# HISTORY OF LEPTOSPIROSIS-LIKE SYMPTOMS AND BEHAVIORAL-ENVIRONMENTAL EXPOSURES AMONG RESIDENTS OF HAT SAMRAN DISTRICT, TRANG PROVINCE

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## ABSTRACT

Leptospirosis is of interest to public health stakeholders in Southern Thailand due to the occurrence of local outbreaks. However, knowledge gaps remain regarding the history of leptospirosis-like symptoms among community residents and the distribution of behavioral and environmental exposures. The objective of this study is to describe the history of self-reported leptospirosis-like symptoms and the distribution of behavioral and environmental exposures to potential sources of leptospirosis among community members in Hat Samran District of Trang Province. We conducted a community-based cross-sectional study among 301 adult residents of Hat Samran District. We selected our participants using convenience sampling. We collected data by face-to-face interview and rapid observation of the environment near the participant's household. We analyzed data using descriptive statistics. Most of our participants (n=301) were women with a mean age of 53 years. Fewer than 4% of the participants reported experiencing leptospirosis-like symptoms within the prior 12 months, although 11% reported mucosal contact with dirty water. Rat droppings were observed in just under 40% of all households. The findings of our study serve as potentially useful basic information for stakeholders. However,

limitations from self-reporting of information and limited generalizability should be considered as caveats in the interpretation of the study findings.
**Keywords:** Leptospirosis, Behavior, Observtion, Infectious disease, Thailand

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# INTRODUCTION

Leptospirosis is a water-related zoonotic bacterial infection caused by the Leptospira sp. bacterium with high fatality (Allyn et al., 2024; Biscornet et al., 2020). Leptospirosis disproportionately affects marginalized populations in tropical regions, likely due to the climate being favorable to the growth of the bacteria and the marginalized having more frequent contact with potential reservoir animals (Biscornet et al., 2020). Leptospirosis is of interest to public health stakeholders in Southern Thailand due to occurrence of local outbreaks. Provincial authorities may be focused on leptospirosis but does not have data on the history of leptospirosis-like symptoms and awareness of leptospirosis.

Although previous studies have described seroprevalence of leptospirosis in the general population and vulnerable populations (Biscornet et al., 2020), a few knowledge gaps remain, including history of leptospirosis-like symptoms among residents, and the distribution of behavioral and environmental exposures that increase the risk of leptospirosis among residents in a given primary health care service area. Such information will be of interest to stakeholders in public health as it would help to shape health education guidelines and prevention campaigns among public health stakeholders (Martins & Spink, 2020). Thus, the objective of this study was to describe the history of self-reported leptospirosis-like symptoms and the distribution of behavioral and environmental exposures to potential sources of leptospirosis among community members in Hat Samran District of Trang Province, an area with higher levels of reported leptospirosis cases.

# LITERATURE REVIEWS

Leptospirosis is a water-related zoonotic bacterial infection caused by the Leptospira sp. bacterium with a high fatality (more than 10%) among severe cases (Allyn et al., 2024; Biscornet et al., 2020). Leptospirosis also disproportionately affects the marginalized population (Martins & Spink, 2020). Leptospirosis is ubiquitous globally but is more common in tropical regions (Allyn et al., 2024).

Although Symptoms of leptospirosis are similar to other infectious diseases (fever, headache, myalgia, and gastrointestinal issues) (Martins & Spink, 2020), case fatality is higher and delayed diagnosis and treatment increases this fatality. However, the extent to which leptospirosis-like symptoms occur in regions at high risk of the disease is unknown. The extent that those who had leptospirosis-like symptoms ever suspected the disease and sought treatment is also unknown. Leptospirosis is associated with occupational exposure (i.e., farming, exposure to wet surfaces, and contact with livestock) (Biscornet et al., 2020), but such basic information is scarce in populations at risk of leptospirosis. Despite the call for targeted public health interventions (Martins & Spink, 2020), few studies have comprehensively assessed awareness of leptospirosis among community members with supposedly high levels of exposure, as well as the determinants of their care-seeking behaviors when experiencing leptospirosis-like symptoms.

