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Relationship of Environmental Factors with Leptospirosis Incidence in Southeast Asia

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Abstract

Southeast Asia is a leptospirosis endemic with the highest estimated incidence of cases. This type of research is a systematic review using the PRISMA. These search results found 2.322 research articles and only thirteen articles that matched the research criteria. Two articles discussed the relationship between sewer conditions and the incidence of leptospirosis, one article discussed the relationship between the presence of trash bins and the incidence of leptospirosis, nine articles discussed the presence of rats and the incidence of leptospirosis, and one article discussed standing water and the incidence of leptospirosis. There is a relationship between the presence of trash bins, the presence of rats, and standing water and the incidence of leptospirosis in Indonesia, Thailand, and Malaysia and there is no relationship between sewer conditions in Thailand and Indonesia.

Introduction

Leptospirosis is a contagious disease that affects people all over the world. It develops from an acute bacterial infection brought on by bacteria of the genus Leptospira, which affects many organs and can have fatal side effects. Leptospirosis occurs across the world, although tropical and subtropical areas are where it is most prevalent. Leptospirosis is thought to cause 58.900 deaths and 1.03 million cases worldwide each year, which represents substantial morbidity and mortality rates. The regions of South Asia, Southeast Asia, Oceania, the Caribbean, the Andes, Latin America, and Eastern Sub-Saharan Africa have the highest estimated rates of leptospirosis morbidity and mortality.

A significant incidence of instances of leptospirosis is thought to exist in Southeast Asia. Leptospirosis is transmitted and distributed differently throughout Southeast Asia due to factors like floods, heavy rainfall, and high temperatures (Douchet *et al*., 2022). Leptospirosis is mostly transmitted by rodents like rats, though it can also spread to livestock like pigs, cows, horses, dogs, buffalo, sheep, and goats. The knowledge and attitudes of those who are less concerned about leptospirosis are to blame for the rise in leptospirosis cases. Many people are unaware of the causes, symptoms, and methods for treating and preventing leptospirosis.

Numerous studies have already examined the literature to determine how certain variables relate to the prevalence of leptospirosis. The environmental elements that affect the countries of Southeast Asia, where leptospirosis is prevalent and its prevalence rises during the rainy season, have not however received much attention. As a result, a thorough study of the literature is required to determine how environmental factors affect the prevalence of leptospirosis. The findings will assist decision-makers and enhance the control of leptospirosis in Southeast Asia. The study's overarching goal is a general understanding of the leptospirosis between environmental conditions and the prevalence of leptospirosis in Southeast Asia.

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Method

This type of research is a systematic review using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) method. The research was conducted by searching data in the form of online electronic-based research articles that have been published in national and international journals in several databases, namely BioMed Central, Google Scholar, ProQuest, PubMed, and Scopus. The research was conducted after obtaining ethical approval from the ethical committee number KE-FK-0496-EC-2023 by the Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University.

Based on established inclusion and exclusion criteria, an electronic research article found online served as the study's sample, inclusion standards: original study, the full text of the paper, observational research, the study was carried out in a Southeast Asia nation, use English and publish between January 2019 and March 2023, examines how leptospirosis occurs in Southeast Asia and how sewer conditions, the presence of trash bins, the presence of rats, and standing water are related. Exclusion standards: thesis with insufficient text, books, seminar and conference proceedings, and article, qualitative research.

Tracking a strategy, The Medical Subject Headings (MeSH) and Booleans (AND/OR) were used in the data search. Useful keywords or phrases comprise 1) "gutter" OR "gutter conditions" OR "sewer" OR "drain" OR "ditch" OR "gully" OR "canal" OR "brook" OR "runnel" OR "waste" OR "garbage" OR "trash" OR "rubbish" OR "trash can" OR "kitchen midden" OR "presence of mice" OR "rats" OR "mouse" OR "shrew" OR "puddle" OR "pool" OR "standing water". 2) "leptospirosis" OR "human leptospirosis", and 3) "southeast asia" OR "indonesia" OR "thailand" OR "malaysia" OR "timor leste" OR "brunei darussalam" OR "singapore" OR "philippines" OR "myanmar" OR "laos" OR "cambodia" OR "vietnam". The search is carried out by putting (1) AND (2) AND (3) together. Article Bias Rating, quality, and relevance ratings are used to avoid recalls, and conclusions based on unreliable data (Effect *et al*., 2020). A bias assessment was carried out using an Office of Health form Assessment and Translation Risk (OHAT) of Bias Tool from The National Institute of Environmental Health Science, National Toxicology Program (OHAT, 2015).

