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Original Article

Understanding Leprosy in An Endemic District: Insights from a Community-Based Study

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Six provinces in Indonesia have yet to eliminate leprosy, with North Sulawesi among them. North Minahasa Regency reported one of the highest prevalence rates in North Sulawesi, at 1.8 per 10,000 population in 2022, with the highest concentration in the Likupang District. To meet the leprosy elimination target, comprehensive management systems must be improved to achieve a prevalence rate below 1 per 10,000 population in this district. This study was part of a community outreach program conducted by the KATAMATAKU team from Universitas Indonesia in collaboration with a team from Sam Ratulangi University. The study aimed to analyze the characteristics of leprosy patients in Likupang District, including leprosy type according to the World Health Organization (WHO), treatment status with multi-drug therapy (MDT), history of relapse, neuritis, leprosy reaction, neurotrophic ulcers, degree of disability, and other dermatoses, to serve as a reference for further research. This quantitative descriptive cross-sectional study employed purposive sampling at the Likupang Public Health Center, Likupang District, North Minahasa Regency, North Sulawesi Province. Among

Introduction

Leprosy is a neglected tropical disease (NTD) caused by *Mycobacterium leprae*, affecting the skin, peripheral nerves, and other organs, potentially resulting in disability and psychosocial disorders (WHO 2021). Indonesia has the highest number of leprosy cases in Southeast Asia and is the third highest in the world, recording

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the suspected cases, 58 patients (72.5%) were confirmed with leprosy, predominantly males (35 patients, 60.3%) aged 20–59 years (44 patients, 75.9%), with a significant proportion working as farmers (13 patients, 22.4%). The most common type of leprosy was multibacillary (43 patients, 74.1%), with 54 patients (93.1%) of patients having received MDT. Of these, 31 patients (53.5%) were released from treatment, 1 patient (1,7%) experienced relapse, and 5 patients (8.6%) had discontinued treatment. Most patients did not have history of leprosy reactions (86.2%). Although the majority of patients (43 patients, 74.2%) exhibited grade 0 disability, 5 patients (8.6%) presented with grade 1 disability in the form of sensory impairment, and 10 patients (17.2%) had grade 2 disability (G2D), characterized by severe visual impairment, cortical opacity, and clawing of the fingers and toes. However, none of the patients had neurotrophic ulcers, and all were still undergoing treatment. Only four patients (6.9%) presented with concurrent dermatoses. This study revealed that leprosy remained a significant public health concern in Likupang District, with a relatively high confirmation rate among suspected cases. Although most patients completed MDT and exhibited mild disease progression, challenges such as G2D, treatment discontinuation, and relapses remained worrying. These findings underscore the need for targeted interventions to prevent disease recurrence, and to enhance and further strengthen control programs in an endemic district.

Keywords: Leprosy, Elimination, Endemic, Case Detection, North Minahasa Regency, Indonesia

approximately 17,000 new cases annually, with a second-degree disability rate of 1.18 per 1 million population (Menaldi 2018). The Indonesian leprosy strategy program prioritizes the early identification of new cases without disabilities and their treatment until recovery, following global standards and the multi-drug therapy (MDT) principle. According to the Regulation of the Minister of Health of the Republic of Indonesia Number 11 of 2019 regarding Leprosy Control, the goal is to achieve leprosy elimination at the provincial level by 2019 and at the district level by 2024, targeting a prevalence rate of less than 1 per 10,000 population (Ministry of Health of the Republic of Indonesia 2019). However, data from the Ministry of Health of the Republic of Indonesia in 2022 indicated that six provinces had not achieved leprosy elimination: West Papua, Papua, Maluku, North Maluku, North Sulawesi, and Gorontalo (Directorate General of Disease Prevention and Control 2022). In Indonesia, challenges to leprosy elimination include structural factors (logistics, financial constraints, geographical access, and health facility management systems), health services (including referral level constraints, limited health personnel, and case detection methods), and their interrelation (Dharmawan et al 2022).

