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THE ROLE OF ENVIRONMENTAL FACTORS IN SUPPORTING THE SPREAD OF LEPROSY IN DR SOETOMO HOSPITAL

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Abstract

Leprosy is a chronic infectious disease caused by Mycobacterium leprae, primarily transmitted through respiratory droplets during prolonged and close contact with untreated individuals. Although it has a relatively low transmission rate, unfavorable environmental conditions can significantly increase the risk of disease spread. This study aims to identify and analyze the environmental factors that contribute to leprosy transmission. A descriptive quantitative study with a cross-sectional observational design was conducted. The study involved 222 leprosy patients with type 1 (reversal) reactions who were registered at the Morbus Hansen Outpatient Clinic from January 2015 to September 2024. Data were collected using structured questionnaires, field observations, and secondary data from medical records. Data were analyzed using descriptive and inferential statistics, with the Mann–Whitney test used to examine the relationship between environmental factors and leprosy cases. The results show that high population density, poor sanitation, inadequate household ventilation, limited access to clean water, and low socioeconomic status are factors significantly correlated with the high incidence of leprosy in the area. These findings highlight the importance of improving environmental conditions, alongside community education and enhanced access to healthcare services, as key components in the prevention and control of leprosy. Therefore, environment-based interventions should be integrated into a comprehensive strategy to eliminate leprosy in Indonesia.
Keywords: Disease Prevention; Leprosy; Environmental Conditions; Population Density; Sanitation.

INTRODUCTION

Leprosy is an infectious disease that can cause medical impacts in the form of physical disabilities as well as social and economic problems for affected individuals (1). Epidemiologically, leprosy remains widely distributed worldwide, with the highest prevalence reported in Southeast Asia. Leprosy is transmitted through prolonged close contact and inhalation of respiratory droplets, as *Mycobacterium leprae* can survive for several days in airborne droplets. Although humans are the primary source of transmission, the bacterium has also been identified in certain animals, such as armadillos and several species of monkeys (2). He transmissibility of leprosy is relatively low, with approximately 5% of exposed individuals developing infection.

Data from the Ministry of Health of the Republic of Indonesia, throughout 2023, recorded 17,251 visits to leprosy patients. This number has increased from 14,821 cases in 2022, with details of 90% of cases of multibacillar leprosy and 8.2% affecting children. As many as 5.7% of leprosy sufferers have a level 2 disability, proving that the prevention of leprosy transmission throughout Indonesia has not been handled

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properly. According to data from the World Health Organization (WHO), in 2022, Indonesia will be the country with the 3rd-most cases of leprosy in the world, after India and Brazil, with a total of 12,612 cases (3).

The diagnosis of leprosy is established based on clinical features, including hypopigmented or erythematous skin lesions accompanied by sensory loss. Other common findings include peripheral nerve thickening with sensory impairment, dry skin, and hair growth disturbances in the affected lesions (3). Examination of the nasal mucosa may reveal *Mycobacterium leprae*, and histopathological findings typically show diffuse infiltrates with numerous bacilli. Leprosy reactions represent hypersensitivity responses that mark the acute phase of the disease, characterized by systemic symptoms and the appearance or worsening of skin lesions (4).

Research by Baba found that high occupancy density increases the likelihood of transmission due to long-term close contact with people with (5). Another study by Hidayati highlighted the role of poor sanitation and limited access to clean water in triggering the high incidence of leprosy, especially in poor, densely populated areas Meanwhile, Ulul noted that poor ventilation in the house also increases the risk of bacterial transmission of *Mycobacterium leprae* (6). These studies reinforce the understanding that the physical and social environment directly influences the continuity of leprosy transmission.

However, most research still focuses on clinical and treatment aspects, while a comprehensive analysis of the linkages among five environmental factors and the spread of leprosy remains limited, particularly at the local level. In fact, in some endemic areas, such as this study area, poor environmental conditions continue to challenge leprosy control efforts. Therefore, this research is important and urgent for clarifying the extent to which the surrounding environment contributes to leprosy transmission and for providing a basis for formulating more context-specific and effective prevention strategies.

