



Characteristics, Behavior, and Environmental Conditions Residence of Leptospirosis Patients in the District of Probolinggo

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Abstract

Leptospirosis is a zoonotic disease caused by the bacterium Leptospira and carried by rats and transmitted through its urine. The risk factors of the sufferer are the condition and daily activities of individuals. Confirmed cases of Leptospirosis in Probolinggo Regency as of January 20, 2020 numbered 4 with 2 deaths. This research aims to analyze the characteristics, behaviors, and environmental conditions of leptospirosis sufferers, especially in Probolinggo Regency. The research was conducted by describing four cases of Leptospirosis in Probolinggo Regency in the period 1 – 20 January 2020. Data analysis is done descriptively and presented in the form of a table or narration. The results shows that 75% of leptospirosis sufferers are male with an age range of 45 – 59 years. Some sufferers (50%) work as farmers and construction workers. Some sufferers (50%) have the habit of washing hands and feet, and live in flood-prone areas. Almost all sufferers (75%) well-aware of the presence of rats and pets in their home. Therefore, discipline is required in the implementation of clean and healthy living habits to prevent the transmission of Leptospirosis.

Introduction

Leptospirosis is a zoonotic disease caused by the bacteria *Leptospira* from the Trepanometaceae family and the order Spirochatales (1). Sources of leptospirosis are rodents, pigs, cows, goats, sheep, horses, dogs, cats, insects, birds and insectivores. In Indonesia, rats are the main source of transmission. Leptospirosis is transmitted from animals to humans through the urine of infected animals, either directly or indirectly. Transmission can occur through direct human contact with infected animals through blood, urine, or other bodily fluids that enter the host's body. Meanwhile, indirect contact can occur through puddles, rivers, lakes, sewers, soil (mud), and plants that have been contaminated with animal urine with leptospirosis (2). Transmission to humans is likely to occur through exposure at work, recreation or hobbies, and natural disasters associated with bacteria *Leptospira* carriers. Bacteria *Leptospira* can enter the body through the surface of the skin of the injured hands or feet and the mucous membranes (mucosa) of the eyes, nose, or ears (3).

Leptospirosis cases are common all over the world, especially in countries with tropical and subtropical climates with high rainfall (4). Floods, which are still frequently encountered in Indonesia, have the potential to transmit rat urine into the human body. The stagnant water makes it easier for rat urine to be washed away and eventually reaches humans. Flood disasters resulting in poor sanitation, poorly managed trash, and messy environmental conditions, allow bacteria *Leptospira* to live and reproduce, as well as infect someone.

From 2015 to 2019 there has been a fluctuation in the number of leptospirosis cases in Indonesia. There were 366 cases with a Case Fatality Rate (CFR) of 17.76% in 2015. Later on the number of cases increased in 2016, then in 2017 the number of cases decreased, the number of cases increased again in 2018, and continue to increased in 2019 to 920 cases with CFR of 13.26% (5). Leptospirosis cases during

the period 2015 to 2019 reached their peak in 2019. However, CFR in 2019 decreased by 3.29% from the previous year. Six of the nine provinces that reported cases of leptospirosis in 2019 experienced an increase in confirmed cases. The six provinces are DKI Jakarta, Central Java, East Java, West Java, North Kalimantan and South Sulawesi. Leptospirosis cases in East Java increased by 19 cases from the previous year. East Java Province is on the third position with the highest number of leptospirosis cases in Indonesia in 2017-2019 after Central Java and DI Yogyakarta.

Probolinggo Regency is one of the districts / cities in East Java that is affected by leptospirosis. In 2018, 10 cases of leptospirosis are confirmed, 1 of which died (CFR 10%). In 2019 there were still 10 cases of leptospirosis but the number of deaths increased to 2 (CFR 20%) (6). Until January 20, 2020, there were 4 cases of leptospirosis with 2 deaths (CFR 50%).

Common risk factors for people with leptospirosis include conditions inherent in individuals and their daily activities (2). Conditions inherent in individuals consist of age, gender, education and occupation. Daily activities are related to the habits and environmental conditions where the sufferer lives, such as the habitual activities in a watery place, not caring for wounds properly, not using footwear and gloves, the presence of garbage in the house, the presence of rats in the house, the presence of pets, areas prone to flooding, waterlogged soils, slum areas, and stagnant sewers.

