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Analysis of Environmental Risk Factors for Leptospirosis in Bantul, Yogyakarta, Indonesia

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ABSTRACT

Background: Leptospirosis is a disease caused by the bacterium leptospira sp. The number of cases and deaths due to leptopirosis from year to year is always increasing. The purpose of this study is to analyze environmental risk factors for the incidence of leptospirosis in Bantul Regency, Special Region of Yogyakarta, Indonesia.
Subjects and Method: This study uses an observational analytical approach with *a cross sectional* design. The research location is in Bantul Regency with a sample of 200 research subjects. The sampling technique is fixed *disease sampling*. The dependent variable was the incidence of leptospirosis and the independent variables were the physical condition of the house, the condition of the residential environment, the presence of rats, the presence of livestock or pets, near rivers, flooded areas, occupation, habits of using personal protective equipment, age and gender. The research instruments used were questionnaires and *checklists* and the data was analyzed using logistic regression analysis.
Results: Risk factors that increase the incidence of leptospirosis are poor home conditions (OR= 2.18; 95% CI = 1.12 to 4.24; p=0.022); Poor residential environmental conditions (OR = 2.58; 95% CI = 1.33 to 5.03; p = 0.005); presence of rats inside and/or outside the home (OR = 4.51; 95% CI = 1.40 to 14.55; p = 0.012). The risk of leptospirosis infection decreases with the use of PPE (OR = 0.17; 95% CI= 0.08 to 0.37; p<0.001).
Conclusion: Poor house conditions, poor residential environmental conditions, the presence of rats inside and or outside the house are risk factors that increase the incidence of leptospirosis. Meanwhile, the use of PPE reduces the risk of leptospirosis infection.

Keywords: Leptospirosis, environmental risk factors, regression analysis

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BACKGROUND

Leptospirosis is a disease caused by the bacterium leptospira sp. Infected animal urine is a source of infection in humans, usually this occurs due to direct or indirect contact. Several types of animals that can be carriers of leptospirosis are dogs, rodents such as rats, and groups of livestock such as cows and pigs (Ministry of Health of the Republic of Indonesia, 2017).

Leptospirosis is a disease that has emerged globally with many outbreaks

reported worldwide over the past few decades (Hartskeerl et al., 2011). Leptospirosis is a worldwide health problem, particularly widespread in countries with tropical and subtropical climates. Leptospirosis is 1,000 times more common in tropical countries than in subtropical countries with higher levels of disease risk. The leptospirosis mortality rate in Indonesia is high, it can reach 2.5-16.45%. Mortality due to leptospirosis increases with age (Anwar and Sugiharto, 2018).

The International Leptospirosis Society stated that Indonesia is one of the tropical countries with relatively high leptospirosis death cases, which ranges from 2.5%-16.45% or an average of 7.1% and is ranked third in the world. This mortality rate can be higher up to 56% in cases that are more than 50 years old, if they are late in getting therapy (Sulistyawati et al., 2016).

In 2022, 1,419 cases of leptospirosis were reported in Indonesia. Ten provinces reported leptospirosis cases, namely DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, Banten, North Kalimantan, South Sulawesi, Southeast Sulawesi, and East Kalimantan. Of these cases, there were 139 cases of death with a Case Fatality Rate (CFR) of 9.8% (Ministry of Health, 2023).

The Special Region of Yogyakarta is one of the provinces in Indonesia that is endemic to leptospirosis. For the past five years, cases of leptospirosis have always been found spread across various districts/ cities in Yogyakarta. In 2021 there were 79 cases with a CFR of 8.8%. Furthermore, in 2022 there was an increase in cases to 274 cases, CFR increased to 16.1%. In 2023, the number of cases will increase again to 400 cases with a CFR of 8.3% (Yogyakarta Health Office, 2023).