The purpose of this study is to identify and analyze five environmental factors that contribute to leprosy transmission. Through this research, it is hoped that a clearer picture of environmental risk factors will be obtained

and that appropriate recommendations will be provided to the government and relevant parties to control leprosy through an environmental and social approach.

RESEARCH METHOD

This type of research is a retrospective descriptive research with a cross-sectional approach (7–9). The design of this study involved describing and analyzing the phenomenon or incidence of relapsing leprosy and type 1 reactions using secondary data from medical records of relapsing leprosy patients for the period from January 2015 to September 2024.

The independent variables in this study were environmental factors, including housing density, sanitation conditions, and access to clean water, home ventilation, socioeconomic and nutritional status, and access to healthcare services. The dependent variable was the occurrence of leprosy, as reflected in the characteristics of leprosy patients with type 1 (reversal) reactions.

The study population consists of patients with reversal reaction leprosy (type 1 reaction) at the Skin and Venerean Outpatient Installation of the Morbus Hansen Division, Dr. Soetomo Hospital, Surabaya. The sample selection technique in this study divided reaction 1 leprosy patients into several strata or groups based on number, sex, age, type of leprosy, reaction symptoms according to MDT, peripheral nerve symptoms, type of therapy, and physical disability. The sample consisted of 222 participants.

The study used structured questionnaires, observation sheets, and documentation to collect data on five environmental factors: housing density and conditions; sanitation and access to clean water; home ventilation; socioeconomic and nutritional status; and access to healthcare services. Questionnaires were used to obtain primary data on household characteristics and clean and healthy living behaviors, while observations and documentation complemented physical environmental data and secondary data to support the validity of the findings.

The collected data were analyzed using SPSS software. The association between independent and dependent variables was examined using the Mann–Whitney test, as the data were not normally distributed and most variables were measured on ordinal or categorical scales, thus not

meeting the assumptions of parametric tests. The results are presented in percentage-based charts. This study was conducted with approval from the Health Research Ethics Committee of Dr. Soetomo Hospital, Surabaya. Participant confidentiality was ensured by using initials only, with patient identities accessible solely to the researcher.

RESULTS AND DISCUSSION

Profile of Leprosy Reversal Reaction

Table 1. Total Number of Reversal Reaction Leprosy Patients

Number of Patients	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
Total	95	42.8	61	27.5	44	19.8	18	8.1	4	1.8	222	100

Table 1 shows that 222 leprosy patients with reversal reactions were recorded during the 2015–2024 period. The highest number of cases occurred in 2015–2016 (42.79%), followed by a gradual decline in subsequent periods, with the lowest number observed in 2023–2024 (1.8%).

Table 2. Total Number of Reversal Reaction Leprosy Patients by Sex

Sex	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
Male	41	43.2	41	67.2	20	45.4	6	33.3	2	50	110	49.5
Female	54	56.8	20	32.8	24	54.6	12	66.7	2	50	112	50.5
Total	95	100	61	100	44	100	18	100	4	100	222	100

The distribution of leprosy based on gender was dominated by female patients, namely 112 patients (50.45%), followed by 110 male patients (49.55%).

Table 3. Data by Age

Age	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
< 15	0	0	0	0	0	0	0	0	1	25	1	0.5
15-20	10	10.5	19	31.1	11	25	1	5.6	2	50	43	19.4
21-25	6	6.3	9	14.7	4	9.1	7	38.9	1	25	27	12.2
26-30	34	35.8	2	3.3	0	0	1	5.6	0	0	37	16.7
31-35	6	6.3	4	6.6	1	2.3	0	0	0	0	11	5
36-40	17	17.9	2	3.3	7	15.9	0	0	0	0	26	11.7
41-45	6	6.3	0	0	6	13.6	5	27.8	0	0	17	7.7
46-50	11	11.6	7	11.5	7	15.9	1	5.6	0	0	26	11.7

Age	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
51.55	5	5.3	11	18	1	2.3	1	5.6	0	0	18	8.1
56-60	0	0	1	1.6	0	0	1	5.6	0	0	2	0.9
61-65	0	0	4	6.6	4	9.1	0	0	0	0	8	3.6
66-70	0	0	1	1.6	0	0	0	0	0	0	1	0.4
71-75	0	0	1	1.6	3	6.8	1	5.6	0	0	5	2.2
Total	95	100	61	100	44	100	18	100	4	100	222	100

Based on Table 3 of the results of the study above, the age group in the reversal reaction was the largest in the age group of 15 to 20 years, which was 43 patients (19.37%), followed by the age group of 26 to 30 years, which was 37 patients (16.7%).

