bivariate analysis with the Chi-square or Fisher's exact test, and multivariate logistic regression. Bivariate analysis showed that education, occupation, personal hygiene, history of close contact, household ventilation, floor condition, and household lighting were significantly associated with leprosy incidence. Multivariate analysis identified education, occupation, and history of close contact as significant factors, with history of close contact being the most dominant risk factor (OR = 15.785; $p = 0.001$). A history of close contact was identified as the strongest risk factor for leprosy. Therefore, leprosy control efforts should prioritize early case detection, household contact surveillance, improvement of personal hygiene practices, health education, and enhancement of household environmental conditions.

Keywords: leprosy; personal hygiene; close contact; household environmental conditions; case-control study

INTRODUCTION

Leprosy is a chronic infectious disease caused by *Mycobacterium leprae* that primarily affects the skin, peripheral nerves, upper respiratory tract, mucosa, muscles, and eyes (1). The disease is classified into two types: multibacillary (MB) and paucibacillary (PB) leprosy (2). If left untreated, leprosy can lead to permanent disability, including nerve damage, sensory loss, and deformities of the hands, feet, and eyes. The World Health Organization (WHO) classifies leprosy as one of the Neglected Tropical Diseases (NTDs) and it remains a major public health challenge, particularly in developing countries. In 2025, approximately 200,000 new leprosy cases were reported worldwide. Indonesia ranked third globally with 16,286 new cases,

following India (45,485 cases) and Brazil (25,218 cases) (3). Between January and August 2025, Indonesia reported 5,474 new cases, including 489 cases among children and 287 cases with disabilities (4). Although leprosy has been eliminated as a public health problem at the national level, several provinces have not yet achieved the elimination target of less than one case per 10,000 population, indicating ongoing transmission in endemic areas. Pekalongan City is one of the leprosy-endemic areas in Central Java, where the number of new cases increased from 43 in 2024 to 75 in 2025. The highest burden was reported in West Pekalongan District, accounting for 35 cases, followed by East (16 cases), North (13 cases), and South Pekalongan (11 cases) (5). The persistence of leprosy in this area may be associated with multiple factors, including individual characteristics, history of close contact, personal hygiene, and household environmental conditions. Pekalongan is also characterized by frequent flooding, inadequate waste management, high population density, and crowded settlements, which may contribute to disease transmission (6). Therefore, this study aimed to analyze the risk factors associated with leprosy incidence in the endemic area of Pekalongan City.

METHODS

This quantitative study employed an observational analytic design with a 1:1 case-control approach and was conducted in Pekalongan City, Indonesia, from October 2025 to April 2026. The case population consisted of all 75 leprosy patients registered at the Pekalongan City Health Office in 2025. A total of 38 cases who met the inclusion criteria were selected as the case group, while 38 individuals without leprosy from the same residential areas were recruited as the control group. Cases were selected using simple random sampling from the list of registered leprosy patients, whereas controls were selected from the community and matched by area of residence. Data were collected through structured questionnaire-based interviews and direct observation. The independent variables included age, sex, education, occupation, personal hygiene, history of close contact, household density, ventilation, floor condition, wall type, household lighting, and temperature, while leprosy incidence was the dependent variable. Univariate analysis was performed to describe respondent characteristics and variable distributions. Bivariate analysis was conducted using the Chi-square test or Fisher's exact test to assess the association between independent variables and leprosy incidence, with Odds Ratios (ORs) and 95% Confidence Intervals (CIs) calculated. Variables with a p -value <0.25

in the bivariate analysis were entered into a multivariable logistic regression model using the Backward Likelihood Ratio (Backward LR) method to identify the most dominant risk factors. Statistical significance was defined as $p < 0.05$.

RESULTS

Univariate Analysis

Table 1. Frequency Distribution of Respondents by Study Variables in Pekalongan City, 2025

No.	Variabel	case	control	
		n= 38	n= 38	
1.	Sex			
	Male	26 (68,4%)	23 (60,5%)	49 (64,5%)
	Famale	12 (31,6%)	15 (39,5%)	27 (55,5%)
2.	Age			
	10-18 years	6 (15,8%)	5 (13,2%)	11 (14,5%)
	19-59 years	26 (68,4%)	27 (71,1%)	53 (69,7%)
	60-100 years	6 (15,8%)	6 (15,8%)	12 (15,8%)
3.	Education			
	SD	9 (23,9%)	7 (18,4%)	16 (21,1%)
	SMP	6 (15,8%)	2 (5,3%)	8 (10,5%)
	SMA/SMK	13 (34,2%)	24 (63,2%)	37 (48,7%)
	D3/S1/S2	1 (2,6)	5 (13,2%)	6 (7,9%)
	Did Not Complete	9 (23,7%)	0 (0,0%)	9 (11,8%)
	Elementary School			
4.	Occupation			
	Civil Servant	1 (2,6%)	5 (13,2%)	6 (7,9%)
	Self-employed	6 (15,8%)	8 (21,1%)	14 (18,4%)
	Laborer	15 (39,5%)	3 (7,9%)	18 (23,7%)

