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Identification of Captured Rat Species and Detection of Leptospira Bacteria: Study at the Gapura Surya Nusantara Passenger Terminal, Tanjung Perak Port, Surabaya

Mas Adhi Hardian Utama[1*)], Suhartono[2], Budiyono[3]

[1*), 2, 3] Master of Environmental Health Study Program, Universitas Diponegoro Semarang

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ABSTRACT

Leptospirosis is transmitted through water or food contaminated by the urine of infected animals, with rats as the potential main reservoir. This research aims to describe the species and gender and analyze the presence of Leptospira bacteria in rats at the Terminal Gapura Surya Nusantara (GSN) Port in Tanjung Perak, Surabaya. This study employed a descriptive cross-sectional design. Samples were captured using traps baited with salted fish. The captured rat kidneys were tested using Real-Time Polymerase Chain Reaction (RT-PCR) at the Vector and Disease Carrier Animal Laboratory Installation of the Center for Environmental Health and Disease Control Technology (BBTKLPP) in Surabaya. Data were analyzed using frequency distribution tables. The research results indicate Rattus norvegicus as the most dominant species, followed by Mus musculus and Rattus tanezumi. Out of a total of 19 captured rats, 89.5% were male, and 10.5% were female. RT-PCR testing for Leptospira bacteria in rat kidneys showed that only 3 rats (15.8%) tested positive, while 16 rats (84.2%) tested negative. Interestingly, rats identified as exposed to Leptospira bacteria were only found in the Rattus norvegicus species and were male. This highlights the potential role of species and gender in the spread of these bacteria. Increased surveillance and control measures are needed to address the issue of rats and the spread of Leptospira bacteria. The Rattus norvegicus species, particularly the males exposed to Leptospira bacteria, requires special attention.

Kata kunci:

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**) corresponding author*

Mas Adhi Hardian Utama, SST, SKM

Master of Environmental Health Study Program, Universitas Diponegoro Semarang
Kantor Kesehatan Pelabuhan Kelas I Surabaya Ditjen P2P Kementerian Kesehatan RI

Email: hardian.utama@gmail.com
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ABSTRAK

Leptospirosis ditularkan melalui air atau makanan terkontaminasi oleh urine hewan terinfeksi, dengan tikus sebagai potensi reservoir utama. Penelitian ini bertujuan untuk mendeskripsikan spesies dan jenis kelamin, serta menganalisis keberadaan bakteri Leptospira pada tikus di Terminal Gapura Surya Nusantara (GSN) Pelabuhan Tanjung Perak Surabaya. Penelitian ini adalah deskriptif cross-sectional. Sampel diambil dengan perangkap menggunakan umpan ikan asin. Ginjal tikus yang tertangkap diuji menggunakan metode Real Time Polymerase Chain Reaction (RT-PCR) di Instalasi Laboratorium Vektor dan Binatang Pembawa Penyakit Balai Besar Teknik Kesehatan Lingkungan dan Pengendalian Penyakit (BBTKLPP) Surabaya. Data dianalisis menggunakan tabel distribusi frekuensi. Hasil penelitian menunjukkan Rattus norvegicus sebagai spesies paling dominan, diikuti oleh Mus musculus dan Rattus tanezumi. Dari total 19 tikus yang berhasil ditangkap, sebanyak 89,5% adalah jantan dan 10,5% betina. Hasil uji RT-PCR untuk bakteri Leptospira pada ginjal tikus menunjukkan hanya 3 tikus (15,8%) positif, sedangkan 16 tikus (84,2%) negatif. Menariknya, tikus yang teridentifikasi terpapar oleh bakteri Leptospira hanya ditemukan pada jenis Rattus norvegicus dan berjenis kelamin jantan. Hal ini menyoroti peran potensial spesies dan jenis kelamin dalam penyebaran bakteri tersebut.

Peningkatan pengawasan dan pengendalian dibutuhkan untuk menanggulangi masalah tikus dan penyebaran bakteri Leptospira. Spesies Rattus norvegicus yang berjenis kelamin jantan, sebagai tikus yang terpapar bakteri Leptospira, memerlukan perhatian khusus.

INTRODUCTION

Leptospirosis is a zoonotic infectious disease that can lead to outbreaks if preventive measures are not promptly taken. This disease is caused by Leptospira bacteria, which can infect both humans and animals. Typically, leptospirosis cases are often associated with events such as floods, high tides in coastal areas, swampy regions, or peatland (Widjajanti, 2020).

