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Identification of Risk Factors and Vaccine Efficacy for Lumpy Skin Disease in Sidoarjo and Blitar Districts of East Java, Indonesia

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ABSTRACT

Lumpy skin disease, also known as LSD, is a highly contagious and economically devastating transboundary disease that affects cattle and water buffaloes. This study aimed to identify the risk factors associated with lumpy skin disease outbreaks and evaluate the effectiveness of a potential vaccination for the condition in two districts (Blitar and Sidoarjo) of East Java. The data were gathered through questionnaires completed via personal interviews. The collected data encompassed demographic information, herd sizes, breeds, and other relevant factors that were present throughout LSD epidemics. Descriptive statistics and univariate logistic regression models were used to analyze the data. The findings revealed that keeping local breeds (P=0.043; OR= 0.19; CI=0.217–0.004), having a large herd size (P<0.001; OR=0.436; CI=0.406–0.163), not using a separate pen for the new cattle (P=0.001; OR=0.136; CI=0.136–0.562), presence of flies on the farms (P<0.001; OR=0.162; CI=0.081–0.325), selling of animals during the LSD outbreak (P=0.006; OR=0.232; CI=0.071–0.755), use of vaccine in the rainy season (P=0.027; OR=1.137; CI=1.018–1.269) and outdoor (grazing) (P=0.001) were significantly associated with the occurrence of LSD in the studied area. It was found that the wet season affects vaccine efficacy. The findings of the current study provide valuable preliminary information on the factors contributing to the spread of the disease and the effectiveness of the vaccine in controlling it, which can be used to develop effective control strategies and policies to minimize the impact of LSD on the livestock industry in Indonesia.

Key words: Risk factors; Efficacy; Lumpy skin Disease; Vaccine; Indonesia.

INTRODUCTION

Lumpy skin disease (LSD) is an economically significant and highly contagious viral disease of cattle and water buffaloes caused by the LSD virus, which is a Capripoxvirus (CaPV) of the Poxviridae family (Tuppurainen et al. 2012a; Uddin et al. 2022). Cattle of all ages and breeds are equally susceptible to LSD, having a high morbidity and low mortality rate; however, newborn animals and lactating cows are particularly vulnerable (Lubinga et al. 2013a; Khan et al. 2022). The disease appears and spreads to several biological and climatic regions, particularly Africa, Asia, the Middle East, and Europe (Alkhamis and VanderWaal 2016; Tasioudi et al. 2016). The season (primarily the rainy season), the introduction of additional animals into the herd, and community grazing and watering places have all been identified as risk factors for the incidence of LSD (Gari et al. 2015; Sameea et al. 2017; Allepuz et al. 2019). LSD was designated as a notifiable illness by the Office International des Epizooties (OIE) due to its potential for rapid dissemination and the possibility of causing significant financial losses (OIE 2016).

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LSD can be transmitted through direct contact with infected animals, as well as through insect vectors such as mosquitoes and flies. Different types of flies have been considered active carriers by a few researchers to transmit the disease (Mekuria and Gadissa 2011; Hailu et al. 2015) but the virus can also be spread through the movement of of infected animals from one location to antoher. Environmental factors such as humidity and rainfall can also facilitate disease spread. The potential role of ixodic ticks in the transmission of LSDV was documented in a recent study (Tuppurainen et al. 2011; Bianchini et al. 2023). The insect vector may be negatively impacted by weather changes such as cold and infected saliva may help the disease spread (Susanti et al. 2023).

The clinical manifestations of the disease range from acute to subclinical (Al-Salihi 2014). The clinical forms of LSD include fever, inappetence, widespread skin nodules, enlarged lymph nodes, emaciation, decreased milk production, and abortion. The mouth, trachea, larynx, and esophageal mucous membranes may develop ulcerative ulcers in severe cases (Assenga et al. 2016). The virus that causes lumpy skin can survive for up to six months under ideal conditions, such dark animal enclosures; nevertheless, it is vulnerable to a variety of chemicals and sunlight.