Based on data from the Bantul Regency Health Office, in 2023 Bantul Regency will occupy the highest number of cases in Yogyakarta Province with 168 cases of leptospirosis with 11 deaths (Bantul Health Office, 2024). Seeing the geographical situation of Bantul Regency, which is mostly lowland and also supported by many spring water sources, makes Bantul Regency a potential agricultural area. However, with many water sources, this can be one of the risks that may be related to the increasing number of leptospirosis sufferers in Bantul Regency every year. Therefore, the purpose of this study is to analyze environmental risk factors for the incidence of leptospirosis in Bantul Regency in 2023.

SUBJECTS AND METHOD

1. Study Design

This study is observational analysis with a cross sectional design, namely by observing the population and sample at the same time.

2. Population and Sample

The population in this study is all people who live in the Bantul Regency area during the research period. In multivariate research, the samples used are 15 to 20 in each independent variable (Murti, 2013). In this study there are 10 independent variables, so that in this study the number of samples that must be used is 150 to 200 research subjects The sample is selected by fixed disease sampling, this technique is a sampling scheme based on the status of the disease being studied (Murti, 2013). Fixed disease sampling ensures a sufficient number of research subjects in both diseased and non-diseased groups. Researchers using a 1:1 ratio obtained as many as 100 people who did not suffer from leptospirosis (never clinically or laboratoryly diagnosed with leptospirosis) and 100 people who suffered from leptospirosis recorded at the Bantul Regency Health Office. As for the inclusion criteria for research residing in Bantul Regency, all age groups and genders, for children aged ≤ 17 years old, interviews were

conducted with the child's parents who were willing to be respondents. As for the exclusion criteria, they are not willing to be respondents and cannot communicate.

3. Study Variables

The dependent variable in this study was the incidence of leptospirosis, while the independent variables were age, gender, occupation, habit of using PPE, house conditions, residential environmental conditions, the presence of rats in and around the house, the presence of livestock/pets, areas near river flows, and flooded areas.

4. Operational Definition of Variables

Leptospirosis: is defined as a patient diagnosed by a doctor at a hospital/health center through clinical and laboratory examinations during January to December 2023 and recorded by the Bantul Regency Health Office.

The physical condition of the house: is defined as having permanent walls, plaster or tile floors, having plavones, the roof is not used as a rat nest, the cleanliness of the kitchen and house is maintained, at least 2 weeks before the leptospirosis event.

Residential environmental conditions : are defined as residential environmental conditions consisting of wastewater channel, good sewer conditions, wastewater conditions that do not have the potential to pass through rats, garbage conditions that are not scattered, closed garbage cans, distance between the house and the garbage disposal site >100 meters and no puddles around the house, at least 2 weeks before the leptospirosis event.

The existence of rats: is defined by the presence or absence of rats in or around the house of the research subject which is characterized by rat droppings, bite marks, rat nests, and rat holes.

The existence of livestock/pets: is the presence or absence of livestock/pets in and around the house known from interviews with research subjects.

The area near the river basin: is the area where the research subjects live whose distance is 0 – 100m from the river is categorized as close to the river. An area that is >100 m away from a river is categorized as far from the river.

Flooded areas: are defined as having a history of flooding or a lot of waterlogging in the area where the respondent lives for at least 2 weeks before suffering from leptospirosis.

Occupation: is defined as a profession performed by a research subject who has the potential to develop leptospirosis in the two-week period prior to being diagnosed with leptospirosis.

The use of personal protective equipment: is defined as preventive actions or efforts taken by respondents to prevent the transmission of leptospirosis, such as the use of personal protective equipment when working, risky work, or cleaning the house and or environment at least 2 weeks before being diagnosed with leptospirosis.

Age: is defined as a number that represents the length of a person's life.

Gender: is defined as the research subjects in this study are male and female.

5. Study Instruments

The research instruments used for data collection are questionnaires and checklists (observation sheets). The questionnaire was used to collect data on research variables, including: physical condition of the house, condition of the residential environment, the presence of rats in or around the house, the presence of livestock/pets in or around the house, areas near river basins, and flooded areas. The checklist is used to be able to give a real picture of the environmental situation to the researcher and as a means to cross-check with the answers given by the

respondents during the questionnaire interview.