Leptospirosis is widespread in tropical climate countries, such as Indonesia. The warm tropical environment with neutral pH in water and soil, high humidity, and abundant rainfall creates conditions highly conducive to the sustainability of Leptospira bacteria. This risk is further heightened if environmental conditions deteriorate, as it would support the development and survival of these bacteria (Widjajanti, 2020). Leptospirosis often emerges in tropical regions after floods, typhoons, or other disasters, and the incidence of the disease is higher in tropical climates compared to subtropical and cold climates (Ari, Budi and Sekar, 2022). Not only is there an increase in reported cases during these events, but there is also rapid and explosive disease spread upon reaching previously unaffected areas (Garba and Moussa, 2021).

In the two states of Central Malaysia, Selangor and Perak, data recorded incidence rates of 14.24 and 11.30 for Selangor, and 13.60 and 11.41 for Perak in 2016 and 2017 (Philip et al., 2020). Over the last decade (2011-2020), there has been a trend of increasing leptospirosis cases in Indonesia, especially during the period from 2018 to 2020. However, it is noteworthy that there was a decrease in the death rate during these three years. One province that recorded a significant increase in cases in 2020 was East Java, where the number of cases rose from 147 in 2019 to 272 cases in 2020 (Kementerian Kesehatan, 2021), and as of October 2022, the situation in East Java indicates 401 cases of Leptospirosis with 14 deaths (Dinas Kesehatan Jawa Timur, 2022).

Leptospirosis transmission occurs when a person interacts directly or comes into contact with water or other food products contaminated by the urine of animals infected with Leptospirosis (Ari, Budi and Sekar, 2022). One potential reservoir for Leptospira bacteria, the causative agent of leptospirosis, is rats, as they have a broader range of movement compared to other animals such as cats, cows, and dogs, which can also serve as reservoirs for Leptospira bacteria (Husni et al., 2023), and rats are often found in proximity to humans (Taruk et al., 2020).

Rats, especially brown rats (Rattus norvegicus), are the main reservoirs for Leptospira and play a crucial role in urban and peri-urban environments. Rats have been identified as Leptospira reservoirs in various countries, including Brazil, India, and the Philippines. In Indonesia, various rat species such as Rattus tanezumi, Rattus norvegicus, Rattus argentiventer, Rattus tiomanicus, Rattus exulans, Bandicota indica, and other species have been detected as infected by Leptospira in various provinces (Sholichah, Ikawati, et al., 2021). Therefore, the presence of rats in an area needs to be monitored for potential health hazards, especially in entry points such as ports, which, according to the International Health Regulation 2005, must have public facilities that are clean and free from sources of infection or contamination, including disease vectors and reservoirs like rats (WHO, 2005).

Based on the research conducted by Sholichah et al. (2021), the results showed that most people infected with Leptospirosis engaged in activities in fields and at home. All patients had untreated or uncovered wounds, and they also had a history of contact with rats, which can be a source of Leptospira transmission to humans. This situation may arise due to the discovery of the Bandicota indica species of rats carrying Leptospira positive in the same area where the Leptospirosis patients were active.

Tanjung Perak Port in Surabaya plays a crucial role in gathering and distributing commodities to and from the Eastern Indonesia region, including East Java. This port also serves as a central connection point linking various islands in the Eastern Indonesia region. Additionally, at Tanjung Perak Port, there is the Terminal Gapura Surya Nusantara (GSN), the most luxurious sea passenger facility in Indonesia, connecting the city of Surabaya to other ports domestically and internationally (Pelindo, 2022).

This research aims to describe the species and gender of rats and analyze the results of Leptospira bacteria examination in rats captured at the GSN Terminal in Tanjung Perak Port, Surabaya. The findings of this research are expected to provide a better understanding of the role of rats in the transmission of leptospirosis in port environments, with significant implications for disease control and prevention actions.

METHODS

This study is a descriptive research with a cross-sectional design. The population in the study includes all rats at the GSN Passenger Terminal of Tanjung Perak Port, and the research sample consists of rats captured during the installation of life traps. The independent variables are the species and gender of the captured rats, while the dependent variable is the presence of Leptospira bacteria in the rats' kidneys. The samples were obtained by setting traps using salted fish as bait. The success of rat capture (trap success) is highly influenced by the type of bait used. The selection of salted fish as bait was made because it has proven to be more effective compared to other types of bait such as grilled coconut and fried food. Trap installation was carried out in the evening, precisely at 4:00 PM local time, and the traps were retrieved the next day between 6:00 AM and 9:00 AM. Traps that successfully caught rats were replaced with new traps filled with appropriate bait. During the research period, traps were set and monitored daily for five consecutive days. The results of rat capture, including species identification and the number of rat species, as well as gender identification and quantity, were recorded each day.