Table 4. Leprosy-type data in patients with reversal reaction leprosy

Types of Leprosy	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
PB	6	6.31	2	3.28	1	2.27	0	0	0	0	9	4.05
MB	5	5.26	0	0	0	0	0	0	1	25	6	2.7
TT	81	85.26	40	65.57	36	81.81	14	77.78	2	50	173	77.93
LL	2	2.1	1	1.64	2	4.55	0	0	0	0	5	2.25
BT	1	1.05	5	8.2	2	4.55	2	11.11	1	25	11	4.95
BB	0	0	12	19.67	1	2.27	2	11.11	0	0	15	6.75
BL	0	0	1	1.64	2	4.55	0	0	0	0	1	1.35
Total	95	100	61	100	44	100	18	100	4	100	222	100

4 Table 4 shows that the leprosy type *multibacillary* (MB) was present in 6 patients (2.7%), and the type *paucibacillary* (PB) in 9 patients (4.1%). TT-type leprosy patients accounted for 173 patients (77.9%), LL-type for 5 patients (2.3%), BT-type for 11 patients (4.9%), BB-type for 15 patients (6.8%), and BL-type for 3 patients (1.3%).

Table 5. WHO Classification Leprosy Type Data on Leprosy Patients

WHO Classification Leprosy Type	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
PB	6	54.54	2	100	1	100	0	0	0	0	9	60
MB	5	45.46	0	0	0	0	0	0	1	100	6	40
Total	11	100	2	100	1	100	0	0	1	100	15	100

Table 5 shows that, according to the WHO classification, the majority of leprosy patients were paucibacillary (PB), accounting for 9 cases (60%), while

multibacillary (MB) cases comprised 6 patients (40%).

Table 6. Ridley Classification Leprosy Type Data – Jopling

Ridley Classification Leprosy Type	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
TT	81	96.4	40	67.8	36	83.72	14	77.8	2	66.7	173	83.6
LL	2	2.4	1	1.7	2	4.6	0	0	0	0	5	2.4
BT	1	1.2	5	8.5	2	4.6	2	11.1	1	33.3	11	5.3
BB	0	0	12	20.3	1	2.3	2	11.1	0	0	15	7.2
BL	0	0	1	1.7	2	4.6	0	0	0	0	0	3
Total	84	100	59	100	43	100	18	100	3	100	207	100

As shown in Table 6, the Ridley–Jopling classification indicated that tuberculoid leprosy (TT) was the predominant type, accounting for 173 patients (77.9%). This was followed by borderline leprosy types, including BB (15 patients; 6.8%), BT (11 patients; 4.9%), and BL (3 patients; 1.3%), while lepromatous leprosy (LL) was the least common, with 5 patients (2.3%).

Table 7. Reaction Symptom Data Based on MDT Administration

Reaction Symptom Data Based on MDT Administration	Years										Total
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	
0-9 months	72	0.3	49	0.2	25	0.1	9	0.04	3	0.01	158
1-3 years or > 3 years	7	0.03	2	0.01	0	0	1	0.004	0	0	10
Before MDT	9	0.04	8	0.03	13	0.06	2	0.01	1	0.01	33
RFT	7	0.03	2	0.01	6	0.03	4	0.02	2	0.01	21
Total	95		61		44		16		6		222

Based on table 7, reaction symptoms based on the administration of MDT often occurred after the administration of MDT for up to 9 months, as many as 158 patients (71.2%) were multibacillary (MB) and paucibacillary (PB) type leprosy; 9 to 12 years or 1-3 years as many as 10 patients (4.5%), before (multy drug therapy) MDT as many as 33 patients (14.9%) and after (release from treatment) RFT as many as 21 patients (9.5%).