# RESEARCH METHODOLOGY

## Study Design and Setting

Community-based cross-sectional study with mixed methods (structured interviews and non-participatory rapid observation of household conditions). We conducted this study at areas under the responsibility of sub-district health promoting hospitals in Hat Samran District, Trang Province. Specifically, we conducted the study in Hat Samran Sub-District and Ba Wi Sub-District, as no cases had been reported in Ta Se Sub-District, according to the Trang Provincial Public Health Office.

**Population & Sample**

The study population included residents of households under the responsibility of sub-district health promoting hospitals in Hat Samran District, Trang Province. We included those who are: 1) 18 years of age or older; 2) identified as a resident of the local area by village health volunteers. We excluded people who we deem to be unable to participate due to physical, mental, or linguistic limitations from the study.

We performed a sample size calculation to meet the primary study objective of describing prevalence of leptospirosis-like symptoms among the study population using the following formula:

$$n = \frac{Z_{\alpha/2}^2 \times p \times (1-p)}{\delta^2}$$

Where

n = The sample size

p = The estimated proportion

$Z_{\alpha/2}$ = Z value for α level of significance

δ = The allowable margin of error

We assumed that the prevalence of leptospirosis-like symptoms in the past 12 months was similar to the reported pooled prevalence in a previous study(Comia et al., 2022) at approximately 19 percent (p=0.19), with an assumed margin of error of five percent (i.e., delta or δ=5% or 0.05). Using the formula for estimation of proportion in a population at 95% level of confidence:

Where Z=1.96; p=0.19; and δ=0.25

Using the R statistical environment and the *epicalc* package, we estimated that we would need to interview 236 residents of Hat Samran and Ba Wi Sub-Districts, Hat Samran District, Trang Province (target sample size n=236 residents). We assumed that an arbitrary 30% of the potential participants would refuse to participate in the study, thus we estimated that we would need to collect data from 236*1.30 = 306.8 ~ 307 community residents and adjusted our final sample size accordingly.

**Study Variables and Data Collection**

We collected data by face-to-face interviews and rapid observation of the vicinity of the participant's household. Our study instruments included a smartphone-based face-to-face structured interview questionnaire and a smartphone-based rapid observation questionnaire. We used the KoboToolbox web-based platform and KoboCollect application to host the study instruments. All interviews were conducted in the Thai language. The operational definitions of the study variables were as follow:

1) History of leptospirosis-like symptoms within the past 12 months

We adapted information from the Thai Ministry of Public Health regarding common symptoms for leptospirosis in Thailand (Department of Disease Control, 2019) as well as information from international authorities in public health (CDC, 2024; WHO SEARO, 2009; World Health Organization & International Leptospirosis Society, 2003). After internal deliberations, we decided to define leptospirosis-like symptoms as having symptoms in the septicemic phase, i.e., a history of fever, headache, myalgia, and conjunctivitis concurrently for a period of at least seven consecutive days.

2) Behavioral exposures to leptospirosis

We adapted information from the Thai Ministry of Public Health (Department of Disease Control, 2019) and international authorities (CDC, 2024; WHO SEARO, 2009; World Health Organization & International Leptospirosis Society, 2003) regarding common transmission routes for leptospirosis. After internal deliberations, we designed the behavioral exposures questions to include exposure at open wounds, exposure to uncovered feet (exposure when

going outside barefoot), and exposure to the mucosa (the "T" zone, i.e., the eyes, the nose, and the mouth).

3) Observed conditions of the participant's household

We designed the rapid observation questions based on previous studies on environmental risks for leptospirosis (Costa et al., 2021; Narkkul et al., 2021) as well as sources regarding leptospirosis transmission (CDC, 2024; Department of Disease Control, 2019; WHO SEARO, 2009; World Health Organization & International Leptospirosis Society, 2003). We deliberated among the investigators and modified items to suit the context of the study setting, with a number of questions to focus on the observed indicators for the presence of house rodents.

4) Data Collection Procedures

The investigation team invited Thai-speaking staff of the Department of Epidemiology at Prince of Songkla University to help conduct the interviews. All interviewers received training by the investigators for a period of 2 days, including research ethics, the study protocols, and all relevant study documents, as well as a pilot testing of the questionnaire as a practice session. The investigators contacted the Trang Provincial Public Health Office and the Hat Samran District Public Health Office to request permission to conduct the study. The investigators asked for assistance in connecting the investigators to health-promoting hospitals in Hat Samran District. The investigators contacted the health-promoting hospitals in Hat Samran District, asked for permission to conduct the study, and asked the hospitals to connect the investigators to the village health volunteers working for each hospital.