Information provided by public health office on the characteristics, behavior, and environmental conditions where people with leptospirosis live will be very useful as the basis for the Leptospirosis prevention and control program for the community. It is also possible for other sectors to work together to reduce risk factors, such as flooding and the presence of rats. This study aims to analyze the characteristics, behavior, and environmental conditions where people with leptospirosis live in Probolinggo Regency. Furthermore, most of the research on leptospirosis in Indonesia is located in Central Java or DI Yogyakarta while this research is located in East Java, especially Probolinggo Regency.

Methods

The study was conducted by describing four cases of leptospirosis found in Probolinggo Regency from 1 - 20 January 2020. The cases found were described according to characteristic variables (age, sex, and occupational types), behavior (using footwear when visiting the yard, washing hands and feet after activities, and wearing gloves when in contact with puddles of water after rain), and environmental conditions (clean water sources, sewer conditions, presence of rats, presence of pets/livestock, types of garbage bins, and flood-prone areas).

The data were obtained from the Probolinggo District Public Health Office in the form of Epidemiological Investigation data for leptospirosis cases, leptospirosis case reports, and health profiles as secondary data for the study. Data analysis was carried out descriptively, which describes the distribution and presentation of each variable. Variables with a ratio scale (age) were seen as the mean, median, minimum and maximum values. Variables with nominal and ordinal scales (other variables) will be seen from the value of the frequency or the percentage (%). The data will be presented in tabular or narrative form.

Results

Based on the analysis of secondary data in Probolinggo Regency for the period dated 1 - 20 January 2020, the following is a table of frequency distribution of characteristic variables in the form of age, gender, and type of work of people with leptospirosis:

Table 1. Frequency Distribution of Age Variables of Leptospirosis Patients in Probolinggo Regency (1 - 20 January 2020)

Age Variables	Mean	Median	Min-Max	Incidence of Leptospirosis	
				n	%
45	51,75	51,5	45 – 59	1	25
51				1	25
52				1	25
59				1	25

Source: Probolinggo District Health Office, 2020

Table 2. Frequency Distribution of Sex and Types of Work Variables for Leptospirosis Patients in Probolinggo Regency (1 - 20 January 2020)

Variables	Category	Incidence of Leptospirosis	
		N	%
Sex	Male	3	75
	Female	1	25
Occupational types	Masseuse	1	25
	Farmer	1	25
	Construction worker	1	25
	Factory worker	1	25

Source: Probolinggo District Health Office, 2020

Frequency Distribution of Age, Sex, and Occupational Types of Leptospirosis Patients in Probolinggo District (1 - 20 January 2020)

Table 1 shows the distribution of sufferers is in the adult group, namely those aged 45, 51, 52, and 59. Age is one of the conditions inherent in the individual Leptospirosis cases often occur at the age of 15 - 69 years (2). This is evident in the four cases, that the patient age group is in the range of 15 - 69 years.

Based on table 2, it can be seen that 75% of leptospirosis sufferers are male and the rest are female. Sex is one part that cannot be separated from an individual figure. Male and female have the same chance of contracting leptospirosis (2). This is evident in the four cases, that the sufferers are male and some are female.

Table 2 also shows the distribution of sufferers by occupational types. The results show that the respondents have jobs as masseuse, farmer, construction worker, and factory worker. Basically, activities associated with mice or the environment contaminated with urine of infected mice are highly at risk for leptospirosis infection, including work. Farming is one of the risky occupations due to contact with water, mud, soil, or grass which all have the potential to be contaminated with the urine of infected rats (2). Although the construction workers were not included, they were most likely in contact with the contaminated neighborhood.