Table 8. Data on Nerve Symptoms in Patients with Leprosy Reversal Reaction

Nerve Symptoms	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
Nerve Disorder	81	85.3	47	77	41	93	15	83.3	4	100	188	84.7
No Nerve Disorders	14	14.7	14	23	3	6.8	3	16.7	0	0	34	15.3
Total	95	100	61	100	44	100	18	100	4	100	222	100

Based on Table 8, there are many peripheral nerve symptoms in people with recessal leprosy, namely 188 patients (84.7%), while those who show no neurological disorders amounted to 34 patients (15.3%).

Table 9. Data on the Type of Therapy for Leprosy Patients with Reversal Reactions

Therapy	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
Without OAINS and Corticosteroids	75	79	48	78.7	36	81.8	10	55.6	2	50	171	77
Corticosteroids	4	4.2	1	1.6	1	2.3	0	0	0	0	6	2.7
NSAID	5	5.3	3	4.9	0	0	0	0	0	0	8	3.6
NSAID + Lamprene	11	11.6	9	14.7	7	16	8	44.4	2	50	37	16.7
Total	95	100	61	100	44	100	18	100	4	100	222	100

Based on Table 9, therapy for patients with relapsing leprosy was mostly given without OAINS and corticosteroids, namely 171 patients (77.02%), corticosteroids as many as 6 patients (2.7%), NSAIDs as many as 8 patients (3.6%), and NSAIDs + Lamprene as many as 37 patients (16.7%).

Table 10. Data on Physical Defects Suffered by Reversal Reaction Leprosy Patients

Nerve Symptoms	Years										Total	
	2015-2016	%	2017-2018	%	2019-2020	%	2021-2022	%	2023-2024	%	Riil	%
There are abnormalities in the eyes	94	98.9	60	98.3	44	100	18	100	4	100	220	99
There are no abnormalities in the eyes	1	1.1	1	1.6	0	0	0	0	0	0	2	1
Total	95	100	61	100	44	100	18	100	4	100	222	100

Table 10 shows that the majority were without disabilities, namely 220 patients (99.1%), and 2 patients (0.9%) had disabilities. Based on this research, the number of leprosy patients in the community tends to decrease significantly; this trend is evident even in Indonesia.

Environmental Factor Analysis

Table 11. Respondent Occupancy Density

Occupancy Density	Number of Respondents	Percentage
< 3 people per house	32	14.4%
4-5 people per house	45	20.3%
>5 people per house	145	65.3%
Total	222	100%

Table 11 shows that most respondents (65.3%) live in houses with more than 5 occupants in a single house unit measuring less than 36 m². This housing density may increase the risk of leprosy transmission through prolonged close contact.

Table 12 . Environmental Sanitation Conditions

Sanitation Conditions	Number of Respondents	Percentage
Good	71	32%
Bad	151	68%
Total	222	100%

Table 12 shows that 68% of respondents live in neighborhoods with poor sanitation, including the absence of adequate sewage drains, standing water around the residence, and limited or absent bathing, washing, and toilet facilities (MCK). This condition reflects an unhygienic environment and has the potential to be a breeding ground for various pathogenic microorganisms, including bacteria that cause leprosy. Poorly sanitized environments are also generally associated with low awareness of clean and healthy living behaviors (PHBS), which can exacerbate the spread of infectious diseases. Poorly managed waterlogging and sewage can attract other disease vectors and increase the risk of secondary infections, ultimately weakening people's immunity.

Table 13. Home Ventilation Conditions

Sanitation Conditions	Number of Respondents	Percentage
Enough	67	30%
Not Enough	155	70%
Total	222	100%

Table 13 shows that 72% of respondents' homes have inadequate ventilation, characterized by poor indoor air circulation and a lack of natural lighting. This condition creates a humid, stuffy, and unhealthy environment, which can increase the risk of disease transmission, including leprosy, especially if there is long-term close contact with active patients. Lack of ventilation not only inhibits the exchange of clean air but also prolongs the presence of droplets in the air that potentially contain *Mycobacterium leprae*. In addition, the lack of natural light can indicate a high occupancy density and limited decent space, which, in turn, reflects the low quality of the dwelling.