6. Data Analysis

The data was analyzed by multivariate analysis. The multivariate analysis used in this study is a double logistic regression analysis, which is an advanced statistical model to analyze the relationship between one or several independent variables (age, gender, occupation, habit of using PPE, house conditions, residential environmental conditions, the presence of rats in and around the house, the presence of livestock/pets, areas near river basins, and flooded areas) with a dependent variable .

7. Research Ethics

Research ethics include informed consent, anonymity, and confidence. The researcher has obtained a letter of ethical eligibility from the Ethics Commission of the Yogyakarta Ministry of Health Polytechnic No. DP.04.03/e-KEPK.1/632/2024.

RESULTS

1. Responsive Features

This univariate analysis explains the general picture in the form of the results of descriptive statistical tests of continuous data which in the research variables including age, physical condition of the house and residential environmental conditions can be seen in Table 1.

Table 1. showing the results of descriptive statistical tests on each variable includeing mean, standard deviation, minimum, and maximum to measure both on independent variables with a continuous scale of 200 subjects. Mean describes the average value, standard deviation describes the variation in the data. A small elementary school is an indication that the data is representative. If the SD value is much greater than the mean value, then the mean value is a poor representation of the overall data. Meanwhile, if the SD value is very small compared to the mean value, then the mean value can be used as a representation of the entire data.

Measurements at age showed results (Mean = 54.28; SD= 12.11) with a minimum age of 17 years and a maximum age of 82 years. Measurements on the age variable show that the SD value is quite large, this indicates that there is a considerable diversity or there is a relatively large gap between the lowest score and the highest score in the data. The larger the elementary school means the more the observation data is spread, and it tends that each data is different from each other. Measurements on the variables of the physical condition of the house showed the result (Mean = 2.97; SD= 1.40) with a minimum age score of 1 and a maximum score of 6 years. Meanwhile, measurements on the variable of residential environmental conditions with a total of 200 subjects, showed results (Mean = 3.04; SD= 1.02) with a minimum score of 2 and a maximum score of 5.

Table 1. Distribution of continuous data respondent characteristics in Bantul Regency (N=200)

Characteristic	Mean	SD	Min	Max
Age	54.28	12.11	17	82
The physical condition of the house	2.97	1.40	1	6
Residential environmental conditions	3.04	1.02	2	5

Table 2 shows that of the 200 respondents studied, the number of research subjects who entered the leptospirosis criteria was 100 people, and those who entered the non-

leptospirosis criteria were 100 people. A total of 52.5% of respondents reported having a house in good physical condition, and 55% rated their residential environment as being in good condition. Rats were present in 86% of households, while 74.5% kept livestock. For 76% of households, the distance to the nearest river was over 100 meters. Flooding had never been experienced by 81% of households, whereas 19% had been affected. Among respondents, 66% worked in wet environments, and 73% did not use personal protective equipment (PPE) for daily work or environmental cleaning. Additionally, 73.5% of respondents were aged between 20 and 60, and 73.5% were male.

Table 2. Distribution of categorical data respondent characteristics (N=200)

Variable	Criteria	n	%
Incidence of leptospirosis	Non leptospirosis	100	50.0
	Leptospirosis	100	50.0
House physical condition	Good	105	52.5
	Poor	95	47.5
Residential environmental	Good	110	55.0
	Poor	90	45.0
The existence of rats	Yes	172	86.0
	No	28	14.0
Presence of livestock/pets	Yes	149	74.5
	No	51	25.5
Areas near watersheds	Far	152	76.0
	Near	48	24.0
Flooded areas	No flooding	162	81.0
	Flood	38	19.0
Work	Dry place	68	34.0
	Wet place	132	66.0
Use of PPE	Yes	54	27.0
	No	146	73.0
Age	< 20 years and ≥ 60 years	53	26.5
	≥ 20 years up to < 60 years	147	73.5
Gender	Female	53	26.5
	Male	147	73.5

2. Bivariate Analysis

Bivariate analysis aims to find out a rough picture of the influence of dependent variables with independent variables. The influence between environmental risk factors and the incidence of leptospirosis is indicated by an OR value of > 1 and a CI value of 95% does not include 1. A summary of the bivariate analysis of environmental risk factors on the incidence of leptospirosis that is significant and insignificant is available in Table 3.