On the day of data collection, the investigators introduced themselves to the village health volunteers, explained to the volunteers about the study, and asked for the volunteers' assistance in bringing the investigators to all households under the volunteers' care. The investigators informed the health volunteers that their compensation was not dependent on the number of participants (in order to reduce potential undue influence upon the participants).

In each visited household, the health volunteer introduced members of the investigation team to the residents. The investigators recruited only one participant per household, i.e., the first participant that the health volunteer encountered who met the study criteria. Investigators made sure that the information and consenting processes were done in a private setting. If the participants were deemed eligible, the investigation team member explained the study according to the Participant Information Sheet. The investigators answered the potential participants' questions about the study (if any), then asked for consent to participate and observe the household environment according to the Consent Form. Thai-speaking investigation team members conducted a structured interview individually with adequate privacy. Other investigation team members simultaneously conducted rapid observation of household conditions. In order to avoid invasion of privacy, the investigation team only observed the household from the outside and did not enter the inside of the house. The observing investigators walked around the house within a 10-meter distance from the walls of the building where the participant resided. The observing investigators recorded the details as could be seen with their own eyes during the walk around the house. After the interview, the investigation team gave a health education brochure on leptospirosis and its prevention to the participants, advised participants to follow hygiene protocols, such as washing hands after exposure to environmental hazards, then thanked the participant for their time and moved to the next household. Investigators repeated this process until the required sample size was met.

**Data Management**

The investigation team members entered all data onto the KoboToolbox platform (or KoboCollect application). Within the platform and the application, all data were uploaded onto a password-protected server. The investigation team did not enter any personally identifiable information into the system to ensure the confidentiality of the study participants. A member of the investigation team served as the data manager and performed regular quality checks to

identify and address potential data-related issues. The investigation team performed routine data cleaning and exported the clean data set for statistical analyses.

**Data Analysis**

We used descriptive statistics to summarize continuous variables as mean and standard deviation (SD) or median with interquartile range (IQR), and we summarized categorical variables as frequencies and percentages.

**Human Research Ethics**

We received ethical approval for the study from the Human Research Ethics Unit (HREU), Faculty of Medicine, Prince of Songkla University (REC.67-586-18-2).

## RESEARCH RESULTS

We collected data from 301 residents of Hat Samran District (n=301 residents), most of whom were female with a mean age of 53 years (*Table 1*). Most of our participants were either farmers, small-scale vendors and service providers, or retired. Educational attainment varied, although income was relatively low (half reported earning 10,000 THB per month or less). The three most common co-morbidities included hypertension, hyperlipidemia, and diabetes.

**Table 1** Characteristics of the study participants (n=301 residents of Hat Samran District, Trang Province)

| **Characteristic** | **Frequency (%) or Mean ± SD** |
|---|---|
| **Sex:** Female | 226 (75.1%) |
| **Age in years** (mean ± SD) | 53.0 ± 13.9 |
| **Primary Occupation (Top 3)** | |
| Agronomy or Horticulture (including rubber and oil palm) | 109(36.2%) |
| Small-scale vendors / service providers | 41(13.6%) |
| Retired / homemaker | 40(13.3%) |
| **Religion:** Buddhism | 276(92.0%) |
| **Marital Status** | |
| Married with children | 233(77.4%) |
| Single | 39(13.0%) |
| Widows / Divorced / Separated | 17(5.6%) |
| Married, no children | 12(4.0%) |
| **Highest Education Level Completed:** | |
| Primary school or lower | 163 (54.1%) |
| Secondary education (Matthayom 6 or Vocational Certificate) | 76 (25.2%) |
| Tertiary education (Associate's degree or higher) | 62 (20.6%) |
| **Personal Monthly Income: 10,000 THB or less** | 154 (51.4%) |
| **Co-morbidities (Three most common answers)** | |
| Hypertension | 80(26.6%) |
| Hyperlipidemia | 85(28.2%) |
| Diabetes | 37(12.3%) |

With regard to the history of leptospirosis-like symptoms behavioral-environmental risks for leptospirosis, fewer than 4 percent of the participants reported experiencing all four leptospirosis-like symptoms within 12 months prior to the survey (*Table 2*). Behavioral and environmental risks were more commonly reported: 11 percent of the participants reported mucosal contact with dirty water, and rat droppings were observed in just under 40 percent of all households.

