

Article Review

Literature Review: Environmental Risk Factors of Leptospirosis in Indonesia

Ike Rachmawati^{1,2*}, Mateus Sakundarno Adi³, Nurjazuli³

¹Program Study of Environmental Health Masters, Universitas Diponegoro, Semarang, Central Java, Indonesia

²Kantor Kesehatan Pelabuhan Kelas II Tarakan, Tarakan, North Kalimantan, Indonesia

³Faculty of Public Health, Universitas Diponegoro, Semarang, Central Java, Indonesia

(Correspondence author's email, ike.sangpemimpi@gmail.com/+6282153468375)

ABSTRACT

Leptospirosis is a zoonotic disease which becomes a health problem in several regions in Indonesia. In 2020, there were 1,170 cases of Leptospirosis with a CFR of 9.1% spread across 8 Provinces. This study aims to determine the environmental factors that influence the incidence of leptospirosis in Indonesia. The method applied here was literature review through the Google Scholar, Pubmed and GARUDA databases which examined the environmental factors of leptospirosis in Indonesia. This was a case control study with cross sectional design with a range of published journal publications from 2016–2022. The number of samples in this study were 11 articles. The results of the study indicated that there were several environmental risk factors for the incidence of leptospirosis in Indonesia, namely the presence of standing water around the house, the poor maintained condition of ditches, the existence of trash bins that did not meet the requirements, the distance between the house and the open drain and the presence of rats inside and outside the house, and 7 articles found the presence of rats as the most dominant influential factor. Communities in leptospirosis endemic areas are expected to be more concerned with the condition of the surrounding environment and always maintain the cleanliness of their houses to prevent rats breeding as a medium for the spread of leptospirosis.

Keywords : Risk Factor, Environmental Factor, Leptospirosis.

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INTRODUCTION

Leptospirosis is a zoonotic disease which becomes a health problem in several regions in Indonesia¹. This disease is caused by a spiral-shaped pathogenic leptospira bacterium which is transmitted directly and indirectly from animals to humans². Leptospirosis in Indonesia is spread by rats which release the bacteria through urine into the environment. Humans are infected through injured skin or mucous membranes³. Mild leptospirosis is estimated to account for 90% of all cases of leptospirosis in the community with symptoms of fever, headache and muscle aches (myalgia). The remaining 10% are severe leptospirosis accompanied by symptoms of kidney failure, jaundice and bleeding¹ and also a high fever, calve muscle aches and brown urine^{4,5}.

In 2020, the Ministry of Health reported

1,170 cases of Leptospirosis with 106 deaths (CFR of 9.1%) spread across 8 Provinces. Provinces that reported leptospirosis were DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, Maluku, South Sulawesi and North Kalimantan⁶. Furthermore, in 2021, there was a decrease in cases of 734 cases, but an increase in the CFR of 11.4% with the largest contributors of Central Java and East Java Provinces⁷.

The influential factors of the occurrence of a disease are the host, agent, and environment. In addition to the high population of rats (rodents), the transmission of leptospirosis is also influenced by the quality of the physical environment, such as untreated ditches, lots of standing water, flood-prone and areas, slums and unmanaged surrounding garbage¹.

Prevention of leptospirosis cases can be

performed by knowing and controlling potential environmental risk factors so that leptospirosis risk factors to reduce the high case fatality rate/CFR and the number of cases (morbidity rate) so as to improve the community health status. This study aims to determine the environmental risk factors that may influence the incidence of leptospirosis in Indonesia.

METHOD

The method applied here was literature review through Google Scholar, Pubmed and GARUDA databases which examined the environmental factors of leptospirosis in Indonesia. This was a case control study with cross sectional design with a range of published

journal publications from 2016–2022 to obtain the latest information and relevant contents of the articles as well as the empirical data which indicated environmental risk factors of leptospirosis in Indonesia. The data sources were scientific publication journals searched by using the keywords of leptospirosis, risk factors for leptospirosis and environmental factors for leptospirosis.

Article selection began with article skimming followed by reviewing the abstract that was considered appropriate to the topic under study. There were 72 articles obtained. Furthermore, screening was carried out according to the inclusion criteria and there were 11 articles that met the predetermined criteria and study variables.