Table 3. Results of bivariate analysis of environmental risk factors for leptospirosis incidence

Independent variables	Leptospirosis				OR	p
	Yes		No			
	N	%	N	%		
Physical condition of the house					2.56	0.001
Poor	36	36	64	64		
Good	59	59	41	41		

Independent variables	Leptospirosis				OR	p
	Yes		No			
	N	%	N	%		
Residential environmental conditions					2.93	0.001
Poor	32	32	68	68		
Good	58	58	42	42		
The existence of rats					7.58	0.001
No	76	76	24	24		
Yes	96	96	4	4		
The existence of livestock/pets					2.24	0.016
No	67	67	33	33		
Yes	82	82	18	18		
Areas near watersheds					0.80	0.508
Far	22	22	78	78		
Near	26	26	74	74		
Flooded areas					1.23	0.472
There is a history	17	17	83	83		
No history	21	21	79	79		
Occupation					2.26	0.008*
Dry workplace	57	57	43	43		
Wet workplace	75	75	25	25		
Use of PPE					0.188	0.001
No	58	58	42	42		
Yes	88	88	12	12		
Age					0.96	0.883
≥ 20 years up to < 60 years	70	70	30	30		
< 20 yeaars and ≥ 60 years	77	77	33	33		
Gender					0.70	0.263
Female	70	70	30	30		
Male	77	77	23	23		

Table 3 shows that poor home physical condition has a 2.56-fold risk of leptospirosis compared to good home physical condition and is statistically significant (OR= 2.56; CI 95%= 1.45 to 4.52; p<0.001). Poor residential environmental conditions had a 2.93-fold risk of leptospirosis compared to favorable residential environmental conditions and was statistically significant (OR= 2.93; CI 95%= 1.65 to 5.23; p< 0.001).The study subjects with the presence of rats in and around the house had a risk of developing leptospirosis 7.58 times compared to those in and around the house where rats were not found and were statistically significant (OR= 7.58; CI 95%= 2.52 to 22.78; p<0.001). The presence of farm animals or pets had a 2.24-fold risk of leptospirosis compared to those without farm animals (OR= 2.24; CI 95%= 1.16 to 4.34: p<0.016).

Study subjects who lived close to rivers had a 0.80 fold risk of leptospirosis compared to those living in areas far from rivers and were statistically insignificant (OR= 0.80; CI 95%= 0.42 to 1.54; p<0.508). Study subjects living in flooded areas had a 1.29-fold risk of leptospirosis compared to those living in non-flooded areas and were statistically insignificant (OR= 1.29; CI 95%= 0.64 to 2.64; p<0.472). Work in wet places had a risk of experiencing leptospirosis incidence 2.26 times compared to those in dry places and was statistically significant (OR= 2.26; CI 95%= 1.24 to 4.13; p<0.008).

The habit of using PPE has a risk of leptospirosis 0.19 times compared to not using PPE (OR = 0.19; 95% CI = 0.091 to 0.388; p<0.001). ≥ age 20 to < 60 years had a risk of leptospirosis 0.96 times compared to those who had a life < 20 years and ≥ 60 years and was statistically insignificant

(OR= 0.96; CI 95%= 0.54 to 1.70; p=0.883). Women had a 0.70-fold risk of leptospirosis incidence compared to men and were statistically insignificant (OR= 0.70; CI 95%= 0.37 to 1.31; p=0.263).

3. Multivariate Analysis

Multivariate analysis using multiple logistic regression analysis can be seen in Table 4.

