



Environmental Risk Factors Associated With Leprosy Incidence In Buton Regency Southeast Sulawesi Province

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Abstract

Leprosy is a chronic infectious disease caused by *Mycobacterium leprae* which attacks peripheral nerves and human skin. The purpose of this study was to analyze environmental risk factors for leprosy in the Buton Regency area. This type of research is an observational analytic study with a case control study design. Interviews and measurements of home conditions were carried out on 156 people (52 cases and 104 controls) using purposive sampling technique with a ratio of 1:2 by age and sex matching. Data analysis using the chi square test and multiple logistic regression were analyzed using the SPSS version 24 computer program. The results showed that the map of distribution of cases at greater risk in Pasarwajo District had significant variables, namely trust (pvalue= 0.003), contact history (p-value = 0.001), bathing habits (pvalue=0.001), lighting (pvalue=0.012), ventilation (pvalue=0.022), occupancy density (pvalue=0.000) while humidity, water availability and latrine ownership were insignificant variables. The results of the logistic regression test showed that occupancy density, bathing habits and contact history were the most influential variables on the incidence of leprosy. Community awareness needs to be increased through counseling and increasing knowledge of environmental hazards, especially unhealthy housing conditions so that home and family health standards can be achieved.

Keywords: Contact History, Lighting, Ventilation, Occupancy Density, Humidity

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Resive : 16 September 2026

Revised : 17 September 2026

Accept : 21 September 2026

Publish : 21 September 2026





Publish: Association of Indonesian Teachers and Lecturers

International Journal of Health Sciences (IJHS)Journal Homepage: <https://jurnal.agdosi.com/index.php/IJHS/index>

Volume 4 | Number 3 | September 2026 |



1. Introduction

Leprosy is one of the infectious diseases that can cause highly complex health problems (Ministry of Health of the Republic of Indonesia, 2020). Leprosy remains a public health concern worldwide. Based on its classification, leprosy is divided into two types: Paucibacillary (PB) and Multibacillary (MB) (WHO, 2018). Leprosy is a chronic infectious disease caused by *Mycobacterium leprae*, which can result in damage to the skin, peripheral nerves, other body tissues, as well as the development of skin lesions and lesions along the pathways of nerve trunks (Suzuki K, et al., 2012).

Environment-based diseases are diseases that occur within a community due to a close relationship between humans and various environmental components in a specific area. Reports from WHO indicate that environmental factors contribute significantly to more than 80% of diseases. These environment-related diseases remain public health problems due to inadequate environmental conditions, both in terms of quality and quantity, which can lead to various diseases, including leprosy (WHO, 2019).

In Indonesia, there was an increase in new leprosy cases from 2017 to 2018, with the number increasing from 15,910 cases to 17,017 new cases. According to the report of the Directorate General of Disease Prevention and Control of the Ministry of Health of the

Republic of Indonesia in 2018, the detection rate of new cases increased to 6.42 cases per 100,000 population compared to 6.08 cases per 100,000 population in 2017. The proportion of grade 2 disability cases in Southeast Sulawesi also increased to 7.54 per 1,000,000 population in 2018 compared to 3.07 per 1,000,000 population in 2017. This indicates that case detection activities have increasingly focused on early detection and preventing delayed diagnosis. However, Southeast Sulawesi has not yet achieved leprosy elimination status, which requires a prevalence rate of less than 1 case per 10,000 population (Ministry of Health of the Republic of Indonesia, 2020).

The environment refers to all conditions and factors surrounding human life that support the growth and development of microorganisms. The physical environment includes temperature, lighting, air circulation, housing conditions, water, and soil. The environment is one of the factors influencing human health. A healthy environment supports a healthy population, while poor environmental conditions may negatively affect health status (Indasah, 2017). Leprosy is an infectious disease, and its spatial distribution can be analyzed using Geographic Information Systems (GIS), which provide information regarding administrative areas, population distribution, and disease distribution patterns (Idayana et al., 2017).

According to the Health Office of Buton Regency, the region is considered an endemic area where new cases of leprosy continue to be identified. The number of newly detected leprosy cases was 31 cases in 2017, 21 cases in 2018, 17 cases in 2019, and 15 cases in 2020, resulting in a total of 84 cases. Although the number of leprosy cases in Buton Regency decreased from 2017 to 2020, the declining trend still represented the highest number of cases compared with other regencies in Southeast Sulawesi.





This condition is supported by the Regulation of the Minister of Health of the Republic of Indonesia Number 11 of 2019 concerning leprosy control indicators, which states that the Case Detection Rate (CDR) for new leprosy cases is defined as the number of newly detected leprosy patients within one year per 100,000 population, with the program target being a CDR of less than 5 per 100,000 population. However, Buton Regency has not yet achieved the elimination target, which continues to pose a threat to the quality of life of the community.