Subsequently, the captured rats underwent a surgical process to extract their kidneys. The kidneys were then sent

to the Vector and Disease Carrier Animal Laboratory Installation of the Environmental and Disease Control Engineering Institute (BBTKLPP) in Surabaya for Leptospira bacteria detection using the Real-Time Polymerase Chain Reaction (RT-PCR) method. The RT-PCR method for detecting Leptospira in rats was chosen for its advantages in sensitivity, specificity, speed, and ability to detect bacteria at low levels. Data on rat species, gender, and laboratory examination results were further analyzed using frequency distribution tables.

RESULTS AND DISCUSSION

Based on the data presented in Table 1, it is evident that three distinct species of rats were captured during the course of this study. These species are predominantly represented by Rattus norvegicus, followed by Rattus tanezumi and Mus musculus. Furthermore, a notable gender disparity is observable, with males constituting the predominant gender among the captured rats.

Rattus norvegicus, commonly referred to as the brown rat, is frequently encountered in urban drainage systems and sewers. Importantly, it serves as the primary reservoir of Leptospira bacteria, the causative agent of Leptospirosis, which can be transmitted to humans. This susceptibility arises from the presence of serovars carried by this rat species, including the potentially harmful ballum and autumnali serovars, as expounded upon by Priyambodo in his work titled "Integrated Rat Pest Control" (Afianto et al., 2021). The presence of Rattus norvegicus at Terminal GSN is likely influenced by the availability of water channels or sewers, which serve as their natural habitat, particularly along the boundary walls between the passenger terminal and the public road. Additionally, the presence of dense vegetation and soil conducive to nesting further contributes to their presence. The densification of vegetation, however, may elevate the risk of leptospirosis transmission, given the rat's role as the definitive host (Muthiadin and Purba, 2022). Moreover, the higher capture rate of Rattus norvegicus can be attributed to the strategic placement of traps outside buildings situated adjacent to drainage channels. This rat species exhibits peridomestic behavior, primarily conducting its daily activities, such as foraging, shelter-seeking, and nesting, outdoors (Wulandari, 2023).

Rattus tanezumi, commonly known as the house rat, exhibits a versatile habitat preference, ranging from primary forests and secondary forests to villages, plantations, office buildings, and human settlements. It is often classified as a commensal rat due to its predominant indoor activities. This species is prevalent in Indonesia, Malaysia, and Thailand and plays a significant role in leptospirosis transmission (Tolistiawaty, Hidayah, and Widayati, 2020). The presence of Rattus tanezumi at Terminal GSN can be attributed to its proximity to office buildings, which increases the likelihood of capture during food-seeking activities. Rats tend to migrate in search of food when faced with scarcity (Widjajanti, 2020).

Mus musculus, commonly referred to as the house mouse, is a rat species highly dependent on human activities and is typically found in homes, warehouses, or offices. These mice prefer dark and unclean environments such as roof spaces and wall crevices, often utilizing remnants of construction materials as shelter. They are also drawn to areas with readily available food sources (Husna and Chandra, 2021), such as food courts, and are frequently captured in locations accessible through holes, particularly those associated with drainage pipes leading to building roofs. Consequently, sealing holes within homes or buildings, particularly those with diameters exceeding 6 mm, is strongly recommended, as mice can utilize these openings as access points (Ristiyanto et al., 2014).

Regarding gender distribution, a higher number of male rats were captured in this study compared to females. Male rats tend to exhibit prolonged outdoor activity compared to their female counterparts, boasting greater mobility and a proclivity for exploring areas beyond their residence. Factors contributing to this disparity, as mentioned by Astuti (2012), include limited food availability and the pursuit of mates (Wulandari, 2023). It is important to note that these findings contrast with the results of the study conducted by Utama (2023), which reported a higher capture rate of female rats. This discrepancy may arise from the fact that female rats often leave their nests repeatedly in search of food during pregnancy and while nursing their offspring, rendering them more susceptible to capture (Utama, Suhartono, and Budiyono, 2023).