Table 4. Results of multiple logistic regression analysis of environmental risk factors on leptospirosis incidence

Variable	Model 1				Model 2			
	OR	CI 95%		p	OR	CI 95%		p
		Upper Limit	Lower Limit			Upper Limit	Lower Limit	
Poor house physical condition	2.18	1.12	4.24	0.022	2.28	1.15	4.52	0.019
Poor residential environmental	2.58	1.33	5.03	0.005	2.87	1.42	5.81	0.003
The existence of rats	4.51	1.40	14.55	0.012	3.66	1.05	12.80	0.042
Use of PPE	0.17	0.08	0.37	0.001	0.14	0.06	0.33	<0.001
Presence of livestock/pets	-	-	-	-	1.66	0.73	3.75	0.226
Near the watershed	-	-	-	-	1.92	0.67	5.50	0.224
Flooded areas	-	-	-	-	1.53	0.50	4.69	0.455
Wet working places	-	-	-	-	1.38	0.66	2.92	0.394
Age (< 20 and ≥ 60 years)	-	-	-	-	1.53	0.75	3.12	0.245
Male	-	-	-	-	0.70	0.33	1.49	0.349
	n observation = 200 Pseudo R^2 = 19.76% p < 0.001				n observation = 200 Pseudo R^2 = 22.38% p < 0.001			

Table 4. showed a double logistic regression analysis of environmental factors affecting leptospirosis infection in Bantul Regency. In the logistic regression analysis, model 1 only included independent variables that showed statistical significance, with the following results:

a. Home conditions and leptospirosis

Table 4 shows that there is a positive relationship between the physical condition of the house and the incidence of leptospirosis. Residents living in poorly conditioned homes had a 2.18-fold risk of contracting leptospirosis compared to well-conditioned homes (OR = 2.18; 95% CI = 1.12 to 4.24; p = 0.022).

b. Residential environment conditions and leptospirosis

Table 4 shows that there is a positive relationship between the environment inside and or outside the home with the incidence of leptospirosis. Residents living in poor home environments had a 2.58 times higher risk of contracting leptospirosis than those with poor conditions (OR = 2.58; 95% CI = 1.33 to 5.03; p = 0.005).

c. The presence of rats inside or outside the house and leptospirosis

Table 4 shows that there is a positive relationship between the presence of rats inside or outside the house with the incidence of leptospirosis. Residents living in homes with rats in or around them had a 4.51 times greater risk of leptospirosis than homes without rats (OR = 4.51; 95% CI = 1.40 to 14.55; p = 0.012).

d. PPE use behavior and leptospirosis

Table 4 shows that there is a negative relationship between PPE and the incidence of leptospirosis. Workers who use PPE have a 0.17 times greater risk of contracting leptospirosis than those who do not use PPE

(OR= 0.17; 95% CI = 0.08 to 0.37; p<0.001).

This model of multiple logistic regression analysis has a low model fit (Pseudo R^2= 19.76%). This means that the four independent variables in the linear model of logodd, namely house conditions, residential environmental conditions, the presence of rats, and the use of PPE were able to explain the variation in leptospirosis incidence by 19.76%.

In addition, Table 4 also shows the regression analysis of model 2 in the logistic regression analysis which includes all independent variables both those that show statistical significance and those that do not. After including all the independent variables in model 2, the independent variables that showed a statistically significant relationship did not change, namely house conditions (OR= 2.28; 95% CI= 1.15 to 4.52; p= 0.019), residential environmental conditions (OR = 2.87; 95% CI= 1.42 to 5.81; p= 0.003), presence of rats (OR= 3.66; 95%CI= 1.05 to 12.80; p= 0.042), and use of PPE (OR= 0.14; 95%CI= 0.06 to 0.33; p <0.001).

In this study, the variables of occupation, livestock ownership, flood history, distance of the house to the river, gender, and age category, did not show a statistically significant relationship with the incidence of leptospirosis.

DISCUSSION

a. The effect of house conditions on the risk of leptospirosis

A healthy house is a house that can meet human needs consisting of physical and spiritual for family members. In addition, the house is also a place of protection against disease transmission (Untari, 2018). The house can be a breeding ground for rats. The house must be clean and orderly, meaning that the house is well organized, neat, there are no piles of goods, and the furniture is neatly arranged and clean. The presence of piles of items can result in the breeding of rats in the house (Ministry of Health, 2017). Conditions that support rat breeding include the availability of food in the house and dirty house conditions. Another thing that supports the entry of rats into the house is the condition of the house with ventilation holes that are not closed and the roof of the house is not given plastic so that rats can easily enter the house through a gap in the roof of the house.