Based on the analysis of secondary data in Probolinggo Regency for the period of January 1 - 20 2020, the following is a table of frequency distribution of behavioral variables in the form of using footwear when visiting the yard, washing hands and feet after activities, and wearing gloves when in contact with puddles after rain of leptospirosis sufferers:

Table 3. Frequency Distribution of Behavioral Variables of Leptospirosis Patients in Probolinggo Regency (1 - 20 January 2020)

Behavioral Variables	Category	Incidence of Leptospirosis	
		N	%
Using footwear when visiting the yard	Yes	2	50
	No	2	50
Washing hands and feet after activities	Yes	2	50
	No	2	50
Wearing gloves when in contact with puddles after rain	Yes	0	0
	No	4	100

Source: Probolinggo District Health Office, 2020

Frequency Distribution of Using Footwear When Visiting the Yard, Washing Hands and Feet After Activities, and Using Gloves When in Contact with Puddles Water After Rain for Leptospirosis Patients in Probolinggo Regency (1 - 20 January 2020)

Table 3 shows the distribution of leptospirosis patients based on their behavior. As many as 50% of sufferers do not use footwear when they visit the yard and do not wash their hands and feet using soap and running water after doing activities. All sufferers also do not use Personal Protective Equipment (PPE) in the form of gloves when in contact with waterpuddles that formed after rain. The behavior or habits of the sufferers resulting in high-risk of contracting the disease because the bacteria *Leptospira* cannot enter itself into the body unless humans allow it by not practicing the three variables (2).

Based on the secondary data analysis in Probolinggo Regency for the period dated 1 - 20 January 2020, the following is a table of frequency distribution of variables namely environmental conditions in the form of clean water sources, sewer conditions, presence of rats, presence of pets or livestock, types of garbage bins, and flood-prone areas with leptospirosis:

Table 4. Frequency Distribution of Environmental Conditions Variables of Leptospirosis Patients in Probolinggo Regency Period 1 - 20 January 2020

Environmental Conditions Variables	Category	Incidence of Leptospirosis	
		N	%
Clean water sources	Well	3	75
	Tap water	0	0
	Unknown	1	25
Sewer conditions	Good	1	25
	Bad	1	25
	Nothing	2	50
Presence of rats	There is	3	75
	Nothing	1	25
Presence of pets/livestock	There is	3	75
	Nothing	1	25
Types of garbage bins	Open	3	75
	Closed	0	0
	Unknown	1	25
Flood-prone areas	Yes	2	50
	No	2	50

Source: Probolinggo District Health Office, 2020

Frequency Distribution of Clean Water Sources, Sewer Conditions, Presence of Rats, Presence of Pets or Livestock, Types of Garbage Bins, and Flood-prone areas for Leptospirosis Patients in Probolinggo Regency (1 - 20 January 2020)

The distribution of leptospirosis sufferers based on the environmental conditions in which they live can be seen from table 4. Most of the sufferers (75%) use well water as a source of clean water for household needs, such as bathing and washing. Water sources are at risk if contaminated with animal urine carrying the bacteria *Leptospira* which is then consumed by humans or transmitted through a wound on the body (2).

From table 4 it is also known that 2 out of 4 sufferers (50%) do not have a sewer in their place of residence, while the conditions of the other sufferers' sewers are good and bad, respectively. The sewer can be said to be well-conditioned when the water flows smoothly, does not overflow, there are no rats, and the housing distance is ≥ 2 meters. Oppositely, bad condition of the sewer is characterized with often overflowing and inundated water, there are rats, and the housing distance is < 2 meters. Generally, sewers that are not well-maintained resulted in stagnant water flow, a place for rats to hide and carry out their activities. This condition is a risk factor because the sewer can be contaminated with rat urine containing the bacteria *Leptospira* in it (2).

Table 4 shows that as many as 75% of leptospirosis sufferers often see rats and signs of rats, and have pets/livestock in their homes. The presence of mice in the house is an important risk factor for leptospirosis because mice are the main animal carriers of the causative bacteria, namely *Leptospira* (2). The presence of pets/livestock at home, such as dogs, cats, goats and cows is also a risk factor. The results of the Microscopic Agglutination Test (MAT) in India in 2011 showed that 52.1% of rats, 66.6% of cats, 50% of dogs, and 52.9% of livestock were positively infected with leptospirosis (2).

From table 4, it is known that most of the sufferers (75%) also have a type of open garbage bin in their respective residences. The existence of garbage in the house becomes risky if it is not managed properly (2). Garbage bins in the house that are left open can invite rats to scavenge for leftovers in them.