Result and Discussion

The process of searching for articles in this study was carried out according to the flow of PRISMA with a time limit of 2019-2023. The first stage is identification, carried out by a research article data search process in five databases using predefined keywords. The database used in searching for research article data is BioMed Central, Google Scholar, ProQuest, PubMed, and Scopus. Results of the identification stage resulted in 2.322 research articles that were detected. As many as 308 research articles were duplicated, so only 2.014 articles research that can be continued in the second stage, namely the search. The search stage was carried out with three exclusion processes, namely excluding research articles based on titles and abstract designs, and articles conducted in countries other than Southeast Asia (n= 1.901).

The next step is to exclude research articles that do not according to the inclusion criteria set by the searcher, namely research articles that have positive cases of leptospirosis in addition to humans that do not test the relationship between environmental factors and events leptospirosis, non-English articles, articles in the form of the final project is a thesis, as well as systematic review articles (n= 100). The final exclusion stage aims to obtain articles, and research that discusses sewer conditions, the existence of trash bins, the presence of rats, and standing water with the incidence of leptospirosis in Southeast Asia. The results of the articles obtained in the second stage were thirteen research articles, which then proceed to the results stage, namely articles research can be done through systematic review.

Based on the search for articles that have been done, there are 2.322 articles. However, only thirteen articles were analyzed, and most of them were research conducted in Indonesia, Malaysia, and Thailand. The thirteen articles are observational analytics with a cross-sectional study design and case-control.