	Student	9 (23,7%)	14 (36,8%)	23(30,3%)
	Other Occupations	1 (2,6%)	2 (5,3%)	3 (3,9%)
	Unemployed	6 (15,8%)	6 (15,8%)	12(15,8%)
5.	History of Close Contact			
	Yes	22 (57,9%)	2 (5,3%)	24 (31,6%)
	No	16 (42,1%)	36 (94,7%)	52 (68,4%)
6.	Household Density			
	High Density	23 (60,5%)	16 (42,1%)	39 (51,3%)
	Low Density	15 (39,5%)	22 (57,9%)	37 (48,7%)
7.	Personal hygiene			
	Good	9 (23,7%)	23 (60,5%)	32 (42,1%)
	Poor	29 (76,3%)	15 (39,5%)	44 (57,9%)
8.	Household Ventilation			
	Adequate	26 (68,4%)	35(92,1%)	61 (80,3%)
	Inadequate	12 (31,6%)	3 (7,9%)	15 (19,7%)
9.	Household Floor			
	Condition	30 (78,9%)	38 (100%)	68 (89,5%)
	Ceramic	8 (21,1%)	0 (0%)	8 (10,5%)
	Earthen Floor			
10.	Wall Type			
	Brick Wal	36 (94,7%)	37 (97,4%)	73 (96,1%)
	Wooden Wall	2 (5,3%)	1 (2,6%)	3 (3,9%)
11.	Household Lighting			
	> 60	14 (36,8%)	25 (65,8%)	39 (51,3%)
	< 60	24 (63,2%)	13 (34,2%)	37 (48,7%)

12.	Household Temperature			
	18° - 30°	23 (60,5%)	26 (86,8%)	49 (64,5%)
	> 30°	15 (39,5%)	12 (31,6%)	27 (35,5%)

Source: Primary Data, 2025

Based on Table 1, this study included 76 respondents, consisting of 38 cases and 38 controls. Most respondents were male (64.5%) and aged 19–59 years (69.7%). The highest educational attainment was senior high school/vocational high school (48.7%), while the most common occupations were students (30.3%) and laborers (23.7%). The majority of respondents had no history of close contact with leprosy patients (68.4%); however, more than half had poor personal hygiene (57.9%) and lived in crowded households (51.3%). Regarding household environmental conditions, most respondents had adequate household ventilation (80.3%), ceramic tile flooring (89.5%), brick walls (96.1%), household lighting of >60 lux (51.3%), and household temperatures within the recommended range of 18–30°C (64.5%).

Bivariate Analysis

Table 2. Bivariate Analysis of Factors Associated with Leprosy Incidence in Pekalongan City, 2025

No.	Variabel	Kasus	Kontrol	<i>p-value</i>	OR	95 % CI	
		n= 38	n= 38			Lower	Upper
1.	Sex						
	Male	26 (68,4%)	23 (60,5%)	0,0472	0,708	0,275	1,819
	Famale	12 (31,6%)	15 (39,5%)				
2.	Age						
	Productive Age	29 (76,3%)	31 (81,6%)	0,778	1,374	0,453	4,170
	Non-productive Age	9 (23,7%)	7 (18,4%)				
3.	Education						
	High	14 (36,8%)	29 (76,3%)	0,001	5,524	2,038	14,968
	Low	24 (63,2%)	9 (23,7%)				

4.	Occupation						
	High risk	22 (57,9%)	11 (28,9%)	0,021	3,375	1,303	8,744
	Low risk	16 (42,1%)	27 (71,1%)				
5.	History of Close						
	Contact	22 (57,9%)	2 (5,3%)	0,000	24,750	5,187	118,103
	Yes	16 (42,1%)	36 (94,7%)				
	No						
6.	Household Density						
	High Density	23 (60,5%)	16 (42,1%)	0,169	2,108	0,844	5,266
	Low Density	15 (39,5%)	22 (57,9%)				
7.	Personal hygiene						
	Good	9 (23,7%)	23 (60,5%)	0,003	4,941	1,834	13,312
	Poor	29 (76,3%)	15 (39,5%)				
8.	Household						
	Ventilation	26 (68,4%)	35 (92,1%)	0,021	5,385	1,378	21,045
	Adequate	12 (31,6%)	3 (7,9%)				
	Inadequate						
9.	Household Floor						
	Condition	30 (78,9%)	38 (100%)	0,005	2,267	1,735	2,962
	Ceramic	8 (21,1%)	0 (0%)				
	Earthen Floor						
10.	Wall Type						
	Brick Wal	36 (94,7%)	37 (97,4%)	1,000	2,056	0,178	23,676
	Wooden Wall	2 (5,3%)	1 (2,6%)				
11.	Household Lighting						
	> 60	14 (36,8%)	25 (65,8%)		3,297	1,288	8,440

< 60	24 (63,2%)	13 (34,2%)	0,022			
12. Household						
Temperature	23 (60,5%)	26 (68,4%)	0,632	1,413	0,550	3,632
18° - 30°	15 (39,5%)	12 (31,6%)				
> 30°						