The results of the statistical test of logistic regression analysis in this study showed a value of OR = 2.18. This shows a positive relationship between the physical condition of the house and the incidence of leptospirosis. Residents who live in houses with poor conditions have a 2.18 times higher risk of contracting leptospirosis than houses with good conditions. The results of this study are in accordance with research conducted by Katulistiwa and Lestari, (2016), where unhealthy house conditions are the dominant risk factor that affects the incidence of leptospirosis with a probability of 74.6% and twice as risky for leptospirosis than healthy house conditions. In addition, research conducted by Sofiyani, et al. (2017) concluded that there was a relationship between the physical condition of the house and the incidence of leptospirosis and was statistically significant.

b. The effect of residential environmental on the risk of leptospirosis

Sanitation, residential environments and waste disposal management are currently major problems in many developing countries that also exert a huge influence on the incidence of infectious diseases and other health problems. The presence of garbage or waste triggers the presence of rats and therefore can also trigger the risk of leptospirosis. Garbage and waste around the

world have been researched and it has been confirmed that contact with garbage and waste is a significant risk factor in the transmission of leptospirosis, especially in urban and rural slums (Mythri, 2016).

A study by Ramadhani and Yunianto (2010) showed that there was a relationship between poor garbage bin conditions and the incidence of leptospirosis (OR= 3.55; 95%CI= 0.97 to 13.07; p<0.045. The role of sewers as a transmission route for leptospirosis occurs when sewer water is contaminated by the urine of rats or other pets infected by the bacterium leptospira sp. and the flow of sewer water is not smooth or stagnant. Bad sewer conditions have a 4.87 times greater risk of developing leptospirosis than good sewer conditions (Maniiah, 2016).

The results of the statistical test of logistic regression analysis in this study showed an OR value = 2.58. This means that there is a positive relationship between the environment inside and or outside the home with the incidence of leptospirosis. Residents who live in poor home environments have a 2.58 times higher risk of contracting leptospirosis than those with poor conditions. The results of this study are by research in Moyudan Sleman that poor sanitation is included in the factors that affect the incidence of leptospirosis. In addition, research conducted by Pertiwi et al. (2014) also showed that the positive variables related to the incidence of leptospirosis were the presence of waterlogging (OR= 5.82; 95%CI= 1.03 to 32.84) and sewer conditions (OR= 7.11; 95% CI= 2.01 to 25.11).

This is different from the research conducted by Suratman, (2006) which concluded that the condition of the home environment does not affect the incidence of severe leptospirosis.

c. The effect of the presence of rats on the risk of leptospirosis

Leptospirosis can be transmitted through rats, pigs, cows, goats, horses, dogs, insects, birds, porcupines, bats, and squirrels. In Indonesia, rats are the main source of leptospirosis to humans through their urine that has been infected with the bacterium *Leptospira sp*. (Ministry of Health, 2017).

Leptospira sp. in rats can be affected by the species of rat. Rattus tanezumi can be a source of leptospira sp. and can spread to humans and the environment exposed by Rattus tanezumi whose habitat can be found in residential areas (Supriyati and Ustiawan, 2013). The presence of rats in or around the house increases the risk of leptospirosis events, this is related to the possibility of being infected with leptospira sp. through the urine of infected rats is greater (Widoyono, 2011). According to Samekto et al. (2019), the presence of rats in and around the house is a factor that affects the incidence of leptospirosis because the condition of the residential environment where many rats are found has the potential for infection with *leptospira sp*. larger.

