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Health Literacy Gaps in Leptospirosis Prevention: Evidence from an Analysis of Knowledge, Attitudes, Practices, and Perceptions in Limboto Lake, Gorontalo

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ABSTRACT

In Indonesia, leptospirosis is a zoonotic disease with rats as the main reservoir that remains a serious public health problem, especially in areas with high prevalence, including Lake Limboto and Gorontalo. The purpose of this study was to identify the presence of Leptospira in rats and examine the relationship between knowledge, attitudes, practices, and perceptions (KAPP) and health literacy. This study used a cross-sectional design with laboratory examination using PCR on 34 rat samples and a survey of KAP, perceptions, and health literacy among 168 respondents in two villages along Lake Limboto. Analysis of the relationship between variables was performed using the chi-square test. A total of 14 of 34 rat samples (41.2%) were detected positive for Leptospira. The study findings showed a strong correlation between health literacy and perceptions ($p=0.002$), practices ($p=0.023$), attitudes ($p=0.008$), and knowledge ($p<0.001$). Significant gaps in health literacy are highlighted by these findings, underscoring the need for integrated community-based interventions aligned with the one health paradigm. Reducing the burden of leptospirosis in coastal communities requires increased knowledge, improved risk perception, and encouragement of ongoing preventive measures.

Keywords: Leptospirosis, health literacy, KAP, One Health

INTRODUCTION

Leptospirosis is a zoonotic disease caused by the Leptospira bacteria, which is transmitted through contact with air or soil contaminated with the urine of infected animals, primarily rats, which are the primary reservoir. This disease occurs worldwide, but is more common in countries with humid subtropical and tropical climates. Poor sanitation, high humidity, and people who have not fully adopted clean and healthy lifestyles make leptospirosis a serious health problem. The World Health Organization (WHO) even categorizes it as one of the Neglected Tropical Diseases (NTDs) with a major impact on morbidity and mortality in developing countries (Triani et al., 2025).

Globally, contact with contaminated environments, particularly through rat urine, is the main route of transmission of leptospirosis (Sari, 2021). Tropical and subtropical countries with poor sanitation and frequent flooding are at higher risk. An estimated one million infections and nearly 60,000 deaths from leptospirosis occur annually worldwide (Costa et al., 2015).

In Indonesia, leptospirosis remains a public health problem. In 2023, 2,554 cases of leptospirosis were recorded in 12 provinces, with 205 deaths (CFR 8%). This figure increased compared to 2022 (1,624 cases), particularly in Java and Kalimantan. However, despite the increase in cases, the case fatality rate decreased from 9.1% to 8%, likely due to earlier detection and faster treatment (Ministry of Health, 2023).

One area also experiencing an increase in cases is the coast of Lake Limboto in Gorontalo Province. In 2024, this area was even declared to have experienced its first Extraordinary Event (KLB) of leptospirosis. Flood-prone coastal villages became the primary hotspots for outbreaks, exacerbated by ecological changes, declining sanitation, and low public health literacy. Data from the Gorontalo Provincial Health Office recorded 60 cases with 5 deaths. This situation indicates that despite repeated epidemics, public understanding of leptospirosis remains very limited.

A Malaysian study found that over 80% of respondents had poor knowledge despite demonstrating positive attitudes (Abdullah et al., 2019). Similar results in Indonesia also highlight low awareness, inadequate prevention practices, and misunderstandings about how the disease is transmitted (Sukeri et al., 2018). Besides behavioural factors, environmental conditions also play a significant role. Research in Indonesia found that residential density, livestock ownership, proximity of pens to homes (<10 meters), and the presence of rats in the home significantly increase the risk of leptospirosis (Notobroto et al., 2021).

Health literacy plays a crucial role in zoonotic disease prevention, influencing the community's ability to understand risks and adopt protective behaviors (Nutbeam, 2000). The combination of an unhealthy environment, low health literacy, and the presence of rats as a natural reservoir of Leptospira increases the risk of transmission. Several studies have shown that controlling rat populations through environmental improvements and public education can significantly reduce the incidence of leptospirosis (Teguh Prihantoro & Siwiendrayanti, 2017) (de Oliveira et al., 2024).

Educational interventions have been shown to improve knowledge, attitudes, beliefs, and practices, but sustaining long-term behavioral change remains a challenge (Ab Rahman et al., 2018). Within the One Health framework, enhancing health literacy not only addresses human behavior but also considers animal reservoirs and environmental factors (Zinsstag et al., 2018) (Ghai et al., 2022).