Table 14. Economic Conditions of Leprosy Patients

Status Economy	Number of Respondents	Percentage
Very Poor	133	59.9%
Poor	67	30.1%
Lower Middle	15	6.75%
Middle Up	7	3.25%
Total	222	100%

The very poor group has the highest number of cases, namely 59.9% of respondents in this group identified as having or living in the same house as a leprosy patient. The poor group also had a fairly high incidence rate (30.1%), while the lower-middle and upper-middle groups had significantly lower rates. These findings strengthen the hypothesis that poverty is closely related to the high risk of spreading leprosy, allegedly through malnutrition, limited immunity, and low access to and exposure to health information.

Table 15. Access to Healthcare Services

Sanitation Conditions	Number of Respondents	Percentage
Easy	67	42%
Difficult	155	58%
Total	222	100%

Table 15 shows that 58% of respondents have difficulty accessing healthcare due to distance, transportation costs, or limited health facilities in their area.

The Relationship between Environmental Factors and Leprosy Cases

Analysis of the Chi-square test showed a significant relationship ($p < 0.05$) between residential density, poor sanitation, inadequate ventilation, and access to clean water, and the presence of leprosy cases in the respondents' environment. This shows that the worse the environmental conditions, the greater the potential for leprosy spread.

Discussion

The study results show that environmental conditions where people live significantly contribute to the risk of leprosy transmission. The five main factors studied are population density and narrow housing, sanitation and access to clean water, home ventilation, poverty and nutrition, and access to health services, which together create an environment that supports the transmission of *Mycobacterium leprae*.

Population Density and Narrow Dwellings

High population density, coupled with narrow residential conditions, is one of the main factors that increase the risk of leprosy transmission in the community. Leprosy, caused by the bacterium Mycobacterium leprae, is transmitted primarily through respiratory droplets during prolonged, close contact between individuals. In densely populated residential environments with limited space, intensive physical interaction among household occupants further increases the risk of disease transmission. In addition, inadequate ventilation in houses with narrow dwellings limits air circulation, so droplets containing bacteria tend to settle and accumulate in indoor air, increasing the risk of transmission between family members.

Empirical research supports the significant role of population density in the spread of leprosy (12,13). Households with more than four residents have a much higher risk of developing a case of leprosy compared to a smaller household with fewer occupants. These findings confirm that

intense, prolonged physical contact in densely populated dwellings is an ideal environment for the spread of M. leprae. Furthermore, the study highlights the importance of thorough treatment for leprosy sufferers, as the existence of one individual who has not received effective therapy in a congested dwelling can be a source of infection for other family members.

Thus, population density and cramped residential conditions not only increase the frequency of contact between individuals but also create a conducive environment for leprosy-causing bacteria to survive and spread. Therefore, interventions that improve housing conditions and reduce household overcrowding are crucial to controlling leprosy, especially in vulnerable and high-risk communities.

Poor Sanitation and Limited Access to Clean Water

Poor environmental sanitation is one of the significant factors contributing to the spread of leprosy, especially in communities with low socioeconomic conditions. Data from field surveys showed that most of the respondents lived in neighborhoods with irregular waste disposal systems, frequent standing water, and a lack of bathing, washing, and toilet facilities. This condition directly affects the low level of personal hygiene and the surrounding environment, which are important factors in lowering the body's resistance to various infections. In addition, limited access to clean water makes it difficult for people to practice routine hygiene practices, such as regular handwashing and bathing, which are indispensable for maintaining healthy skin and preventing the entry of disease-causing germs.

Research reveals that the link between poor sanitation and limited access to clean water can increase the risk of leprosy transmission (10,11). The study found that slum environments with inadequate sanitation facilities create conditions that favor the spread of leprosy-causing bacteria, either directly through skin contact or indirectly through lowering community hygiene standards. Poor sanitation also worsens public health conditions, weakening the body's immune system and making it more susceptible to infection. This underscores the importance

of interventions that improve access to clean water and sanitation facilities as part of leprosy control strategies in endemic areas.

Thus, improving sanitation and providing adequate access to clean water not only enhances the community's quality of life but is also an important step in reducing the risk of leprosy transmission. A holistic approach that involves improving sanitation infrastructure, health education, and community empowerment is urgently needed to effectively break the chain of transmission of this disease.