The results of the statistical test of logistic regression analysis in this study showed that there was a positive relationship between the presence of rats inside or outside the house with the incidence of leptospirosis. Residents living in houses with rats in or around them had a 4.51-fold risk of leptospirosis compared to houses without rats (OR = 4.51; 95% CI = 1.40 to 14.55; p = 0.012). This research is in line with research conducted by Dewi PS, et al., (2020) that the presence of rats in or around the house has a higher risk of developing leptospirosis than in the house without the presence of rats.

d. The effect of the use of PPE on the risk of leptospirosis

According to Endarto (2020), one of the factors that can affect the incidence of

leptospirosis is personal hygiene or clean and healthy living behavior (Endarto, 2020). When cleaning sewers or ditches and garbage cans, always use gloves, and footwear (shoes) which is a hygiene behavior. Not using PPE can cause wounds or scratches on the body, making it more likely to be exposed to leptospirosis bacteria.

One of the efforts to prevent the occurrence of leptospirosis is to provide health education about leptospirosis such as the mode of transmission, dangers, and prevention, including the use of PPE. The use of personal protective equipment (PPE) when doing activities in places where there is a risk of exposure to rat urine that causes leptospirosis, is one way to take preventive measures against the transmission of leptospirosis. Based on research by Royanialita (2017), the results showed that 13 former leptospirosis sufferers (65%) did not wear personal protective equipment (PPE) when doing activities or work related to the transmission medium of leptospira sp. such as water, mud, or soil (Royanialita, 2017).

The results of the statistical test of logistic regression analysis in this study showed an OR= 0.18. This means that there is a negative association between PPE and the incidence of leptospirosis. Workers who use PPE have a 0.188 times higher risk of contracting leptospirosis than those who do not use PPE (OR = 0.18; 95% CI = 0.09 to 0.38; p<0.001). This research is in line with a study conducted by Tunissea, (2011), stating that the majority of sufferers do not wear footwear and gloves as personal protection from leptospirosis transmission. In addition, research conducted by Rejeki et al. (2013) found that there is a relationship between the use of PPE and the incidence of leptospirosis. A person who does not use PPE when doing risky activities has a 2.33 times greater risk of developing leptospirosis than those who use PPE.

AUTHOR CONTRIBUTION

Andri Setiawan as the main author formulates research articles, collects research data and processes data. Noor Alis Setiyadi formulated the framework of his study. Bhisma Murti took part in formulating learning methods and discussing learning outcomes.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

REFERENCE

Anwar M, Sugiharto (2018). Analisis spasial kasus leptospirosis berdasar faktor epidemiologi dan faktor risiko lingkungan (Spatial analysis of leptospirosis cases based on epidemiological factors and environmental risk factors). J higeia. 2(3): 386–395. https://doi.-org/10.15294/higeia.v4i4.36324.

Dewi PS, Rahardjo SS, Murti B (2020). Analysis of environmental risk factors on the leptospirosis disease in Klaten, Central Java. J Epidemiol Public Health. 3(1):11-24. https://doi.org/10-.26911/jepublichealth. 2018.03.01.02.

Dinas Kesehatan Bantul (2024). Profil Kesehatan Kabupaten Bantul Tahun 2023 (Bantul Regency Health Profile in 2023). Yogyakarta: Dinas Kesehatan Bantul.

Dinkes DIY (2023). Profil Kesehatan Daerah Istimewa Yogyakarta Tahun 2022 (Yogyakarta Special Region Health

Profile in 2022). Yogyakarta : Dinkes DIY.

Endarto Y (2020). Pengetahuan personal hygiene dengan perilaku pencegahan kejadian leptospirosis di Kota Bima NTB . J Delima Harapan. 7(1): 24–30. https://doi.org/10.31935/delima.v7i1.92.

Hartskeerl RA, Collarres PM, Ellis WA (2011). Emergence, control and re-emerging leptospirosis: dynamics of infection in the changing world. Clin Microbiol Infect. 17(4): 494–501. https://doi.org/10.1111/j.1469-0691.-2011.03474.x.

Katulistiwa N, Lestari K (2016). Analisis kondisi rumah dan keberadaan tikus yang terkena kasus leptospirosis di Kabupaten Klaten (Analysis of house conditions and the existence of rats affected by leptospirosis cases in Klaten Regency). J Environ Health. 8(1): 1–13. https://e-journal.unair.ac.-id/JKL/article/view/3095/2249.