According to the study's findings,

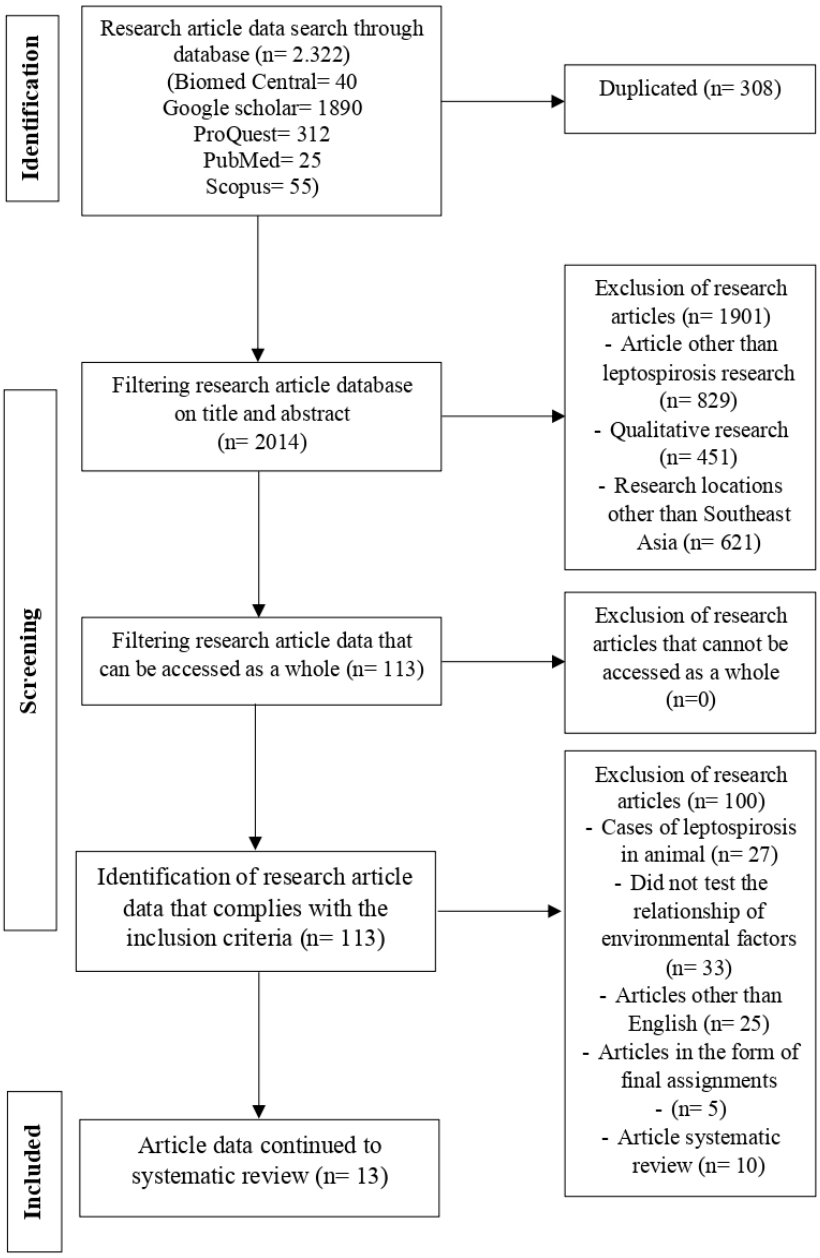

Figure 1. PRISMA Diagram

leptospirosis cases in Indonesia, Thailand, and Malaysia correlated with the presence of rats. The primary reservoir for leptospirosis transmission has been identified as rats. Because rats can access garbage cans through sewer linked to the sewage system, their presence has been recognized as a significant risk factor for developing leptospira antibodies in slums (Narkkul *et al.*, 2021). Rats carcasses, rat urine, rat droppings, and rats roaming around the house are indications that can spread the leptospira bacterium.

Rats gather in places with food, water, and shelter, which presents an opportunity for the spread of leptospira bacteria. Rats that were infected with the leptospira bacteria did not exhibit persistent symptoms and can spread the germs to the environment through urination. Rat urine, rat droppings, rat trails in the ground, garbage, ditches, standing water, and vegetation are all ways that rats can directly transmit the leptospira bacterium to people (Notobroto *et al.,* 2021). Rats can adapt to changes in humidity, temperature, light, and soul texture to survive.

Table 1. Summary of Research on Factors Associated with The Incidence of Leptospirosis

Study identity	Location	Method	Adjusted variables
Hinjoy et al. (2019)	Mahasarakham, Thailand	Case-control	Sewer conditions
Sulistyawati et al. (2020)	Gunungkidul, Indonesia	Case-control	Sewer conditions
Setyaningsih et al. (2022)	Boyolali, Indonesia	Case-control	The presence of trash bins
Notobroto et al. (2021)	Ponorogo, Indonesia	Case-control	The presence of rats
Harisa et al. (2022)	Semarang, Indonesia	Case-control	The presence of rats
Narkkul et al. (2021)	Hua, Thailand	Cross-sectional	The presence of rats
Goh et al. (2019)	Johore and Malaysia, Malaysia	Cross-sectional	The presence of rats
Mohd Hanapi et al. (2021)	Peninsular, Malaysia	Cross-sectional	The presence of rats
Suwannarong et al. (2022)	Nakhon Sawan, Thailand	Cross-sectional	The presence of rats
Dewi et al. (2020)	Klaten, Indonesia	Case-control	The presence of rats
Dung et al. (2022)	Thai Binh, Thailand	Case-control	The presence of rats
Toemjai (2023)	Si Sa Ket, Thailand	Case-control	The presence of rats
Pawitra & Diyannah (2021)	Ponorogo, Indonesia	Cross-sectional	Standing water