To address the problem of leprosy cases, collaborative strategy involving dermatologists, health workers in public health centers, and support from the local community is essential. A thorough understanding of the profile of leprosy patients is also crucial for the effectiveness of these interventions. An active contact tracing and chemoprophylaxis approach have also been implemented to facilitate the early detection of leprosy cases. These steps form the basis of this research, which aims to analyze the characteristics of leprosy patients in the Likupang District. Recognizing the condition of leprosy patients in this district will provide insights for developing more tailored and effective management strategies.

Materials and Methods

Geographical background

The Likupang District is a coastal area with high humidity, averaging 80–90%. It consists of three subdistricts: East Likupang, West Likupang, and South Likupang, all coastal and located at 1.6720° N, 125.0553° E, at sea level, covering a total area of 298.27 km². In 2022, the district had a population of 44,660, with an average population growth rate of 1.39% between 2020 and 2022 (BPS-

Statistics of North Minahasa Regency, 2023). The district's unique geographical conditions include coastal areas with small islands and agricultural zones. The Likupang Public Health Center is the sole first-level health facility serving the eastern coastal district of North Minahasa. It is the only center offering leprosy care, with jurisdiction over 14 mainland villages and four villages on Bangka Island: Sarawet, Likupang Satu, Likupang Dua, Wineru, Maen, Winuri, Pinenek, Rinondoran, Kalinaun, Marinsow, Pulisan, Lihunu, Kahuku, Libas, Likupang Kampung Ambong, Resetlemen, Kinunang, and Ehe (approximately with 44 300 people in 2021) (Fig. 1). The Likupang Public Health Center has one certified healthcare provider specializing in leprosy care with regular training annually.

Study Design

This descriptive-analytical study utilized quantitative research methods with a cross-sectional design at the Likupang Public Health Center, North Minahasa Regency, North Sulawesi Province (Fig. 1), as part of Health Program activities for leprosy patients.

The study population included all suspected leprosy cases and registered leprosy patients in the coastal and island areas of Likupang, as documented by the leprosy program case manager at the Likupang Public Health Center and the regional Health Service staff and presented for examination at the Likupang Public Health Center on August 19, 2022. The authors contacted local public health officers a month before the event and coordinated with the Likupang Public Health Center to notify the residing population and registered leprosy patients. Patients were referred to the Likupang Public Health Center to participate in the Health Program activities for leprosy patients.

Inclusion criteria: This study included patients suspected or diagnosed with leprosy within the Likupang Community Health Center's leprosy