Inadequate Home Ventilation

Poor ventilation in housing is a crucial factor that affects the spread of leprosy. When air circulation in the house is suboptimal, droplets containing Mycobacterium leprae can persist longer in the air of an enclosed room. This condition increases the risk of transmission between family members or household occupants, especially in environments with high occupancy density. On the other hand, homes with natural lighting and good air circulation can reduce the concentration of harmful droplets in the air, thereby lowering the likelihood of transmission of droplet-based diseases such as leprosy. Therefore, improving ventilation is an important aspect of the strategy to prevent the spread of infectious diseases.

Research shows that ventilation is associated with leprosy incidence. The study found a positive correlation between poor ventilation conditions and increased leprosy cases (12,13). Homes with limited air circulation allow bacteria-laden droplets to linger indoors for longer, increasing the risk of transmission. These findings confirm the importance of physical environmental factors in controlling leprosy, especially in areas with high disease prevalence.

Thus, interventions that prioritize improving home ventilation, such as adding windows, vents, or simple mechanical ventilation systems, are highly recommended as part of leprosy control efforts. Improving indoor air quality not only helps suppress the spread of leprosy but also supports residents' overall respiratory health.

Poverty, Poor Nutrition, and Low Immunity

Poverty is a fundamental factor that directly contributes to public health,

particularly through its effects on nutritional status. In this study, most respondents reported low expenditure levels and unbalanced, unnutritious food consumption patterns. A lack of essential nutrients weakens the immune system, making individuals more susceptible to various infections, including bacterial infections that cause leprosy. In addition, poor socioeconomic conditions are also closely related to low awareness and clean and healthy living behaviors, which have the potential to exacerbate the risk of disease transmission.

Previous findings provide empirical evidence supporting a close relationship between low economic status and poor nutritional intake and decreased immunity (18,19). The study underscores that chronic malnutrition not only leads to nutritional deficiencies but also slows down the body's immune response to bacterial attacks, thus increasing the likelihood of infection. This condition is especially dangerous in the context of leprosy, which requires a strong immune system to resist the spread and development of Mycobacterium leprae bacteria in the body.

Therefore, efforts to control leprosy must not only focus on the medical aspects but also include socio-economic interventions to improve the community's quality of life. Nutrition improvement programs, health education, and economic empowerment are needed to increase people's immunity and effectively reduce the risk of leprosy infection. This multisectoral approach will strengthen sustainable measures to prevent and treat leprosy.

Limited Access to Healthcare

Access to health services remains a major obstacle to leprosy control efforts, especially in remote and infrastructure-limited areas. Most respondents in this study reported difficulty reaching health facilities due to limited transportation, high costs, and long distances. This condition causes delays in diagnosis and treatment, so leprosy sufferers do not get timely and complete therapy. As a result, untreated individuals become active sources of transmission in their communities, extending the chain of disease transmission.

In addition to physical and economic constraints, the lack of education and public

awareness about the importance of early screening also worsens the situation. The lack of initiatives to carry out detection and treatment in the early stages has led to many new cases of leprosy being diagnosed in already severe conditions, making it increasingly difficult to control the disease. Previous studies have confirmed that delays in diagnosis and treatment contribute significantly to the ongoing transmission of leprosy in the community (14). Sufferers who persist for a long time without effective treatment remain a source of infection that is harmful to the surrounding environment.

Therefore, increasing access to health services through infrastructure improvements, subsidizing medical costs, and intensive education campaigns is very important in breaking the chain of leprosy transmission. An approach that integrates social, economic, and health aspects will strengthen the early detection and treatment system, enabling leprosy cases to be controlled more effectively and sustainably.

CONCLUSION AND RECOMMENDATION

This study demonstrates that environmental factors are significantly associated with leprosy. Unfavorable environmental conditions increase the risk of transmission and prolong the disease chain within communities. These findings underscore that leprosy control requires a comprehensive approach that extends beyond clinical management alone. Therefore, leprosy control efforts should focus on integrating medical management with improvements in environmental conditions and strengthened access to healthcare services. This integrated approach is expected to reduce sustained transmission and enhance the long-term effectiveness of leprosy control.

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