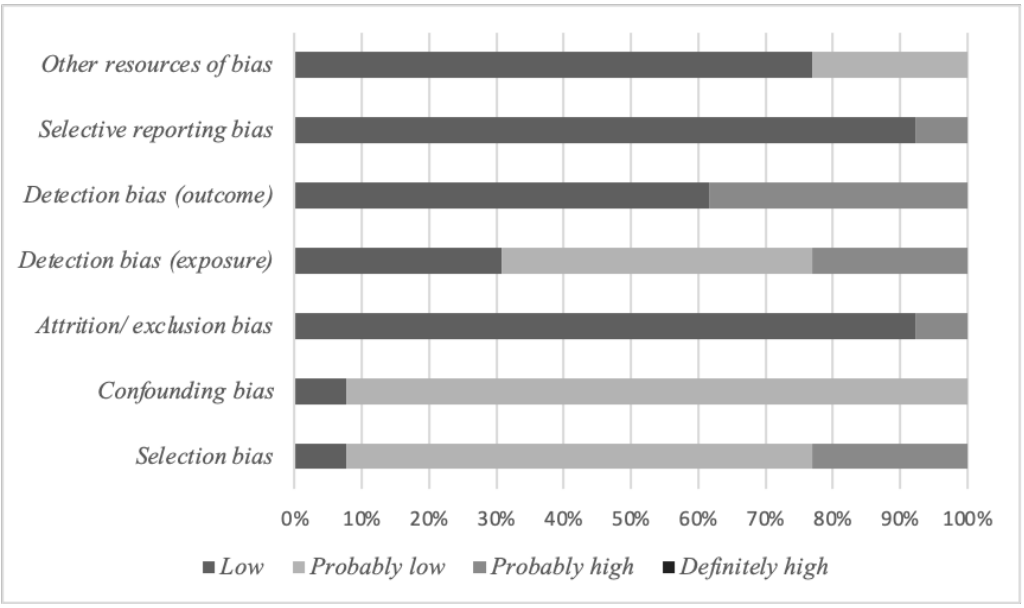

Figure 2. Risk of Bias and Publication Bias

In both tropical and temperate cities, Rattus rattus and Rattus norvegicus have been identified as transmission leptospirosis reservoirs. However, Rattus norvegicus, a species of rat, is the most common vector of leptospirosis. One of the most invasive species is the Rattus norvegicus, sometimes known as the Norwegian rat. Rattus norvegicus has adapted to occupy a variety of environments, making it a dominating species in Southeast Asia (Griffths *et al*., 2022). Rattus norvegicus is the species most frequently infected with leptospira bacteria because it is frequently discovered in sewer systems with damp habitats. Rattus norvegicus always requires water to drink because it cannot stand to be thirsty.

Rattus rattus is one of the most common domestic rats found in cities, open spaces, and residential areas. It is a rodent species that can adapt well to a variety of climates and environmental situations. Rattus rattus is an ideal reservoir for transferring numerous infectious diseases to humans because it may use trash as food and piles of trash as a refuge. In poorly maintained buildings with dry ecosystems, Rattus rattus is frequently discovered in cracks and ceilings (Innes *et al.,* 2018).

Leptospira bacteria can be transmitted from rats to humans through wounds on

their bodies and old age. These rats are more likely to be a source of the bacterium than rats without wounds. Leptospira bacteria are spread between rats by fighting, which results in rat bites on other rats and speeds up the spread of the bacteria between them. The majority of leptospirosis outbreaks happen during prolonged periods of severe rain and flooding, which has increased the number of cases of leptospirosis being reported. This is so that the environment is made more conducive to the spread of leptospira bacteria between rats and humans and helps wash away the rats that are transmitting the disease.

Leptospirosis can be spread through livestock, such as cattle or goats, and is brought on by direct contact with infected animal urine or by coming into contact with people after coming into contact with contaminated soil (Rees *et al*., 2021). In addition to rats, livestock and pets such dogs, pigs, horses, buffaloes, cats, insects, and sheep can also spread the leptospira bacteria. Maintaining a clean home environment is one way to stop the cycle of transmission and manage rats. Rats can be individually controlled by tearing out rat holes, vaccinating pets (dogs, cats, and ghost birds), maintaining a clean home, or setting up rat traps. To stop the spread of leptospirosis, it is crucial to actively monitor people, pets, and wild animals while implementing rodent control measures for community rodents and farm animals. To this end, it is crucial to work with a variety of partners and stakeholders from the agricultural, animal, and health sectors.

According to the study's findings, Indonesia's incidence of leptospirosis is correlated with the presence of trash bins. Open trash bins in the environment have the potential to turn into rat habitats. The incidence of leptospirosis with a rat reservoir will be impacted by the amount of trash in the home and surrounding area (Mamonto *et al*., 2020). As a result, it is recommended that residents cover trash bins in their residences and the neighborhood. Rats that flourish in the environment may not develop too if there is open rubbish nearby.

Rats adore places where there are trash bins, provided that the trash bins are both open and not watertight. Rats find it simpler to enter trash bins and search for food because of these circumstances. Unsafe garbage disposal locations are one of the factors contributing to the rise of leptospirosis cases. This is because trash bins are a particular favorite of the vector that carries the leptospira bacteria. Leptospira bacteria are spread by rats contaminating water from wet trash bins with their urine, which is then transferred to rats hunting for food (Ridzuan *et al.,* 2016). As a result, rats become sick and die as a result of the infection.

The presence of trash bins is an environmental component that may have an impact on disease vectors, particularly those that are related to the environment. Rats carry the leptospira bacteria, which causes leptospirosis. The community is urged to conduct leptospirosis management measures by maintaining good trash bin conditions. Rats will enter an open trash might that is not watertight.