This study investigates the association between KAPP and health literacy on leptospirosis prevention among coastal communities in Lake Limboto, Gorontalo.

METHOD

A cross-sectional study was conducted in two coastal villages around Lake Limboto, Gorontalo, namely Laowonu Village, Tilango District, and Iluta Village, Batudaa District, between July and August 2025. Using a stratified random sampling method, 168 respondents aged ≥18 years were selected. For reservoir detection, the design used was a laboratory experiment with an active surveillance approach to the disease reservoir by capturing rats in the community environment, then laboratory tests using the Polymerase Chain Reaction (PCR) method were conducted on kidney samples to detect Leptospira DNA. A structured questionnaire was developed to assess knowledge, attitudes, practices, and perceptions. Health literacy was categorized into low, medium, and high based on a composite score. Data were analyzed using SPSS 26.0 with the chi-square test. A p-value <0.05 was considered statistically significant.

This study has received approval from the Hasanuddin University Ethics Committee (Ref: UH/KEPK/2024/112). Written informed consent was obtained from all participants.

RESULTS

This study involved 168 respondents. Respondent characteristics are presented as follows:

Table 1. Distribution of Respondents Based on Respondent Demographic Characteristics

Demographic Characteristics	Total (N=168)	(%)
Gender		
Male	117	69.6
Female	51	30.4
Age Group (years)		
20-29	27	16.1
30-39	46	27.4
40-49	31	18.5
50-59	44	26.2
>59	20	11.9
Educational level		
Elementary School (SD)	82	48.8
Junior High School (SMP)	26	15.5
Senior High School (SMA)	46	27.4

Higher education	14	8.3
Work		
Civil servants	5	3.0
Self-employed	77	45.8
Laborer	13	7.7
Farmer	15	8.9
Housewife (IRT)	40	23.8
Fisherman	11	6.5
Private sector employee	7	4.2

Table 1 shows the distribution of respondents based on demographic characteristics, showing that of the 168 respondents, the majority were male, representing 117 respondents (69.6%). According to age distribution, the largest percentage of respondents were in the 30-39 age group, representing 46 respondents (27.4%). Most respondents had an elementary school education, representing 82 people (48.8%). Based on occupation, the majority of respondents were self-employed, representing 77 respondents (45.8%).

Table 2. Results of Leptospira Detection in Rat Kidneys

Types of Rats	Number of Checked (n)	Positive for Leptospira (%)	Negative Leptospira (%)
Rattus norvegicus	31	14 (45.2)	17 (54.8)
Bandicotta Indica	2	1 (50)	1 (50)
Rattus Tanezumi	1	0	1 (100)
Total	34	15 (44.1)	19 (55.9)

Univariate Analysis

Table 3. Distribution of Respondents Based on the Variables Studied

Variables	Total (N=168)	(%)
Knowledge		
Sufficient	88	52.4
Poor	80	47.6
Attitude		
Positive	71	42.3
Negative	97	57.7
Practice		
Positive	91	54.2
Negative	77	45.8
Perception		
High	92	54.8
Low	76	45.2
Health Literacy		
Good	22	13.1
Sufficient	108	64.3
Poor	38	22.6

Table 3 shows that the majority of respondents, 88 people (52.4%), had a sufficient level of understanding. In terms of attitudes, 97 people (57.7%) of the total respondents had a negative attitude towards leptospirosis prevention. On the other hand, positive practices outweighed negative practices, amounting to 91 people (54.2%). Based on perception, 92 respondents (54.8%) of the sample had a high opinion of leptospirosis. Regarding literacy related to leptospirosis, 108 respondents (64.3%) of the total respondents were in the sufficient category.

Bivariate Analysis

Table 4. Relationship between Knowledge and Health Literacy

	Health Literacy						Total		*p-value*
	Good		Sufficient		Poor				
Knowledge	n	%	n	%	n	%	N	%	
Sufficient	7	8.0	47	53.4	34	38.6	88	100	0.000
Poor	15	18.8	61	76.3	4	5.0	80	100	
Total	22	13.1	108	64.3	38	22.6	168	100	

Based on Table 4, the relationship between knowledge and health literacy, only 4 respondents (5.0%) with poor knowledge had poor literacy, while the majority had sufficient (76.3%) and good (18.8%) literacy. Conversely, the percentage of respondents with poor literacy (38.6%) was higher among those with sufficient knowledge. The chi-square test results showed a strong correlation between knowledge and health literacy, with a p-value of 0.000 (<0.05).