2. Research Method

This study was an observational analytic study using a case-control research design. The objective of this study was to analyze environmental and host risk factors associated with the occurrence of leprosy in Buton Regency, Southeast Sulawesi Province. The study was conducted from March to May 2021 in Buton Regency, which is under the working area of the Buton Regency Public Health Centers.

The study population consisted of 84 leprosy patients recorded from 2017 to 2020 across all working areas of the Public Health Centers in Buton Regency. The sample consisted of 156 participants, including 52 cases and 104 controls. Samples were selected using a purposive sampling technique with a case-to-control ratio of 1:2. Matching was performed based on age and sex.

Data were collected through interviews using questionnaires, observation of housing conditions, and environmental measurements using a roll meter, lux meter, and thermo-hygrometer. The spatial distribution of leprosy cases was mapped by collecting coordinate points using a Global Positioning System (GPS). Data processing and analysis were performed using SPSS version 24, including the Chi-square test and logistic regression analysis..

3. Results And Discussions

a. Result

Based on the results of the univariate analysis presented in Table 1, the case group consisted of 16 individuals (30.8%) aged 10–20 years and 11 individuals (21.2%) aged 21–30 years. Meanwhile, the control group consisted of 32 individuals (30.8%) aged 10–20 years and 22 individuals (21.2%) aged 21–30 years.

Regarding sex distribution, the case group included 33 males (63.5%) and 19 females (36.5%), while the control group consisted of 66 males (63.5%) and 38 females (36.5%). In terms of occupation, the majority of participants in the case group were categorized as having other occupations, comprising 23 individuals (44.2%), while in the control group, 52 individuals (50.0%) were included in the same category.





Tabel 1. Results of the Univariate Analysis of Risk Factors for Leprosy Occurrence in Buton Regency

Characteristics		Leprosy				Total	
		Cases		Controls		n	%
		n	%	n	%		
Age (years)	10 – 20	16	30,8	32	30,8	48	30,8
	21 – 30	11	21,2	22	21,2	33	21,2
	31 – 40	8	15,4	16	15,4	24	15,4
	41 – 50	8	15,4	16	15,4	24	15,4
	51 – 60	6	11,5	12	11,5	18	11,5
	>61	3	5,8	6	5,8	9	5,8
Sex	Male	33	63,5	66	63,5	99	63,5
	Female	19	36,5	38	36,5	57	36,5
Occupation	Farmer	15	28,8	28	26,9	43	27,6
	Fisherman	10	19,2	16	15,4	26	16,7
	Housewife	4	7,7	8	7,7	12	7,7
	Others	23	44,2	52	50,0	75	48,1

The results of the bivariate analysis presented in Table 2 showed that trust, history of contact, bathing habits, lighting, ventilation, and housing density were significantly associated with the incidence of leprosy. Meanwhile, humidity, water availability, and latrine ownership were not associated with the incidence of leprosy. A history of contact increased the risk of developing leprosy by 6.550 times, while inadequate housing density increased the risk by 8.298 times compared with other variables.

Tabel 2. Bivariate Analysis of Environmental Risk Factors Associated with Leprosy Incidence

Risk Factors		Leprosy				Total		p-value	OR	95% CI
		Cases		Controls						
		n	%	n	%	n	%			
Trust	Risk	37	71,2	48	6,2	85	4,5	0,003	2,878	1,410-5,872
	Not Risk	15	28,8	56	3,9	71	5,5			
Contact history	Risk	39	75,0	32	0,8	71	5,5	0,001	5,750	3,178-4,336
	Not Risk	13	25,0	72	9,2	85	4,5			
Bathing habits	Risk	36	69,2	30	8,8	66	2,3	0,001	4,659	2,287-9,492
	Not Risk	16	30,8	74	1,2	90	7,7			
Lighting	Adequate	31	59,6	40	8,5	58	5,5	0,012	2,362	1,196-4,664
	Inadequate	21	40,4	64	1,5	98	4,5			
Ventilation	Adequate	29	55,8	38	6,5	67	2,9	0,022	2,190	1,112-4,311
	Inadequate	23	44,2	66	3,5	89	7,1			
Humidity	Adequate	23	44,2	35	3,7	58	7,2	0,198	1,564	0,791-3,092
	Inadequate	29	55,8	69	6,3	98	2,8			
Housing density	Adequate	43	82,7	38	6,5	81	1,9	0,000	3,298	3,648-8,876
	Inadequate	0	17,3	66	3,5	75	8,1			
Water availability	Risk	29	55,8	47	5,2	76	8,7	0,213	1,529	0,783-2,988
	Not Risk	23	44,2	57	4,8	80	1,3			
Latrine ownership	Risk	25	47,1	35	3,7	60	8,5	0,081	1,825	0,925-3,600
	Not Risk	27	51,9	69	6,3	96	1,5			





Publish: Association of Indonesian Teachers and Lecturers

International Journal of Health Sciences (IJHS)Journal Homepage: <https://jurnal.agdosi.com/index.php/IJHS/index>

Volume 4 | Number 3 | September 2026 |

**b. Discussion**

The population distribution by sub-district in Buton Regency consists of 45,173 people in Pasarwajo Sub-district, 16,415 people in Siontapina Sub-district, 15,666 people in South Lasalimu Sub-district, 15,126 people in Kapontori Sub-district, 12,960 people in Lasalimu Sub-district, 6,466 people in Wolowa Sub-district, and 6,456 people in Wabula Sub-district (Buton Regency Statistics Agency, 2020). In this study, the distribution of leprosy cases was identified using a Global Positioning System (GPS) device to generate coordinate point data through visits to each respondent's house.