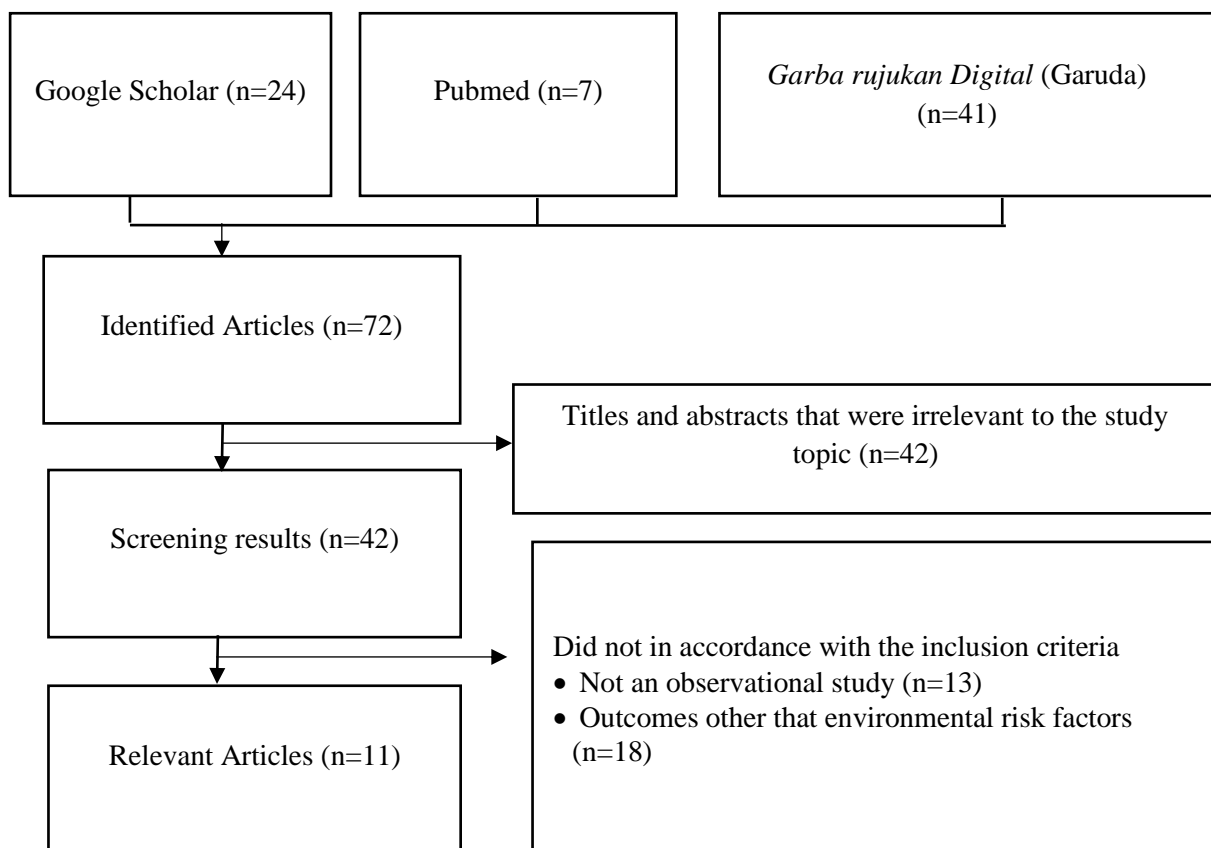


Figure 1. Article Selection Flowchart

RESULTS

A summary of the results of previous studies on environmental risk factors for the incidence of leptospirosis in Indonesia is described in table 1. The risk factor included the presence of standing water, the condition of the

ditches, the presence of rats, the presence of pets, flooded areas, the presence of garbage, the distance between the house and open drain, housing condition and poor physical condition of the house.

Table 1. Variables and Results of Previous Studies related to Environmental Risk Factors for Leptospirosis in Indonesia.