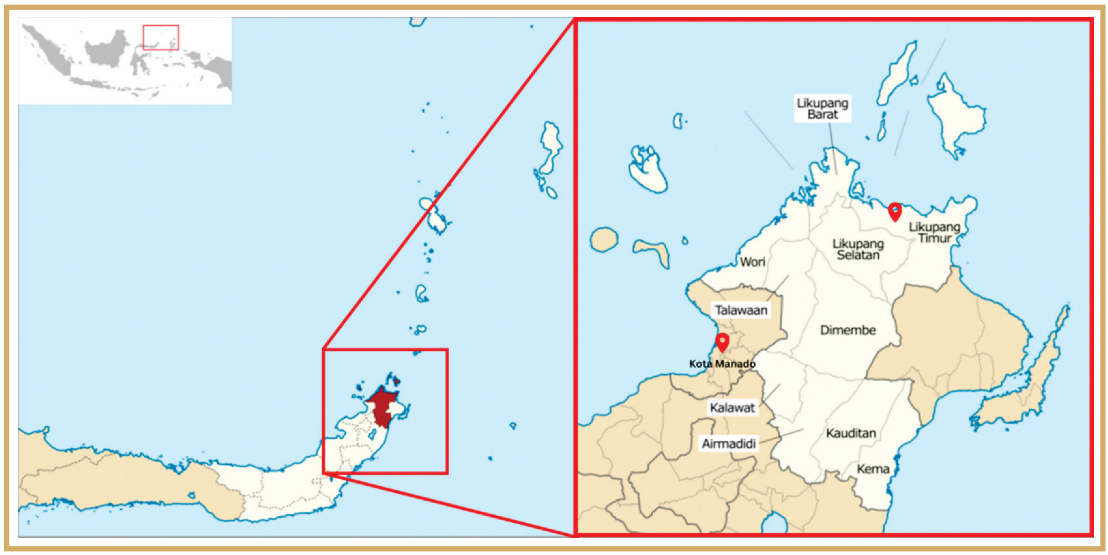


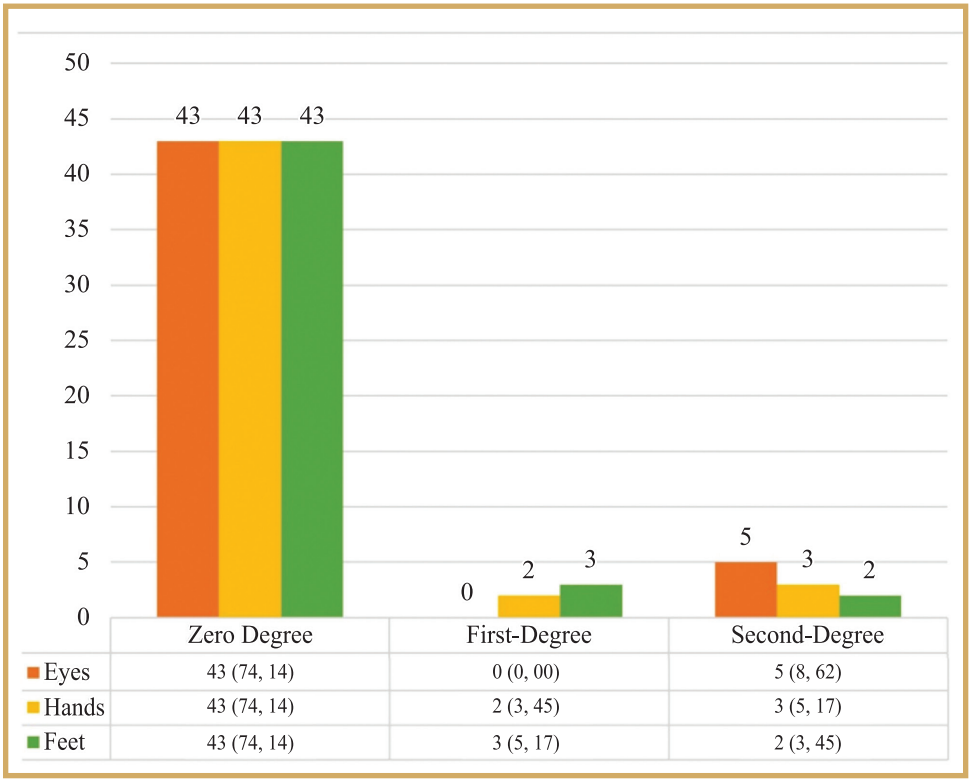
Fig. 1: Geographical representation of North Minahasa Regency (BPS-Statistics of North Minahasa Regency, 2023)

monitoring program who were willing to undergo examinations by a team of dermato-venereologists. The research subjects were informed about the examination's purpose and asked to provide written consent.

Data collection

Data collection involved history-taking by the Likupang Public Health Center's general practitioners. Subsequently, a physical examination was conducted by a team of doctors from the Department of Dermatology and Venereology at the Faculty of Medicine, Sam Ratulangi University, in collaboration with the Department of Dermatology and Venereology at the Faculty of Medicine, Universitas Indonesia, in August 2022 as part of the KATAMATAKU initiative.

Diagnosis of leprosy was based on the presence of at least one of the three cardinal signs of leprosy, with a monofilament used as a tool for nerve examination. The WHO recommends diagnosing leprosy based on these cardinal signs to simplify the diagnostic process for health workers in the field. Physical examination can confirm the first two cardinal signs using simple tools such as twisted cotton wool and a pen tip (WHO 2020a) when a 10-gram monofilament is unavailable (Frade et al 2021). The third important criteria of acid fast positivity requires bacteriological examination of skin scraping smears, it was not performed



	Zero Degree	First-Degree	Second-Degree
Eyes	43 (74, 14)	0 (0, 00)	5 (8, 62)
Hands	43 (74, 14)	2 (3, 45)	3 (5, 17)
Feet	43 (74, 14)	3 (5, 17)	2 (3, 45)

Fig. 2: Distribution of disability degree among leprosy patients in Likupang District, North Minahasa Regency, North Sulawesi Province.

for all patients due to the limited availability of local health facilities, particularly laboratories and laboratory personnel required for routine acid-fast bacilli examinations, especially during island visits. Patients with confirmed leprosy were further evaluated for type (multibacillary-MB/ paucibacillary-PB) according to WHO classification (WHO 2018), MDT treatment status, history of leprosy reactions, presence of neuritis, degree of disability, neurotrophic ulcers, and other dermatoses.