Table 5. Relationship between Attitudes and Health Literacy

	Health Literacy						**Total**		***p-value***
	Good		Sufficient		Poor				
Attitude	n	%	n	%		%	N	%	
Positive	10	14.1	37	52.1	24	33.8	71	100	0.008
Negative	12	12.4	71	73.2	14	14.4	97	100	
Total	22	13.1	108	64.3	38	22.6	168	100	

Table 5 shows that respondents with negative attitudes were more likely to have sufficient literacy (73.2%) compared to those with positive attitudes (52.1%). The chi-square test showed a p-value of 0.008 (<0.05), confirming a significant relationship between attitudes and health literacy.

Table 6. Relationship between Health Practices and Literacy

	Health Literacy						**Total**		***p-value***
	Good		Sufficient		Poor				
Practice	n	%	n	%	n	%	N	%	
Positive	11	12.1	52	57.1	28	30.8	91	100	0.023
Negative	11	14.3	56	72.7	10	13.0	77	100	
Total	22	13.1	108	64.3	38	22.6	168	100	

Analysis of health practices and literacy showed that respondents with negative practices were more likely to have sufficient literacy (72.7%) compared to those with positive practices (57.1%). The chi-square test yielded a p-value of 0.023 (<0.05), indicating a significant relationship between practices and health literacy.

Table 7. Relationship between Perception and Health Literacy

	Health Literacy						**Total**		***p-value***
	Good		Sufficient		Poor				
Perception	n	%	n	%	n	%	N	%	
High	9	9.8	53	57.6	30	32.6	92	100	0.002
Low	13	17.1	55	72.4	8	10.5	76	100	
Total	22	13.1	108	64.3	38	22.6	168	100	

The analysis of the relationship between perception and health literacy showed that respondents with low perception were more likely to have sufficient literacy (72.4%) compared to respondents with high perception (57.6%). The chi-square test yielded a p-value of 0.002 (<0.05), indicating a significant relationship between perception and health literacy.

DISCUSSION

This study identified the presence of Leptospira in rats along the shores of Lake Limboto. Field observations revealed that the environmental conditions along Lake Limboto's shores strongly support the presence of rats as the primary reservoir of leptospirosis. Traces of rat activity were found in several densely populated areas, while examination of 34 rat samples showed that 14 (41.2%) sample positive for Leptospira. This indicates a close relationship between environmental conditions, the presence of the rat reservoir, and the behavior patterns, perceptions, and health literacy of the local community. Regarding the presence of rats, rat control efforts carried out by communities along Lake Limboto's shores generally remain traditional, involving manual killing or the use of rat poison. However, most dead rats are simply discarded without proper treatment. Many residents even dispose of rat carcasses around residential areas or directly into the waters of Lake Limboto. This practice has the potential to increase the risk of environmental contamination, as Leptospira-infected rat carcasses can infect soil and water, increasing the likelihood of leptospirosis transmission to humans. This finding aligns with previous research that emphasized that people's behavior of disposing of rat carcasses without safe procedures contributes to the high environmental risk of leptospirosis transmission. Consistent with previous findings in Malaysia and Indonesia, knowledge emerged as the strongest predictor of literacy (Abdullah et al., 2019). However, limited knowledge often leads to misunderstandings, such as equating leptospirosis with 'rat urine disease' without understanding the transmission pathway (Sukeri et al., 2018).

A total of 168 respondents indicated that the majority were male (69.6%), aged 31–40 years (27.4%), and had low education, namely only elementary school graduates (48.8%). The majority worked as self-employed (45.8%)

and housewives (23.8%). These demographic characteristics illustrate the profile of the coastal community of Lake Limboto, which is highly vulnerable to environmentally-based infectious diseases, including leptospirosis. Low levels of education affect limited access to information and the ability to understand health messages, thus impacting low public health literacy. This is in line with previous research that states that education is an important determinant in behavior to prevent zoonotic diseases (Notobroto et al., 2021).