Writer	Design	Variable	Findings
Nurulia Unggul P.R, Budiyono, Nurjazuli 2016 ⁸	Case control	The presence of rats, condition of the ditches and the presence of standing water.	The results showed that there was a relationship between the presence of standing water (OR=3.273 95% CI=1.008 to 10.621) as the risk factor for leptospirosis in the city of Semarang.
Ghinaa Maniihah, Mursid Raharjo, Nikie Astorina 2016 ⁹	Case control	The presence of standing water, condition of ditches, the presence of rats and pet ownership, activity in water.	Bivariate analysis showed a relationship between standing water (p=0.040, OR=3.385), ditch condition (p=0.014, OR=4.875), and the presence of rats (p=0.002, OR=1.705) with the level of leptospira bacteria. Laboratory results showed that among 62 water samples examined, 38 (61.29%) was positive for leptospira bacteria content, most of which came from bathing water.
Novie Ariani, Tri Yunus Miko Wahyono 2020 ¹⁰	Cross sectional	The presence of rats in the house, pets, livestock pets and floods in the last 2 weeks.	The results of the study showed that the influential factors for the incidence of leptospirosis in 2 districts wherein sentinel leptospirosis surveillance was conducted in Banten Province in 2017 – 2019 were the presence of rats (POR 4.08 95% CI: 1.738 – 9.566) and the presence of pets (POR 2.24 95% CI: 1.418 – 5,827)
Hajar Camelia Dewi, Ririh Yudhastuti 2019 ¹¹	Case control	The presence of standing water, condition of ditch, history of floods and the presence of vegetation.	There was a relationship between the presence of standing water (p=0.001 and OR=22) and the condition of ditch (p=0.053 and OR=0.2050).
Patria Sari Dewi, Setyo Sri Rahardjo, Bisma Murti 2020 ¹²	Case control	The physical condition of the house, environmental condition, settlements, the presence of rats, the presence of cows, areas bordering rivers, flooded areas.	The risk of leptospirosis directly increased in the presence of rats (b=7.34; 95% CI= 4.44 to 10.24; p <0.001), and in flooded areas (b=8.99; 95% CI= 5.02 to 12, 96; p<0.001). The risk of leptospirosis is indirectly influenced by the presence of rats, the presence of livestock, flooded areas, as well as housing condition and poor physical condition of the house.
Arief Nugroho, Wiwik Trapsilowati, Bernadus Yuliadi, Siska Indriyani 2018 ¹³	Cross sectional	Vegetation around the house and the presence of rats.	Statistically, there was no relationship between vegetation and the presence of rats with the incidence of leptospirosis. However, the trap success finding (9.37% outside the home and 18.65% inside the home) at the study site could be be a potential risk of leptospirosis.

Writer	Design	Variable	Findings
Beby Prima Amaliyah, Syamsuar, Erniwati Ibrahim 2018 ¹⁴	Cross sectional	Flood, the existence of trash bins, the condition of the ditches/SPAL and the presence of rats inside/outside the house.	The description of environmental factors in the study area showed that 100% of respondents experienced flooding around the respondent's house every year, 30% had garbage scattered around/inside the house, 70.6% had ditches with unsmooth flow, and 78.3% of respondents said that there were rats in or around their houses.
Marek Samekto, Suharyo Hadisaputro, Mateus Sakundarno Adi, Suhartono, Bagoes Widjanarko 2019 ¹⁵	Case control	The presence of standing water around the house, the presence of garbage near the house, characteristics of the permeability of the house, condition of the ditches, the presence of rats,	Variables that influenced the incidence of leptospirosis were impermeable house to rats (OR=3.14; 95% CI=1.16 – 8.47), and the presence of rats in and around the house (OR=3.66; 95% CI=1.67 – 12.28)..
Maya Sofiyani, Ruben Dharmawan, Bhisma Murti 2018 ¹⁶	Case control	Residential environmental condition, house condition, the presence of rats/livestock, and history of rain/floods.	The results showed that there were relationships between the physical condition of the house (b= -1.92; 95% CI= -3.08 to -0.77; p=0.001), the condition of the residential environment (b= -2.35; 95% CI= -3.48 to -1.23; p<0.001) and the presence of rats/livestock (b= -1.41; 95% CI= -2.15 to -0.67; p<0.001) with the incidence of leptospirosis.
Defryana Rakebsa, Citra Indriani, Widagdo Sri Nugroho 2018 ¹⁷	Case control	The distance between the house and the open drain, the piles of garbage in the house, the presence of livestock and the presence of rats in the house.	Multivariate analysis showed that the distance between the house and the open drain (OR: 2.96, 95% CI: 1.22 – 7.14) and the presence of garbage in the house (OR: 2.03, 95% CI: 1.14 – 3.62) were associated with the incidence of leptospirosis.
Ragil Andriani, Dyah Mahendrasari Sukendra 2020 ¹⁸	Cross sectional	The distance between the house and the ditch, the presence of ponds, the presence of garbage around the house and the presence of standing water.	The results showed that the distance between the house and the ditch (p=0.0007) and the presence of standing water (p=0.0004) were associated with the incidence of leptospirosis.