In August 2022, the Health Research Ethics Committee of RSUP Prof. Dr. R. D. Kandou, Manado (No. 131/EC/KEPK-KANDOU/VIII/2022) approved this study. Written informed consent was obtained from all participants.

Results

Demographic characteristics of leprosy patients

Of the 80 community members who participated in the study, 58 patients were found to be leprosy patients (72.5%), while 22 patients were excluded as non-leprosy patients because, after the comprehensive examination, no conditions or risk factors indicative of leprosy were observed. The majority of the patients were male 35 patients (60.3%) from a productive age (20-59 years old) 44 patients (75.9%), working as farmers 13 patients (22.4%) or fishermen 12 patients (20.7%) (Table 1). Alarmingly, two patients (3.4%) were children with leprosy, specifically multibacillary (MB)-type leprosy.

Table 1 : Demographic characteristic of leprosy patients in Likupang District, North Minahasa Regency, North Sulawesi Province.

Characteristic	N (%) (N = 58)
Sex	
Male	35 (60.3)
Female	23 (39.7)
Age (years old)	
0-14	2 (3.4)
15-19	1 (1.7)
20-59	44 (75.9)
≥ 60	11 (19.0)
Occupation	
Student	4 (6.9)
Construction worker	7 (12.1)
Housewife	12 (20.7)
Teacher	1 (1.7)
White-collar worker	1 (1.7)
Not working	2 (3.4)
Fisherman	12 (20.7)
Farmer	13 (22.4)
Other	6 (10.4)

Table 2 : Distribution of leprosy type based on sex, age, and age group classification among leprosy patients in Likupang District, North Minahasa Regency, North Sulawesi Province.

		Paucibacillary n (%)	Multibacillary n (%)
	Age (years old)		
Male		10 (17.2)	25 (43.1)
Child	0-14	0	2
Adult	15-59	7	19
Elderly	>60	3	4
Female		5 (8.6)	18 (31.0)
Child	0-14	0	0
Adult	15-59	4	18
Elderly	>60	1	0

Table 3 : Clinical characteristics of leprosy patients in Likupang District, North Minahasa Regency, North Sulawesi Province.

Characteristic	N (%) (N = 58)
Type of leprosy	
Paucibacillary	15 (25.9)
Multibacillary	43 (74.1)
History of MDT consumption	
MDT	54 (93.1)
Does not know	4 (6.9)
Current status of MDT	
Not yet/ will be receiving therapy	4 (6.9)
On therapy	18 (31.0)
Discontinued	5 (8.6)
Release from treatment	31 (53.5)
History of relapse	
Absent	51 (87.9)
Present	1 (1.7)
Does not know	6 (10.4)
History of neuritis	
Absent	49 (84.5)
Present	6 (10.3)
Does not know	3 (5.2)
History of leprosy reaction	
Absent	50 (86.2)

Reversal reaction	0 (0.0)
Erythema nodosum leprosum	4 (6.9)
Does not know	4 (6.9)
Neurotrophic ulcer	
Present	0 (0.0)
Absent	58 (100.0)
Other dermatoses	
Allergic contact dermatitis	1 (1.7)
Atopic dermatitis	1 (1.7)
Post-inflammatory pigmentary disorder	2 (3.5)
Absent	54 (93.1)

MDT = Multidrug therapy

Clinical characteristics of leprosy patients

The most commonly found leprosy type was MB-type leprosy, affecting 43 patients (74.1%), with a higher occurrence in males (25 patients, 43.1%) and predominantly in the productive age group (19 patients, 76.0%) (Table 2**)**. The majority of leprosy patients (54 patients, 93.1%) received MDT, and 31 patients (53.5%) were released from treatment (RFT) with no history of relapse (51 patients, 87.9%), neuritis (49 patients, 84.5%), and leprosy reactions (50 patients, 86.2%) (Table 3). In this study, four patients (6.9%) were identified as new cases and have not yet started MDT/ will be receiving therapy.