According to the research findings, there was no correlation between the state of the gutters and the prevalence of leptospirosis in Thailand and Malaysia. The greater percentage of leptospira bacteria in standing water proves that rats frequently contaminate it. Leptospira bacteria can live in soil and water, and they do so better in standing water than in rainwater or underground water (Hinjoy *et al*., 2019; Sulistyawati *et al*., 2020). Standing water surrounding the house brought on by overflowing gutters and rainwater that does not seep in properly are environmental factors that have been linked to the prevalence of leptospirosis. gutters that comply with the regulations must not overflow when it rains, flow smoothly, be free of rubbish and rodents, and be less than two meters from the house. Ditches with non-current flows, rats crossing them, and overflowing after rain are indicators of poor sewer conditions.

Household wastewater is often disposed of in cement tubs that are buried in the ground and tightly closed in areas without sewage systems. In the meanwhile, those who own ditches use them to dispose of household wastewater, but they fall short of the standards for a decent ditch, turning it into a pathway or a rat colony. Leptospirosis incidence is unrelated to the quality of the ditch since not all rats that

cross across it are infected with the leptospira bacteria (Sofiyani *et al.*,2018).

According to the study's findings, Indonesia leptospirosis cases are correlated with the presence of standing water. One of the leptospirosis transmission mediums is standing water. Leptospira bacteria from rodents contaminate standing water, which infects people through scraped skin. Leptospirosis can be brought on by drinking water that has been tainted with the leptospira bacterium in both people and animals. The leptospira bacteria are spread through standing water. This is because standing water in and around the home can spread leptospira bacteria when people come into contact with it accidentally. Leptospira bacteria are spread to standing water by rats carrying the leptospira bacteria when they move through puddles or urinate in them.

Standing water that can become a place for leptospira bacteria to live is found in old water reservoirs that are not wasted, pools of water in rice fields, and standing water that does not flow into rivers. In agricultural areas, there is much-standing water, so agricultural areas are very suitable for the development of leptospira bacteria and rats. Patients with leptospirosis are typically infected by standing water, household waste-contaminated standing water, or rainwater (Manyullei *et al.*, 2020).

Conclusion

The results of a systematic analysis that looked into the relationship between sewer conditions, trash bins, rats, and standing water and the incidence of leptospirosis in Southeast Asia revealed the following: there is a relationship between the presence of trash bins and the incidence of leptospirosis in Indonesia. In Malaysia, Thailand, and Indonesia leptospirosis cases are correlated with the presence of rats. In Indonesia, there is a connection between the prevalence of leptospirosis and standing water. In Thailand and Indonesia, there is no correlation between sewer conditions and the prevalence of leptospirosis. Based on research findings, the following recommendations can be made: recommendations for the government, including the provision of closed trash bins in people's houses and the management of rat pests, to build collaboration with the cross-sector in efforts to prevent leptospirosis. Recommendations for raising community awareness of the prevalence of leptospirosis, including the fact that open trash cans, rats in the home, and standing water all contribute to the disease's occurrence. Recommendations for future researchers to expand on this study include including additional variables related to the prevalence of leptospirosis and performing a meta-analysis.

References

Dewi, P.S., Rahardjo, S.S., & Murti, B., 2020. Analysis of Environmental Risk Factors on the Leptospirosis Disease in Klaten, Central Java, Indonesia. *Journal of Epidemiology and Public Health*, 5(2), pp.158-167.

Douchet, L., Goarant, C., Mangeas, M., Menkes, C., Hinjoy, S., & Herbreteau, V., 2022. Untraveling The Invisible Leptospirosis in Mainland Southeast Asia and Its Fate Under Climate Change. *Sciene of The Total Environment*, 8(32), pp.155018.

Dung, L. P., Hai, P. T., Hoa, L. M., Mai, T. P., Hanh, N. M., Than, P. D., Tran, V.D., Quyet, N.T., Hai, H., Ngoc, D.B., Thu, N.T., & Mai, L.T.P., 2022. A Case-Control Study of Argicultural and Behavioral Factors Associated with Leptospirosis in Vietnam. *BMC Infectious Diseases*, 22(1), pp.1-8.

Goh, S. H., Ismail, R., Lau, S. F., Rani, P. M., Mohidin, T. M., Daud, F., Bahaman, A.R., Khairani-Bejo, S., Radzi, R., & Khor, K. H. 2019. Risk Factores and Prediction of Leptospiral Serospositivity Among Dogs and Dog Handlers in Malaysia. *International Journal of Environmental Research and Public Health*, 16(9), pp.1-12.

Griffths, J., Yeo, H. L., Yap, G., Mailepessov, D., Johansson, P., Low, H. T., Siew, C.C., Lam, P., & Ng, L. C. 2022. Survey of Rodent-Borne Pathogens in Singapore Reveals the Circulation of Leptospira spp., Seoul Hantavirus, and Rickettsia Typhi. *Scientific Reports*, 12(1), pp.1-14.