Source: Primary Data, 2025

This study included 76 respondents, comprising 38 cases and 38 controls. The majority of respondents were male (64.5%), of productive age (78.9%), had a high level of education (56.6%), and had low-risk occupations (56.6%). Most respondents had no history of close contact with leprosy patients (68.4%); however, more than half had poor personal hygiene (57.9%). Regarding household environmental conditions, most respondents had adequate household ventilation (80.3%), ceramic tile flooring (89.5%), brick walls (96.1%), household lighting of >60 lux (51.3%), and household temperatures within the recommended range of 18–30°C (64.5%). Bivariate analysis showed that education (OR = 5.524; $p = 0.001$), occupation (OR = 3.375; $p = 0.021$), history of close contact (OR = 24.750; $p < 0.001$), personal hygiene (OR = 4.941; $p = 0.003$), household ventilation (OR = 5.385; $p = 0.021$), household floor condition (OR = 2.267; $p = 0.005$), and household lighting (OR = 3.297; $p = 0.022$) were significantly associated with leprosy incidence. In contrast, sex ($p = 0.472$), age ($p = 0.778$), household density ($p > 0.05$), wall type ($p = 1.000$), and household temperature ($p = 0.632$) were not significantly associated with leprosy incidence.

Multivariate Analysis

Table 3. Final Multivariate Analysis Model

Variabel	Sig.	Exp(B)	CI 95%	
			Lower	Upper
Education	0.023	4.501	1.235	16.410
History of close contact	0.001	15.785	2.949	84.487
Occupation	0.038	3.821	1.076	13.570

Ventilation	0.072	4.961	0.869	28.315

Source: Primary Data, 2025

Multivariate analysis showed that education, occupation, and history of close contact remained significantly associated with leprosy incidence. Individuals with low educational attainment were 4.5 times more likely to develop leprosy than those with higher education (OR = 4.501; $p = 0.023$). Respondents with high-risk occupations had a 3.8-fold higher risk of leprosy than those with low-risk occupations (OR = 3.821; $p = 0.038$). A history of close contact was identified as the strongest predictor of leprosy, with respondents who had close contact being approximately 15.8 times more likely to develop the disease than those without such contact (OR = 15.785; $p = 0.001$). In contrast, household ventilation was not significantly associated with leprosy after adjustment for other variables ($p = 0.072$), as its 95% confidence interval included the null value.

DISCUSSION

This study aimed to analyze the risk factors associated with leprosy incidence in the endemic area of Pekalongan City. The findings showed that education, occupation, personal hygiene, history of close contact, household ventilation, floor condition, and household lighting were significantly associated with leprosy incidence. Multivariate analysis further identified education, occupation, and history of close contact as significant predictors, with history of close contact being the most dominant risk factor. A history of close contact was the strongest predictor of leprosy, with individuals who had close contact being approximately 15 times more likely to develop the disease than those without such contact. This finding supports the theory that *Mycobacterium leprae* is primarily transmitted through prolonged and close contact with untreated patients. It is also consistent with previous studies by Amiruddin et al. and Hairil Akbar, emphasizing the importance of early case detection, household contact investigation, and regular monitoring of close contacts to interrupt disease transmission. Education and occupation were also significantly associated with leprosy incidence. Individuals with lower educational attainment were at greater risk of developing leprosy, possibly because limited education reduces awareness of disease prevention and early detection. Likewise, high-risk occupations may increase opportunities for exposure to infection. These findings are consistent

with previous studies, indicating that individual characteristics remain important determinants of leprosy. This study also found that poor personal hygiene, inadequate household ventilation, unsuitable floor conditions, and insufficient household lighting were significantly associated with leprosy incidence. Poor hygiene practices and unhealthy housing conditions may facilitate disease transmission. Therefore, promoting personal hygiene and improving household environmental conditions should be integrated into leprosy prevention and control programs. In contrast, sex, age, household density, wall type, and household temperature were not significantly associated with leprosy incidence. These findings suggest that, in the study area, leprosy is more strongly influenced by history of close contact, individual characteristics, personal hygiene, and household environmental conditions than by demographic factors.

CONCLUSION

This study demonstrated that educational level, occupation, history of close contact, personal hygiene, household ventilation, household floor condition, and household lighting were significantly associated with leprosy incidence in Pekalongan City. A history of close contact was identified as the most dominant factor associated with leprosy incidence. In contrast, sex, age, household density, wall type, and household temperature were not significantly associated with leprosy. Therefore, leprosy prevention and control efforts should focus on strengthening health education, monitoring close contacts, promoting personal hygiene through health education, and improving household environmental conditions to meet healthy housing standards.

LIMITATION

This study has several limitations. First, the case-control design does not allow causal relationships to be established because exposure to risk factors was assessed after the occurrence of the disease. Second, the relatively small sample size may have reduced the precision of the estimated risk. Third, some data were collected through questionnaire-based interviews, which may have introduced recall bias, particularly for the variables of history of close contact and personal hygiene. In addition, this study was conducted only in Pekalongan City; therefore, the findings should be interpreted with caution when applied to populations with different demographic or environmental characteristics. Despite these limitations, the study provides important evidence on the factors associated with leprosy incidence in an

endemic area and may serve as a basis for developing and strengthening leprosy control programs at the local level.

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