Although most patients (43 patients, 74.2%) exhibited grade 0 disability, 5 patients (8.6%) presented with grade 1 disability in the form of sensory impairment, and 10 patients (17.2%) had grade 2 disability (G2D), characterized by severe visual impairment, cortical opacity, and clawing of the fingers and toes. However, none of the patients had neurotrophic ulcers, and all were still undergoing treatment (Fig. 2, Table 3). Only four patients (6.9%) presented with concurrent dermatoses.

Discussion

North Minahasa Regency is among the highest regency for patients with leprosy in North Sulawesi, with a prevalence rate of 1.8 per 10,000 population in 2022 (BPS-Statistics of North Minahasa Regency 2021), particularly in the Likupang area, which includes the districts of East Likupang, West Likupang, and South Likupang. According to the population data registry of 2021 and the findings of this study, the prevalence of leprosy cases in Likupang District is 4.9/10.000 population. This number is high compared to the target from the World Health Organization. However, this may be based on the enthusiasm of the public outside of the Likupang District towards the community outreach program offering services from a multidisciplinary team, which has led to a high number of new cases of leprosy.

The number of patients diagnosed with leprosy was 58 patients, consisting of leprosy patients who have been ongoing therapy, RFT, discontinued, and patients who were just about to start treatment. In the present study, the ratio of men to women is 1.5:1. This finding is not much different from the retrospective study of Prakoeswa et al (2022) in Indonesia (ratio

of 2:1) and Wang et al (2018) in China (ratio of 1.7:1) which is thought to be related to men's behavior being more active outside and paying less attention to health care (Lubis et al 2022). Another crucial disparity factor among genders is the leprosy-related stigma highlighted by Dijkstra et al (2017), where female leprosy patients are more severely affected by stigma than male patients. This may lead to a lower willingness to seek care among females than males, leading to a lower case finding among females.

Regarding occupation, farmers and fishermen constitute the largest demographic groups in Likupang, reflecting its geographical features as a district characterized by plantations, agricultural land, and a coastline dotted with small islands. Even though the majority of patients were of productive age, there were 3.4% of children with leprosy whose parents were also diagnosed with leprosy. This figure was similar to a report in Surabaya, Indonesia, where 6.7% of cases recorded were pediatric leprosy (Reza et al 2022). In endemic areas, leprosy in children <15 years is common. The incidence of leprosy in children can indicate the disease's prevalence in the general population, the transmission of new infections, and related sources of active transmission (Gunawan et al 2021, Patil 2013). Multibacillary-type of leprosy in children has been considered important due to the higher bacterial index in some cases, increased risk of transmission, and association with deformity and disability (Reza et al 2022). Zero disability and zero transmission among children is a priority globally as well.

According to studies by Prakoeswa et al (2022) and Lubis et al (2022) in Indonesia, and Wang et al (2020) in China, the most common type of leprosy is MB. The ratio of MB-type leprosy in China fluctuates between 80.8% and 91.8% (2001-2018), which indicates that new leprosy patients have a higher level of infectivity, so intensive intervention is required to break the chain of transmission (Wang et al 2020). Men are more susceptible to MB-type leprosy than women; this situation may be related to the stimulation of male hormones, resulting in a less effective immune response (Lubis et al 2022). More than 90% of cases are treated with MDT, where patients on the mainland receive the drug from the Likupang Public Health Center, while patients on the islands obtain health services and medicine from visiting health workers using water transportation every one-to-two months. This approach has been proven effective in achieving a robust clinical response and a low relapse rate (Slater 2023), further supporting its widespread use. In this study, 6.9% of the patients were newly diagnosed and had not received an MDT regimen.

Newly diagnosed cases of leprosy in endemic areas pose significant challenges for both local health systems and the broader community. As such, active case detection should be a priority in any leprosy control program (Saunderson 2022). Delays in case detection (CDD) contribute to ongoing transmission and increase the likelihood of disability among patients. To address this, Dharmawan et al (2023) suggest reducing CDD through an integrated intervention program that combines active case detection with targeted health education.