DISCUSSION

The Presence of Standing Water

The presence of standing water can result in the incidence of leptospirosis. This is due to contamination through the urine of infected animals. So, if the standing water is not contaminated by the urine of rats infected with leptospira bacteria, then it may not cause leptospirosis². A previous study conducted in the city of Semarang showed that people who

had standing water around the house had 3.273 times higher risk of contracting leptospirosis compared to respondents who did not have standing water around the house⁸. This was reinforced by the presence of leptospirosis bacteria in 38 positive water samples or around 61.29% taken from the houses of case and control respondents⁹.

A study conducted in the Gresik District area showed that 12 respondents in the case group (80%) and 3 respondents in the control group (20%) had standing water around the house. Therefore, those respondents would have 22 times higher risk of getting leptospirosis than those who had no standing water¹¹. In another study located in the work area of Bonang Community Health Center, which was an endemic area, there was a significant relationship between the presence of standing water and the incidence of leptospirosis ($p=0.004$, $RP=2.857$)¹⁸. The presence of standing water around the house can be a source of indirect transmission of Leptospira bacteria if the water is contaminated with infected animal urine¹⁹.

The presence of standing water is one of the factors that supports the transmission of leptospirosis, especially in Indonesia. This is supported because the country of Indonesia is a tropical country with moderate temperature and climate and the pH level of the water and soil is in a neutral condition. Such condition allows the leptospira bacteria to survive and live in standing water that has been contaminated with rat urine²⁰.

Indonesian people often walk outside their homes without using footwear in their daily lives. And those like crossing standing water will be more likely to be exposed to leptospirosis²¹.

Condition of Ditch

The good and poor conditions of a ditch can be seen from the construction and the condition of the water flow in the ditch. Such condition will certainly put the community at risk if the tidal water which is contaminated with leptospirosis bacteria⁹. A good ditch refers to a ditch with closed and smooth flow of water with no rats that can enter and leave the house²². Based on the results of a study conducted in the city of Semarang, there was a relationship between the condition of ditch and the incidence of leptospirosis with $p=0.014$ (<0.05) and $OR=4.875$. Such finding indicated that respondents who had poor ditch condition had 4.875 times higher risk than respondents who had good ditch condition⁹.

Similar finding was also revealed in a study conducted in the Work Area of Tempe CHC in Wajo District, that most of residents had ditches but the existing ditches did not meet the criteria. Garbage was found 35.3% of

ditches, 70.6% of ditches had unsmooth water flow, and rats were found in 15.7% of ditches around the respondent's houses¹⁴.

The results of another study conducted in the Gresik District area showed that there was a relationship between the condition of ditch and the incidence of leptospirosis with $p=0.053$ and $OR=0.025$. Based on the results of field observations in both the case group and the control group, most of the respondents' ditches were open, clogged and the distance from the house was <2 meters. Such condition was due to the houses were close one another and the position of the ditch was higher than the house, so that when it rains, the water in the ditch overflowed and flooded the surrounding houses¹¹.

The poor condition of the ditches with the presence of puddles allows leptospira bacteria to grow and develop due to the presence of water contaminated with rat urine. People who clean ditches without wearing footwear will certainly be more likely to be exposed to leptospirosis, especially if they have uncovered wounds.

The Presence of Trash Can

Trash cans are one of the places that rats like because they are a source of food for rats, especially open and non-watertight trash cans. However, if the trash can is tightly closed and watertight, then rats cannot enter and look for food in it, so that the house and the environment will be free from the presence of rats²³.