In Indonesia, LSD is a significant problem, particularly in the East Java province, where large numbers of cattle are raised. The disease was first detected at the beginning of 2022 on the island of Sumatra and later on spread in different parts of the country rapidly in a short period of time. As a result of the ongoing outbreak, more than 22000 animals in 13 provinces in Indonesia have been infected with LSD. This disease is linked to reduced milk production, traction loss of energy, loss of weight, poor growth, abortion, infertility, and skin injury, all of which contribute to economic losses. Pneumonia is a common consequence of lesions of the pharynx and respiratory tract in animals (Ahmed and Zaher 2008; Gari et al. 2011). In endemic LSD-affected countries, LSD has been prevented and controlled by utilizing easily accessible attenuated vaccination (Moudgil et al. 2024). A survey of the risk factors for the occurrence of LSD and the effectiveness of its vaccine in selected districts of East Java, Indonesia, would be beneficial in controlling the spread of the disease. The risk factors associated with the occurrence of LSD include the following 1) Contact with infected animals: Direct contact with infected animals is the primary mode of LSD transmission, 2) Insect vectors: Insects, particularly mosquitoes and flies, can transmit viruses from infected to healthy animals, 3) Movement of animals: The movement of infected animals from one location to another can spread the disease, 4) Environmental factors: Environmental factors such as high humidity and rainfall can facilitate the spread of disease and 5) Lack of vaccination: Lack of vaccination against LSD can contribute to the spread of the disease. The effectiveness of the LSD vaccine in controlling the spread of the disease is well documented. However, vaccine's effectiveness can be influenced by several factors, including 1) Vaccine quality: The quality of the vaccine can affect its effectiveness, 2) Timing of vaccination: The timing of vaccination is critical for ensuring the effectiveness of the vaccine, 3) Vaccination coverage: The effectiveness of a vaccine is dependent on the vaccination coverage in the population, and 4) Animal immunity: An animal's immune system response to a vaccine can affect its effectiveness.

To the best of our knowledge, this is the first study carried out in Indonesia to evaluate the factors that lead to the occurrence of LSD in the study areas and to examine the effectiveness of its vaccination. In 2022, an epidemic of LSD was identified in all districts of the province, which could be caused by a number of factors such as weak biosecurity measures, poor husbandry skills, and a lack of vaccine for the newly emergent disease. Thus, it is vital to identify the risk factors that may be linked to LSD and develop effective LSD preventive and control measures at the national and international levels.

MATERIALS AND METHODS

Ethical approval

This research was given the go-ahead by the Animal Care and Use Committee of the Faculty of Veterinary Medicine at the University of Airlangga in Surabaya, as shown by the approval letter number 4.KE.096.03.2023.

Study area

The study was conducted in two (2) districts (Sidoarjo and Blitar) of East Java province, Indonesia. In the studied areas, cattle were raised using natural grasses and agricultural leftovers that were maintained under the conventional management approach.

Study design and population

A cross-sectional study was carried out to analyze the risk variables for LSD occurrence in the study area, as well as the efficacy of vaccines. In collaboration with the corresponding district livestock and dairy development departments, two (2) districts (Sidoarjo and Blitar) in East Java were chosen using a random sampling approach.

Sampling technique and sample size determination

A random sampling technique was adopted to pick livestock owners for the survey. The sample size was calculated using the Raosoft online calculator (Raosoft 2004), which is designed for population surveys and determines the number of responses needed to attain the chosen confidence level with a margin of error typically 5%. The recommended sample size for livestock owners using Raosoft’s method in the two districts was 108.

Questionnaire survey

Farmers (n=108) completed the questionnaires. The native language of Indonesia, "Bahasa” was used to complete the questionnaire during face-to-face interviews. The required data were collected using 20 major questions. The survey questionnaire included questions about the socioeconomic status of the farmers, potential risk factors, and the effectiveness of vaccination. As an additional measure, we directly asked them about the signs and symptoms of the disease. Finally, important data were gathered through questionnaires from randomly selected farmers in the pertinent districts. Each participant was given a brief overview of the study's purpose before obtaining verbal informed consent and completing the questionnaire.

Control and regulating data quality

After reviewing the literature, a standardized questionnaire format was carefully developed to ensure data quality. To increase the quality of the responses and lower the margin of error among the respondents, the questionnaire was originally created in English and then translated into the native language (Bahasa Indonesia) by experts. The primary investigators and local veterinary officers of the relevant districts kept an eye on the quality of the data collected throughout the process. Cross-checking of a few filled-out questionnaires were performed and necessary corrections were made.

Management and analysis of data

The collected data were entered into Excel and then transferred to SPSS version 25 for analysis. To determine the proportions of these parameters in relation to the occurrence of LSD, descriptive statistics such as percentages were computed as applicable. Factor-related outcome variables were evaluated as required. Independent variable(s) were included in univariate logistic regression models, with 95% confidence intervals. For statistical analysis, the threshold level of significance was fixed at 0.05.

RESULTS

Two districts in East Java (Blitar and Sidoarjo) were selected and 108 livestock owners were interviewed randomly. Compared to Sidoarjo (Table 1), more respondents were participated from Blitar district (P<0.05; OR=12.7; CI=1.598-1.598).