Pasarwajo Sub-district has a high population density, with residential environmental conditions characterized by houses located close to each other and villages positioned near one another, resulting in a higher risk of direct contact with leprosy patients. To identify the chain of leprosy transmission, surveillance systems should be able to identify the distribution of leprosy cases at the individual level. Previous research by Cendaki, Q. A. (2018) found positive *Mycobacterium leprae* DNA in the nasal mucosa of leprosy patients. This finding demonstrates that air is an environmental component that acts as a bridge between hosts or carriers of leprosy and other environmental components (water and soil) surrounding patients. Adaptation processes involve various aspects of life, including economic, social, educational, and environmental vulnerabilities (Setiawan et al., 2025).

The results of the bivariate analysis regarding beliefs about leprosy showed an association with leprosy incidence. Respondents who did not believe that leprosy was a medical disease had a 2.878-fold higher risk of developing leprosy compared with respondents who believed that leprosy was a medical disease. Respondents with strong beliefs were mostly leprosy patients, who were vulnerable because they believed that leprosy was caused by curses or hereditary factors. Many community members still strongly adhere to cultural beliefs and assume that leprosy can be cured through traditional medicine by visiting traditional healers or community elders.

Therefore, health education regarding leprosy should be provided by healthcare workers to increase respondents' awareness and encourage them to seek treatment at hospitals or community health centers. This finding differs from the study conducted by Singh R. et al. (2019), which reported that 21.1% of respondents believed that dirty blood was the cause of leprosy, followed by God's curse (8.8%), heredity (3.2%), and evil deeds (2.7%). Healthcare workers emphasized that treatments involving rituals were inappropriate approaches for managing leprosy.

Leprosy is caused by *Mycobacterium leprae* or *Mycobacterium lepromatosis*. The infection mechanism involves host-pathogen interactions mediated by *M. leprae*. Highly exposed populations, including household members, family members, and social contacts of patients, are considered to have the highest risk of contracting leprosy; however, the disease does not necessarily develop throughout their lifetime.





Therefore, mycobacterial infection is necessary but not sufficient for the development of leprosy (Toledo Pinto, T. G. et al., 2018).

The results of the bivariate analysis showed that respondents with a history of contact had a 6.750-fold higher risk of developing leprosy compared with respondents without contact history. In this study, respondents with a high-risk contact history accounted for 75.0% of leprosy cases. This condition occurred because community members frequently gather and interact socially, which has become a cultural tradition in Buton Regency. Such interactions increase the possibility of transmission because there is no physical distance between patients and non-patients.

This finding is consistent with the study by Siswanti and Wijayanti (2018), which found that respondents with contact history were more frequently identified among leprosy patients (69%) compared with those without contact history (24.1%). Household contact history was significantly associated with leprosy incidence (p -value = 0.002), and respondents with household contact history had a 6.98-fold higher risk of developing leprosy compared with respondents without household contact history.

4. Conclusion

Based on the results of this study, it can be concluded that the spatial distribution map showed that areas with a higher risk of leprosy cases were located in Pasarwajo Sub-district. Beliefs, contact history, bathing habits, lighting, ventilation, and housing density were identified as risk factors associated with leprosy incidence, whereas humidity, water availability, and latrine availability were not identified as risk factors. Furthermore, multivariate analysis using logistic regression showed that contact history, bathing habits, and housing density were the variables that had the greatest influence on leprosy incidence.

5. Compliance with ethical standard

Acknowledgements

The authors would like to express their gratitude to the Government of Buton Regency, Southeast Sulawesi Province, particularly the Health Office, for providing opportunities, facilities, collaboration, and support throughout the entire research process until its completion. The authors also extend their appreciation to all individuals and institutions who contributed to the successful completion of this study.

Disclosure of conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. All authors contributed to the research implementation, participated in the preparation of the manuscript, approved the final version of the manuscript, and are accountable for all aspects of the work.

This research was conducted independently without any financial, personal, or institutional relationships that could have influenced the research design, data collection process, data analysis, interpretation of the findings, or reporting of the research results.





Statement of informed consent

Written informed consent was obtained from all participants prior to their participation in this study. The participants were provided with explanations regarding the objectives of the study, research procedures, potential risks and benefits, confidentiality of the collected data, and their right to withdraw from the study at any time without any consequences.

All participants voluntarily agreed to participate and provided written informed consent before the interviews were conducted.

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