Table 1.
Distribution of Captured Rat Species and Gender

Rat Species	Gender				Total	
	Male		Female			
	N	%	N	%	n	%
Rattus norvegicus	12	85,7	2	14,3	14	70,6
Rattus tanezumi	2	100	0	0	2	11,8
Mus musculus	3	100	0	0	3	17,6
Total	17	89,5	2	10,5	19	100

Table 2.
Distribution of Captured Rat Species and Results of Rat Kidney Leptospira RT-PCR

Rat Species	RT-PCR Result				Total	
	Positive		Negative			
	N	%	N	%	n	%
Rattus norvegicus	3	21,4	11	78,6	14	70,6
Rattus tanezumi	0	0	2	100	2	11,8
Mus musculus	0	0	3	100	3	17,6
Total	3	15,8	16	84,2	19	100

Table 3.
Distribution of Captured Rat Gender and Results of Rat Kidney Leptospira RT-PCR

Rat Gender	RT-PCR Result				Total	
	Positive		Negative			
	N	%	N	%	n	%
Male	3	17,6	14	82,4	17	89,5
Female	0	0	2	100	2	10,5
Total	3	15,8	16	84,2	19	100

Table 2 provides a clear indication that the sole species confirmed to be positive for Leptospira bacteria is Rattus norvegicus. This outcome concurs with the findings of Wulandari (2023), who also reported the presence of Leptospira bacteria in Rattus norvegicus.

Rattus norvegicus has consistently emerged as the principal reservoir for leptospirosis (Boey, Shiokawa, and Rajeev, 2019). This predilection can be attributed, in part, to the heightened affinity of Leptospira spp. bacteria for specific receptors (PRRs) found within the kidneys of Rattus norvegicus. This affinity results in a diminished immune response, allowing for the persistence of Leptospira in this particular animal (Udechukwu et al., 2021).

Furthermore, the presence of stagnant water during the study period likely facilitated the transmission of leptospirosis among rats. Stagnant water has been recognized as a contributing factor to the dissemination of this disease, as previously noted by Kusmiyati et al. (2005) (Wulandari, 2023).

Research conducted by Izquierdo-Rodríguez et al. (2020) and Udechukwu et al. (2021) has consistently demonstrated a higher prevalence of leptospirosis in Rattus norvegicus compared to other rat species (Izquierdo-Rodríguez et al., 2020; Udechukwu et al., 2021). One contributing factor to this elevated prevalence of pathogenic Leptospira infection in Rattus norvegicus is their habitat, often characterized by high humidity and moisture levels, which create an environment conducive to the survival and proliferation of Leptospira bacteria (Sholichah, Wahyudi, et al., 2021).

Table 3 presents a noteworthy finding, indicating that male rats are the individuals confirmed to be positive for Leptospira bacteria. This observation could be attributed to the general tendency of male rats to engage in extended outdoor activities, surpassing the duration of such activities among female rats. Male rats exhibit heightened mobility and a greater propensity to explore areas beyond their nesting sites (Wulandari, 2023), thereby elevating their susceptibility to exposure to Leptospira bacteria in the surrounding environment.

The outcomes of this study diverge from those of prior research conducted by Wulandari (2023), which reported a higher prevalence of Leptospira bacteria in female rats. Female rats often assume the role of foraging for food for their offspring. Moreover, during periods of pregnancy and lactation, female rats frequently venture outside their nests in pursuit of nourishment (Ristiyanto et al., 2014). These behaviors potentially expose them to Leptospira bacteria in the environment. Female rats, due to their distinct behavioral patterns, are indeed at a heightened risk of infection by Leptospira bacteria, rendering them more susceptible to exposure (Desvars-Larrive et al., 2020).

LIMITATION OF THE STUDY

The research is constrained by its limited scope, primarily focusing on the rat population at the GSN Terminal of Tanjung Perak Port. As a result, its findings cannot be generalized.

CONCLUSION AND RECOMMENDATION

The captured rat species at the GSN Terminal of Tanjung Perak Port are predominantly Rattus norvegicus, followed by Mus musculus and Rattus tanezumi, with the majority being males. Leptospira bacteria have been confirmed in male Rattus norvegicus rats. Surveillance and control measures are necessary to address the rat problem and improve sanitation conditions by eliminating rat hiding places, cleaning the surrounding environment, and sealing rat entry points into buildings.

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Conflict of Interest Statement

The authors declare that they have no involvement with any external parties and this paper is purely from the sources listed in the bibliography and does not contain plagarism from any journal article. All sources of writing have been listed in the bibliography

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