**Table 2** Behavioral risks and self-reported history of leptospirosis-like symptoms among residents of Hat Samran District, Trang Province (n=301 participants)

| Characteristic | Frequency (%), unless otherwise indicated |
|---|---|
| **History of leptospirosis-like symptoms*** | |
| No history of symptoms within the past 12 months | 290 (96.3%) |
| **History of symptoms within the past 12 months** | **11 (3.7%)** |
| **Open wounds history: Had open wound(s) within the past 12 months** | **35 (11.7%)** |
| (Among those with open wounds in the past 12 months) | (n=35) |
| Open wound contacted dirty water | 5 (14.7%) |
| Open wound contacted anything that smells like urine | 0 (0%) |
| Open wound contacted anything that smells like feces | 0 (0%) |
| **Open wound exposure (any of the above)** | **5 (1.7%)** |
| **Barefeet history: Went outside barefeet within the past 12 months** | **41 (13.6%)** |
| (Among those who went outside barefeet in the past 12 months) | (n= 41) |
| Feet contacted dirty water or open sewers | 12 (29.3%) |
| Feet contacted garbage | 9 (22%) |
| Feet contacted flood water | 10 (24.4%) |
| **Barefeet exposure (any of the above)** | **16 (5.3%)** |
| **Mucosa contact history** | |
| Eyes contacted dirty or untreated water in the past 12 months | 10 (3.3%) |
| Mouth contacted dirty or untreated water in the past 12 months | 12 (4%) |
| Nose contacted dirty or untreated water in the past 12 months | 7 (2.3%) |
| **Mucosa exposure (any of the above)** | **33 (11.0%)** |
| **Household observation results** | |
| Rodent marks observed | 72 (23.7%) |
| Rodent runs observed | 26 (8.6%) |
| Rat droppings observed | 117 (38.7%) |
| Smelled rat urine | 50 (16.4%) |

*"Within the past 12 months, have you experienced all of the following symptoms for at least 7 days straight? 1. Fever; 2. Headache; 3. Myalgia (muscle pain, body ache); 4. Conjunctivitis (red eyes)

## DISCUSSION & CONCLUSION

In this community-based cross-sectional study, we described the history of self-reported leptospirosis-like symptoms and the distribution of behavioral and environmental exposures to potential sources of leptospirosis among community members in Hat Samran District, Trang Province. We found that although self-reported history of leptospirosis-like symptoms and behavioral exposure (particularly through contact with open wounds) were relatively uncommon among the participants, our data collectors observed rat droppings in the vicinity of nearly two-fifths of the households. The findings of this study can provide basic information for stakeholders in public health in the study areas and other locations.

The findings of our study regarding the discrepancies between behavioral exposure vs. environmental exposure were similar to those from a previous study (Delight et al., 2024). In that regard, the high level of observed traces of rats was concerning. Rats are the primary reservoirs of leptospirosis and can harbor the bacterium for extended periods (Boey et al., 2019). Occupational exposure should also be considered in future studies, as agricultural workers (like our participants) are at higher risk of leptospirosis (Narkkul et al., 2021).

The strength of this study was the inclusion of rural residents engaged in a mixed of agricultural and non-agricultural occupations who have low income, which addresses knowledge gaps regarding risk factors for leptospirosis in high-risk populations. However, a number of limitations should be considered in the interpretation of the study findings. Firstly, self-reporting lifetime history of leptospirosis and past-year symptoms might have introduced information bias due to errors in recall of information. Secondly, the vast majority of our participants were female with minimal engagement in livestocks farming or fishery, which limited the generalizability of our study findings. Thirdly, the measurement of behavioral risks in our study relied on self-reported data, which were prone to various sources of information bias (e.g., social desirability, subjective decision made by observers during household observation). Future studies should consider measures to address these limitations accordingly.

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