Table 4 shows that some of the sufferers live in flood-prone areas, namely Kedungdalem Village and Dringu Village, Dringu District. One of the environmental conditions that is a risk factor for the emergence of leptospirosis is a flood-prone area. High rainfall can cause flooding. Puddles of water and mud after rain/flood can be a place of survival for the *Leptospira*. *Leptospira* can survive for months in stagnant water and mud with a pH between 7.0 - 7.4 and a temperature between 28 °C - 30 °C (2).

Discussion

Geographically, Probolinggo regency is located at 7°40' - 8°10' South Latitude and 112°50' - 113°30' East Longitude with an area of about 1,696.17 km², and consists of 24 sub-districts, 325 villages, and 5 villages. Most of Probolinggo regency consists of moors (513.80 km²), forest (426.46 km²), and rice fields (373.13 km²). Its location on the slopes of the mountains from west to east makes the temperature of Probolinggo regency range from 27° - 30°C. In April-October there is a dry season with rainfall of 29.5 mm per rainy day and rainy season in October-April with an average rainfall of 229 mm per rainy day. The peak of rain occurs in December-March with an average rainfall of 360 mm per rainy day (7). Most of probolinggo regency's residents work in agriculture, forestry, hunting, and fisheries (8).

In other cases, the previous research was mostly located in Central Java (especially Semarang) and D.I. Yogyakarta. Semarang has an area of 373.70 km² and most of the area is residential (33.70%), moors

(15.77%), and mixed gardens (13.47%) (9). Work as a farmer and farmworker is the least type of work in Semarang (10). While in D.I. Yogyakarta the area is 3,185.80 km² and land use is dominated by settlements (27.32%), shrubs (19.93%), and irrigation and moor rice fields (17.54%) (11). Most of the D.I. Yogyakarta residents work as laborers/employees/employees and agriculture jobs are jobs with the least total population (12).

Based on table 1, the age group of leptospirosis patients is in the age range of 45-59 years with an average age of 51.75 years and a median of 51.50 years. This age group is included in the final adult age group with an age range of 36-45 years and the elderly age group with an age range of 46-65 years (13). The results of this study are in line with a study by Prihantoro and Siwiendrayanti (2017) which also showed that the most age group of leptospirosis sufferers was at the age of 40 years and over (4). Adult age groups are more susceptible to exposure to leptospirosis because adults have an obligation to work and do more outdoor activities. Not to mention if there are comorbidities or comorbid diseases in patients (14) and the patient's immune system decreases with age (15), it can increase the potential for death. It is advisable for adults to pay attention to health and safety during outdoor activities by maintaining endurance and using supporting equipment that is required while working for safety measures.

Based on gender as shown in table 2, 75% of leptospirosis sufferers are male. The results of this study are in line with the two studies by Prihantoro, Siwiendrayanti (2017) and Ramadhani, Astuti (2015) which also showed that the most leptospirosis sufferers were male (4,15). Although men and women have the same chance of contracting leptospirosis, in fact, adult men as the majority certainly spend most of their time doing activities outside their residences and are more likely to be exposed to the bacteria *Leptospira*. It is better if both men and women remain disciplined in maintaining cleanliness and safety while working because there are many things that can be encountered unconsciously, such as viruses or bacteria.

Based on the type of work in table 2, Leptospirosis sufferers each work as masseurs, farmers, construction workers, and factory workers. When viewed from the type of work, some of the sufferers' jobs (50%) were non-risk jobs, namely masseurs and factory workers. While the rest are farmers and construction workers. The results of this study are different from the two studies by Prihantoro, Siwiendrayanti (2017) and Ramadhani, Astuti (2015) which showed that most of the occupations of patients at risk were not at risk (4,15), and in contrast to two other studies by Rakebsa, Indriani, Nugroho (2018) and Pratamawati, Handayani, Kinansi (2018) which showed that most of the occupations of patients at risk were farmers (16,17). Indirect exposure of infected rat urine to risky jobs such as farmers, butchers, hunters, or veterinarians, through water, mud, or soils largely predominates in human infections (18). However, it does not mean that a job that is not at risk is not exposed to leptospirosis bacteria. It is also necessary to pay attention to the patient's behavior in carrying out daily activities, both at home and at work, as well as the presence of rats in the workplace. Therefore it is important to always prioritize health and safety in any activity.