Kementerian Kesehatan RI (2017). Petunjuk Teknis Pengendalian Leptospirosis Cetakan ke-3. Jakarta: Kementerian Kesehatan RI.

Kementerian Kesehatan RI (2023). Profil Kesehatan Indonesia Tahun 2022. Jakarta: Kementerian Kesehatan RI.

Maniiah G, Raharjo M, Astorina N (2016). Faktor lingkungan yang berhubungan dengan kejadian leptospirosis di Kota Semarang. J Public Health. 4(3):792–798. https://doi.org/10.14710/jkm.v4-i3.13539.

Pertiwi SMB, Setiani O, Nurjazuli (2014). Faktor lingkungan yang berkaitan dengan kejadian leptospirosis di Kabupaten Pati Jawa Tengah. J Environ Health. 13(2): 51–57. https://doi.org/-10.14710/jkli.13.2.51%20-%2057.

Murti B (2013). Desain dan Ukuran Sampel untuk Penelitian Kuantitatif dan Kualitatif di Bidang Kesehatan. Yogyakarta: Gadjah Mada University Press.

Mythri B (2016). Leptospirosis an enigmatic zoonosis. Inter J Cur Res. 8(17): 22-28. https://ijcrr.com/abstract.php?article_id=199#/.

Ramadhani T, Yunianto B (2010). Kondisi lingkungan yang tidak sehat berisiko terhadap kejadian leptospirosis (studi kasus di Kota Semarang) (Unhealthy environmental conditions are at risk of leptospirosis (case study in Semarang City). Health Dev. 20:546-554. https:-//dx.doi.org/10.22435/mpk.v0i0.747.

Rejeki DSS, Nurlaela S, Octaviana D (2013). Pemetaan dan analisis faktor risiko leptospirosis. Natl Public Health J. 8(4):179-186. https://scholarhub.ui.-ac.id/kesmas/vol8/iss4/7/.

Royanialita W, Adi M, Yuliawati S (2017). Gambaran faktor risiko kejadian leptospirosis di Kabupaten Boyolali. J Public Health. 5(1): 243–247. https://-doi.org/10.14710/jkm.v5i1.15530.

Samekto M, Hadisaputro S, Adi MS, Suhartono S, Widjanarko B (2019). Faktor-faktor yang berpengaruh terhadap kejadian leptospirosis (Studi Kasus Kontrol di Kabupaten Pati). J Comm Health Epidemiol. 4(1): 27-34. https:-//doi.org/10.14710/jekk.v4i1.4427.

Sofiyani M, Dharmawan R, Murti B (2018). Risk factors of leptospirosis in Klaten, Central Java. J Epidemiol Public Health. 3(1):11-24. doi: 10.26911/jepublichealth.2018.03.01.02

Sulistyawati S, Nirmalawati T, Mardenta R N (2016). Spatial analysis of leptospirosis disease in Bantul Regency Yogyakarta. Natl Public Health J. 12(1): 111–119. https://doi.org/10.152-94/kemas.v12i1.4615.

Supriyati D, Ustiawan A (2013) Spesies tikus, cecurut dan pinjal yang ditemukan di pasar Kota Banjarnegara. Bala-

ba. 9(02): 39–46. https://dx.doi.org-/10.22435/balaba.v9i2%20Des.3351.

Suratman (2006). Analisis faktor risiko lingkungan dan perilaku yang berpengaruh terhadap kejadian leptospirosis berat Di Kota Semarang. Tesis. Universitas Diponegoro Semarang.

Tunissea A (2011). Analisis Spasial Faktor Risiko Lingkungan Pada Kejadian Leptospirosis di Kota Semarang. Tesis. Universitas Diponegoro Semarang.

Untari (2018). Pilar Utama Ilmu Kesehatan Masyarakat (Main Pillars of Public Health Sciences). Yogyakata: Thema Publising.

Widoyono (2011). Penyakit Tropis Epidemiologi, Penularan, Pencegahan dan Pemberantasan. Edisi Kedua (Tropical Diseases Epidemiology, Transmission, Prevention and Eradication. Second Edition). Jakarta: Erlangga.