Harisa, E., Hary, C. W., & Budiono, I., 2022. Factors Affecting the Incidence of Leptospirosis in Semarang City. *Public Health Prespectives Journal*, 7(1), pp.2022-2079.

Hinjoy, S., Kongyu, S., Doungchawee, G., Colombe, S.D., Tsukayama, R., & Suwancharoen, D., 2019. Environmental and Behavior Risk Factors for Severe Leptospirosis in Thailand. *Tropical Medicine and Infectious Disease*, 2019, pp.1-12.

Innes, J., Kelly, C., Fitzgerald, N., Warnock, M., & Waas, J., 2018. Detection of Wild House Mice and Other Small Mammals up Trees and on the Ground in New Zealand Native Forest. *New Zealand Journal of Zoology*, 45(3), pp.227-237.

Mamonto, H., Manyullei, S., Hamid, F., Daud, A., Syam, A., & Birawida, A., 2020. Relationship Between Waste with Ecoparasites and Endoparasites (Nematodes and Cestodes) in Rats. *South Asian Research Journal of Biology and Applied Biosciences*, 2, pp.79-85.

Manyullei, S., Natsir, M.F., & Batkunda, A., 2020. Identification of Rat Density and Ecoparasites in Seaport Area of Manokwari, Papua Province. *Open Access Mecadonian Journal of Medical Sciences*, 8, pp.204-208.

Mohd Hanapi, I.R., Sahimin, N., Maackara, M.B., Anisa, A.S., Abdul Mutalib, R.S., Lewis, J.W., Behnke, J.M., Lau, Y.L., & Mohd Zain, S.N., 2021. Prevalence of Anti-Leptosprira Antibodies and Associated Risk Factors in The Malaysian Refugee Communities. *BMC Infectious Diseases*, 21(1), pp.1-11.

Narkkul, U., Thaipadungpanit, J., Srisawat, N., Rudge, J.W., Thongdee, M., Pawarana, R., & Pan-ngum, W., 2021. Human, Animal, Water Source Interactions and Leptospirosis in Thailand. *Scientific Reports*, 11(1), pp.1-13.

Notobroto, H.B., Mirasa, Y.A., & Rahman, F.S., 2021. Sociodemographic, Behavioral, and Environmental Factors Associated with Incidence of Leptospirosis in Highlands of Ponorogo Regency, Province of East Java, Indonesia. *Clinical Epidemiology and Global Health*, 12, pp.100911.

Pawitra, A.S., & Diyannah, K.C., 2021. Leptospirosis Transmission in Ponorogo District of East Java, Indonesia: A Cross-Sectional Study. *Medico-Legal Update*, 21(2), pp.1-6.

Ridzuan, M.J., Azizah, B.D., & Zahiruddin, W.M., 2016. Work Environment Related Risk Factors for Leptospirosis Among Plantation Workers in Tropical Countries: Evidence from Malaysia. *Indonesian Journal of E-Learning and Multimedia*, 7(1), pp.7-14.

Setyaningsih, Y., Bahtiar, N., Kartini, A., Pradigdo, S.F., & Saraswati, L.D., 2022. The Presence of Leptospirosis sp. and Leptospirosis Risk Factors Analysis in Boyolali District. *Journal Of Public Health Research*, 11(1).

Sofiyani, M., Dharmawan, R., & Murti, B., 2018. Risk Factors of Leptospira in Klaten, Central Java. *Journal of Epidemiology and Public Health*, 3(1), pp.11-24.

Sulistyawati, S., Pradana, R., & Sugathan, S., 2020. Human and Environmental Risk Factors of Leptospirosis in Gunungkidul, Indonesia: A Case-Control Study. *International Journal Of Community Medicine and Public Health*, 7(8), pp.2967.

Suwannarong, K., Soonthornworasiri, N., Maneekan, P., Yimsamran, S., Balthip, K., Maneewatchararangsri, S., Saisongkorh, W., Saengkul, C., Sangmukdanun, S., Phunta, N., & Singhasivanon, P., 2022. Rodent-Human Interface: Behavioral Risk Factors and Leptospirosis in a Province in The Central Region of Thailand. *Veterinary Science*, 9(2).

Toemjai, T., 2023. Risk Factors Associated with Leptospirosis in Si Sa Ket Province, Thailand. *International Journal of Tropical DIsease and Health*, 44(4), pp.13-23.