Based on the behavior of Leptospirosis sufferers in table 3, no one uses gloves when in contact with water puddles after rain (0%). Research in Gunungkidul states most of the participants had a similar habit of not using personal protection during work (19). In the research of Nursitasari (2019), it is known that there is a significant relationship between the variable contact with stagnant water on the incidence of leptospirosis in Ponorogo Regency. Even this variable is 10 times more likely to develop leptospirosis than those who do not come into contact with stagnant water (20). This proves that stagnant water is one of the great potentials in which rat urine contains the bacteria *Leptospira*. While the use of footwear when visiting the yard was also only done by some patients (50%). Research in Thailand stated that not wearing boots during activity related to water and soil can increase the risk of contact with *Leptospira* (21). Two studies by Pratamawati, Handayani, Kinansi (2018) and Samekto, Hadisaputro, Adi, Suhartono, Widjanarko (2019) show that there is a relationship and the effect of not using footwear when going to the yard or outside the house on the incidence of leptospirosis (17,22). If there is an open wound on the leg, consciously or unconsciously, the bacteria *Leptospira* from rat urine that is in the soil, mud, or puddles can enter the body. Some patients also did not wash their hands and feet using soap and running water after doing activities (50%). Meanwhile, washing hands and feet using soap and running water can reduce the risk of contracting the disease that bacteria *Leptospira* adhering due to touching objects contaminated with urine of infected mice (23).

Based on the living conditions shown in table 4, three out of four leptospirosis sufferers use well water as a source of clean water for bathing and washing. Research by Prihantoro and Siwiendrayanti (2017) implies that clean water sources have no effect on leptospirosis, but water sources from wells have a higher risk of developing leptospirosis (4). According to Ramadhani and Astuti (2015), clean water facilities that do not meet the requirements are related to the occurrence of leptospirosis. Especially in dense and slum areas, it is likely that bacterial recontamination of drinking water will occur (15). Leptospirosis can come from infected animals that contaminate water sources and enter the human body if consumed or transmits through open wounds. Therefore, the community should be able to ensure the cleanliness of water sources or use water sources that have been guaranteed cleanliness.

Table 4 also shows that as many as 50% of sufferers' residential areas do not have sewers while the

others have with their respective good and bad conditions. Previous studies by Samekto, Hadisaputro, Adi, Suhartono, Widjanarko (2019) and Nugroho (2015) have produced mixed results. Both studies state that poor sewer conditions are not a risk factor for leptospirosis (22) and the presence of wastewater in people's homes is not associated with the incidence of leptospirosis (24). Another case with research by Kurniawati, Nuryati (2018) which stated that there is a connection between the existence of sewers near the dwelling and the incidence of Leptospirosis (25). However, two other studies state that when the urine of mice infected with the bacteria *Leptospira* contaminating sewer water and the flow is inundated or overflows, sewers can play a role as a factor of leptospirosis transmission (26), as well as clogged sewer conditions, piling garbage, and stagnant water have an effect on flooding and can also invite rats (4). This difference occurs because the sewer acts as a transmission route for leptospirosis if the sewage water is contaminated by the urine of rats or other animals infected by the bacteria *Leptospira* (26). Moreover, if the sewer water overflows and the distance between the house and the ditch is close enough, the contaminated water stagnates in the environment around the house. Furthermore, during the community service, cleaning the gutters is not accompanied by the use of PPE in the form of gloves and footwear and washing hands and feet with soap and running water afterwards. Not only is body cleanliness important, but environmental cleanliness is also worth paying attention to.