There were 8.6% of subjects who discontinued the drug, which may be caused by various factors: the geographical conditions in the island area making it difficult to distribute the drug during bad weather; during the COVID-19 pandemic, the distribution of medicines from the center is hampered; lack of patient understanding, because they have not seen any improvement, the patients stopped taking the medication by themselves.

More than 50% of subjects had RFT, and only one patient had experienced a relapse. Release from treatment is a crucial point to be noticed due to the nature of ENL, which may occur years after RFT. Healthcare staff and patients need to be aware of the development of late episodes of ENL (Kinanti et al 2023). ENL reactions occurred in 6.9% of subjects; several factors, including the duration of MDT treatment, the onset of ENL, leprosy type BL and LL, coinfection, and bacterial index, may be related to reaction variations (Fransisca et al 2021, Indrawati et al 2022, Prakoeswa et al 2022, Mulianto et al 2023). Around 10.3% of subjects experienced neuritis, which may be associated with ENL.

The findings of patients with grade 1 disability of 8.6% and grade 2 of 17.2% were a situation that needs to be highlighted. Assessment of grade 1 disability is critical because it is the stage patients go through before progressing to grade 2. Prevention of disability (POD) must be carried out routinely. Self-care education is vital to prevent the worsening of the deformity (WHO 2020a) and contribute to supporting the achievement of the WHO's target to reduce the number of new cases of leprosy with grade 2 disabilities. Other dermatoses found, namely allergic contact dermatitis due to rubber, atopic dermatitis, and post-inflammatory pigmentary disorders, are incidentally unrelated to leprosy.

The continued occurrence of leprosy cases in Likupang District is a challenge to the leprosy elimination program in endemic areas in Indonesia. The challenge is contributed partly by the several factors as reported by a previous meta-analysis of environmental risk factors for leprosy in Indonesian society, which has identified the risk factors for personal hygiene and occupancy density (*i.e.*, the physical condition of the house, such as ceiling, floor type, humidity, and bedroom density) and environmental factors (*e.g.*, soil, humidity, vegetation, and thermal-hydrological climate). These risk factors contribute to leprosy transmission (Edi & Azizah 2023, Sapriadi & Wanci 2018, Rahmah et al 2018).

Continuous knowledge update for the health workers involved in leprosy prevention and control programs is urgently prompted, in line with increasing intensive active case detection and appropriate and timely distribution of MDT for confirmed leprosy patients. To overcome geographical constraints, the availability of specialist health workers, a tiered referral system, and simple teledermatology facilities are solutions that can support the establishment of long-distance communication and consultation for local health workers in confirming the diagnosis of suspected leprosy patients. This way, health workers can appropriately manage the patient's clinical condition. At the same time, complex cases that require further assessment can be referred to specialist doctors in dermatology and venereology on the local mainland or health facilities at a higher level.

Another effort done by the Likupang Public Health Center, in line with the World Health Organization Technical Guidance of Leprosy/ Hansen disease: Contact tracing and post-exposure prophylaxis (2020b), are contact tracing and chemoprophylaxis, *i.e.*, the Likupang Public Health Center traced 20 contacts around the living area of a leprosy patient and were given a single dose of rifampicin (WHO 2020b, Kar & Sethy 2023). This effort allowed for fewer new cases, especially among leprosy contacts. Improving a comprehensive governance system is needed to break the chain of transmission and help achieve a prevalence of less than 1 per 10,000 population in this district according to the leprosy elimination target, thereby supporting the eradication of neglected tropical diseases in Indonesia.

Profile of leprosy cases and important epidemiological markers in the present study will have commonalities with important countries like India (Joshi 2017), thus the analysis of determinants and solutions tried/ being tried would have relevance beyond the boundaries of the countries.

One-time data collection is a limitation of present study. Therefore, it is recommended that research involving their follow-up be conducted, such as a clinical audit, to observe further impacts on patients and to evaluate programs toward eliminating leprosy.

Conclusions

This study revealed that leprosy remained a significant public health concern in Likupang District, with a relatively high confirmation rate among suspected cases. Although most patients completed MDT and exhibited mild disease progression, challenges such as G2D, treatment discontinuation, and relapses remained worrying. These findings underscore the need for targeted interventions to prevent disease recurrence and to enhance and further strengthen control programs in an endemic district.

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