A previous study conducted in the Work Area of the Tempe CHC in Wajo District showed that in addition to the presence of trash bins, the type of trash can also influenced the incidence of leptospirosis¹⁴. The existence of piles of garbage from food scraps placed in open trash cans would also provide an opportunity to invite the presence of rats in the house¹⁷.

Uncovered trash can is a source of food for rats to survive, so that rat breeding will increase to continue to live and develop.

Distance between the House and Open Drain

The distance between the house and open drain is one of the environmental risk factors for the incidence of leptospirosis. This is supported by the presence of rats as a reservoir for leptospira bacteria, so they have the opportunity to move a wide range of 200 meters in search of food. However, if it is difficult to

get food, rats can move even further, namely 700 meters to 1000 meters to get food²⁴. A study conducted in the work area of the Bonang I CHC showed that respondents who had a distance from their house to a ditch by ≤ 700 meters had 2,690 times higher risk of experiencing leptospirosis than respondents who had a distance from their house to a ditch by >700 meters¹⁸. This is also supported by a study conducted in Yogyakarta City and Bantul District which found that distance between the house and open drain had a significant relationship with the incidence of leptospirosis (OR=2.96 95% CI=1.22 – 7.14)¹⁷. The distance between the house and open drain lead to a higher potential presence of rats so that rat urine can be spread more widely.

The Presence of Rats

Based on the 11 articles reviewed, there were 7 articles which stated that the presence of rats was proven to be significantly associated with the incidence of leptospirosis. A study conducted in the city of Semarang showed that respondents who had rats in the house were 6.234 times more likely to be exposed to leptospirosis than respondents who did not have rats in the house⁹. Another study conducted in Tangerang District showed that trap success inside the house was 18.65% and outside the house was 9.37%. Poor maintained environmental and sanitation conditions and unsmooth flow of sewage water were the supporting factor for rats to breed and nest so that they were related to high trap success¹³.

The presence of rats around the house was also influenced by the dense and dirty environmental conditions and distance to rivers and rice fields as breeding grounds for rats¹⁴. This was also reinforced by the result of a study conducted in Klaten District, that the presence of rats was found to increase the risk of leptospirosis through unfavorable living condition and housing condition that did not meet the requirements¹⁶.

A similar study was also conducted in Pati District which showed that the presence of rats in and around the house led to 4.51 times higher risk than the absence of rats inside or outside the house for the incidence of leptospirosis¹⁵. A study conducted in 2 sentinel surveillance districts, namely Tangerang District and Serang District, also showed that the presence of rats was the most dominant risk factor for leptospirosis ($p=0.001$ OR=4.08 95%

CI=1.738-9.566)¹⁰.

The presence of rats inside and outside the house can be seen from rat droppings, rat footprints, rat bite marks and rat nests and excavations¹². Leptospirosis in Indonesia is primarily spread by rats which release the bacteria via urine into the environment. Reservoirs that are resistant to infection with leptospira bacteria are the brown rat (*R.norvegicus*) and the garden/field rat (*R.exulans*) which can be a source of infection to humans and animals. Meanwhile, rats that are sensitive to infection with leptospira bacteria are Asian house rats (*R.tanezumi*) and brown rats (*R.norvegicus*)¹.

In everyday life, rat control can be carried out using non-chemical method by using traps and chemical method by using poisoned bait²⁵.

CONCLUSION

Based on the 11 articles reviewed, it was revealed several environmental risk factors for the incidence of leptospirosis in Indonesia, namely the presence of standing water around the house, the poor maintained condition of the ditches, the existence of trash bins that did not meet the requirements, the distance between the house and open drain and the presence of rats inside and outside the house, and 7 articles found the presence of rats as the most dominant influential factor. Communities in leptospirosis endemic areas are expected to be more concerned with the condition of the surrounding environment and always maintain the cleanliness of their houses to prevent rats breeding as a medium for the spread of leptospirosis. In addition, there should be collaboration by all parties, both from the government sector private sector, religious leaders and all levels of society to commit to leptospirosis prevention in Indonesia.

Conflicts of Interest: The authors declare no conflict of interest.

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