In table 4, it can also be seen that as many as 75% of sufferers have pets or livestock and aware of the presence of rats in their house. The presence of rats known from some holes and rat trackings in respondents's house. Also rats emergence through the banks of waterways immediately after a flood. Research in Semarang stated that rats can get through a small gap and waterways into the house (27). The results of this study are also similar to several studies by Rakebsa, Indriani, Nugroho (2018) and Sofiyani, Dharmawan, Murti (2018) that show the presence of livestock is a risk factor for leptospirosis (16) and the presence of rats or livestock increases the risk of leptospirosis transmission (26). Research by Samekto, Hadisaputro, Adi, Suhartono, and Widjanarko (2019) also states that the presence of rats in and around the house had a 4.51 times greater risk of getting leptospirosis ($p = 0.003$; 95% CI = 1.66-12.28) (22). Rats are the main animal carriers of *Leptospira* and a major factor in the occurrence of leptospirosis. The presence of pets or livestock also increases the risk of exposure to the bacteria *Leptospira*. A pet or livestock pen can be a place for rats to stop by. This is not to mention the added contact with every item related to rats and pets or livestock without using PPE. This condition is very likely increase the risk of *Leptospira* transmission. Keeping the house clean and tidy by not allowing household appliances to scatter can prevent rats from being in the house. Maintenance of animals/livestock must also be followed by efforts to keep the pen clean and check animal/livestock health regularly and periodically.

Almost all sufferers have an open garbage bin in their place of residence (75%) as shown in table 4. Open garbage bins have a 3.556 times greater risk of being exposed to leptospirosis (15). Bins that are piled up and exposed to open air can invite rats to come because the garbage contains food scraps, a source of rat food, and they can be a hiding place for rats, ensuring the possibility of contact between rat urine and humans. If garbage bins are placed outside or remain indoors and closed and thrown away regularly, there would not be enough room for rats to hide in the house.

Table 4 shows that some of the sufferers live in flood-prone areas (50%). According to Anggit Hermanuadi, Head of BPBD of Probolinggo Regency, several flood-prone areas include Besuk District (Kecik Village and Bago Village); Dringu District (Desa Randu Putih, Tamansari, Kedungdalem, and Dringu); Gending District (Sebaung Village); Kraksaan District (Kalibuntu, Asembagus, Kraksaan Wetan, Patokan, and Sidomukti Villages), Pakuniran District (Gunggungan Lor, Gunggungan Kidul, Patemon Kulon, and Ranon Villages); Sumberasih District (Banjarsari Village and Coastal Village); and Tongas District (Bayeman, Dungun, and Sumendi Villages) (28). Dringu District, Gending District, Kraksaan District, Sumberasih District, and Tongas District were also mentioned as a flood-prone areas in research by Riberu, Enderwati, W (29). The two respondents live in flood-prone areas, precisely in Dringu and Kedungdalem Villages, Dringu District. Research by Mwachui et al. (2015) states that floods and heavy rain are risk factors of leptospirosis (30). Flood-prone areas should be aware of disease outbreaks as a result of flooding, one of which is Leptospirosis. *Leptospira* can continue to survive for up to 43 days in soil flooded with rainwater (31). Floods can carry the urine of mice infected with *Leptospira* and then enter the body through open wounds or contaminated food and drink that are consumed by humans. Some efforts that can be made to prevent and reduce the possibility of flooding include throwing out the garbage regularly, ensuring the flow of sewer water, and making biopores or infiltration wells as a solution to reduce organic waste and risk of flooding.

Conclusion

The results of the study shows that 75% of leptospirosis sufferers were male with an age range of 45-59 years. The occupations of some patients (50%) are risky jobs, namely farmers and construction workers. The rest work as masseurs and factory workers. There were no patients who used gloves when in contact with water puddles after rain, wearing footwear when visiting the yard and washing hands and feet after activities were only done by some patients (50%). Most of the sufferers (75%) use well water as a

source of clean water. 50% of sufferers' residential areas do not have sewers and the rest have sewers with their respective good and bad conditions. Most of the sufferers (75%) owned pets or livestock and were aware of the presence of rats in the house. Open garbage bins can be found in almost all sufferers' (75%) house. Half of the sufferers live in flood-prone areas.

The effort that needs to be done to prevent leptospirosis is maintaining self-discipline in using PPE in the form of gloves and footwear when in contact with things that have the potential to transmit leptospirosis, including soil, mud, puddles after rain, or objects that are possible to be in contact with rodents, such as garbage bins and animal or livestock pens. Also do not forget to regularly wash your hands using soap and running water after doing activities, and maintain the cleanliness and tidiness of the house to avoid pest so that it does not become a nesting place for rats.

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