In terms of knowledge, 52.4% of respondents had sufficient knowledge, while 47.6% were considered inadequate. This low level of knowledge was reflected in the respondents' attitudes, with the majority (57.7%) having negative attitudes toward leptospirosis prevention. This is in line with research in Malaysia, which found that although most respondents expressed positive attitudes, more than 80% still had poor knowledge about leptospirosis (Abdullah et al., 2019). Limited knowledge implies low public awareness of environmental risks and disease transmission methods, which then affects the implementation of preventive practices. Positive attitudes toward prevention improve literacy, although practical implementation remains hampered by poor sanitation infrastructure. Previous interventions have shown that despite improvements in attitudes and beliefs, long-term practice remains low without structural support (Jiameng Yuan a, Xiu Yu b, Yuhan Ba c, Hui Wang d, 2025).Risk perception also plays an important role, in line with the Health Belief Model, which emphasizes the mediating role of perceived susceptibility and severity in shaping protective behavior (Nutbeam, 2000).

The analysis results showed a significant relationship between attitudes and health literacy ($p = 0.008$). Respondents with negative attitudes tended to have better health literacy (12.4%) compared to respondents with positive attitudes (14.1%), although proportionally, most were still in the adequate literacy category. This finding indicates that positive attitudes toward leptospirosis prevention do not always align with good health literacy levels. This condition is in line with research in Malaysia which found that although most respondents showed positive attitudes, more than 80% still had poor knowledge about leptospirosis (Abdullah et al., 2019). This discrepancy between attitudes and literacy may be influenced by limited public understanding of the complications and severity of the disease, resulting in positive attitudes not fully translated into preventive measures. This emphasizes that attitudes alone are not sufficient to drive protective behavioral changes; they must be supported by adequate health literacy. Therefore, education-based interventions need to be directed not only at building positive attitudes but also at strengthening the public's literacy capacity so they can understand the risks, severity, and preventive measures of leptospirosis more comprehensively.

Analysis of practices showed that respondents with positive practices were slightly more numerous (54.2%) than those with negative practices (45.8%). However, a large group of people remained inconsistent in implementing protective behaviors. For example, the habit of maintaining environmental cleanliness, using personal protective equipment when working in flooded areas, and rat control efforts were not optimally implemented. This low level of preventive practices is closely related to health literacy. Respondents with negative practices were more likely to be in the sufficient literacy category (72.7%) compared to respondents with positive practices (57.1%), with chi-square results indicating a significant relationship ($p=0.023$). This finding aligns with research in coastal communities of Lake Calamba and Los Baños, Laguna, Philippines, which showed that despite relatively good knowledge and attitudes about leptospirosis, preventive practices remained low, particularly among agricultural workers, who tended to have lower practice scores compared to non-agricultural groups (Arbiol et al., 2016). This indicates that the level of knowledge and positive attitudes have not been fully converted into consistent preventive behavior, so that increasing health literacy remains an important factor in encouraging changes in protective behavior against leptospirosis.

In terms of perception, the majority of respondents (54.8%) had a high perception of leptospirosis. However, the analysis showed that good health literacy was more common among respondents with low perception (17.1%) compared to respondents with high perception (9.8%). Nevertheless, overall, there was a significant relationship between perception and health literacy ($p=0.002$). This indicates that although the public is aware of the risk of leptospirosis, limitations in understanding health information prevent them from being able to apply this perception into effective preventive measures. The findings of this study reinforce the role of health literacy as a key factor in leptospirosis prevention. Health literacy not only influences an individual's ability to obtain and understand information but also determines the public's attitudes, practices, and perceptions toward this disease (Pasay-an et al., 2024). Low health literacy on the shores of Lake Limboto could be a major obstacle to leptospirosis control efforts. Therefore, public health interventions in this region need to focus on improving literacy through community-based education, with an approach that takes into account environmental and cultural factors, as well as the presence of rats as the primary reservoir.

From a One Health perspective, strengthening health literacy must involve multidimensional interventions, including addressing human behavior, rodent control, environmental sanitation, and participatory risk communication. An integrated strategy can build communities resilient to leptospirosis and other zoonotic diseases (Zinsstag et al., 2018)(Ghai et al., 2022).

CONCLUSION

This study shows that knowledge, attitudes, practices, and perceptions significantly influence health literacy regarding leptospirosis prevention in the coastal communities of Lake Limboto. Literacy gaps remain substantial, necessitating integrated interventions. Strengthening education, increasing community engagement, and instilling One Health principles are crucial steps towards sustainable leptospirosis prevention.

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