Table 1: Participants (n=108) in the study assigned to districts

Districts	Numbers of respondents	Percentage	P-value	OR	95%CI
Blitar	58	53.7	0.003	12.7	1.598-2.627
Sidoarjo	50	46.3			

Regarding socio-demographic variables, the study also took into account the respondents' gender, age, level of education and economic status (i.e., occupation). The majority of the participants were male (87.96%), aged over thirty (87.04%), possessed a high school education (46.29%) and depended on cattle for their livelihood (53.7%). Statistically significant differences (P<0.05) were observed in this study between male participants and those who had previous experience working with animals (Table 2).

Based on the findings in Table 3, the results of the univariable analysis show strong statistical evidence suggesting that indigenous breeds (P<0.043) and with larger herd size (P<0.001) are significantly associated with the existence of LSD in the analyzed area. Table 4 provides an overview of the several characteristics that could be considered potential risk factors for an LSD outbreak.

The results of the univariable analysis revealed that there was a significant association (P<0.05) between the presence of LSD in the studied area and not keeping new animals in separate pens, the presence of flies on farms (Fig. 1), the selling of new animals during the LSD epidemic, the failure to isolate sick animals in separate pens, and the vaccination of animals against LSD during the rainy season. There was no significant correlation between the LSD vaccine and the onset of the sickness, according to the majority of participants (96.29%), who admitted that the vaccine was beneficial against the condition.

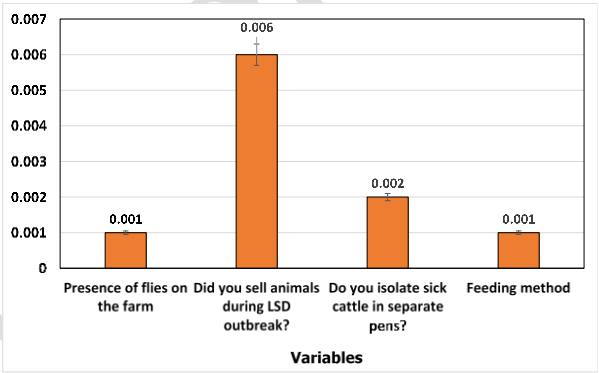

Fig. 1: Variables of lumpy skin disease with significant P value with LSD in multivariable analysis. 1) Presence of flies on the farm, 2) Did you sell animals during LSD outbreaks, 3) Do you isolate sick cattle in separate pens? and 4) Feeding methods.

DISCUSSION

LSD has been categorized as a transboundary animal disease owing to the intensity of the losses it causes, its propensity to spread to adjacent countries, and its considerable effects on trade and food availability (Rossiter and Al Hammadi 2009). This study is the first to document the occurrence of LSD in East Java, Indonesia.

Table 2: Demographic characteristics of the respondents (n=108)

Demographic variables	Categories	Districts		Frequency No. (%)	P-value/ OR	95%CI
		Blitar (n=58)	Sidoarjo (n=50)	n=108		
Gender	Male	46	49	95 (87.96)	0.003/0.286	0.156-0.722
	Female	12	1	13 (12.04)		
Age	Young 15-30 years	9	5	14 (12.96)		
	Adults > 30 years	49	45	94 (87.04)	0.399/0.082	0.406-0.163
Level of education	No School	1	3	4 (3.7)		
	Primary	4	6	10 (9.3)		
	Middle	19	12	31(28.70)	0.795/0.260	0.086-0.112
	High	30	20	50 (46.29)		
	Bachelor	3	9	12(11.11)		
	Master	1	0	1 (0.9)		
Occupation	Livestock only	16	42	58 (53.7)		
	Mixed agriculture	42	8	50 (46.3)	<0.001/0.564	0.405-0.723

OR=Odd ratio; Cl=Confidence interval; >=Large than.

Table 3: Univariable analysis of type of cattle and herd size with occurrence of lumpy skin disease

Parameters	Categories	Districts		Frequency N0. (%)	P-value/ OR	95%CI
		Blitar (n=58)	Sidoarjo (n=50)	n=108		
What type of cattle you have?	Local	46	29	75 (69.44)	0.043/ 0.195	0.217-0.004
	Exotic	0	4	4 (3.7)		
	Crossbreed	12	17	29 (26.86)		
Herd Size	Large (>10)	0	21	21 (19.4)	<0.001/0.436	0.406- 0.163
	Medium (1-9)	18	8	26 (24.1)		
	Small (1-3)	40	21	61 (56.5)		

OR=Odd ratio; Cl=Confidence interval; >=Large than.

Table 4: Univariable analysis of risk factors for the occurrence lumpy skin disease

Variables	Response	Districts		Frequency No. (%)	P-value/OR	95%CI
		Blitar (n=58)	Sidoarjo (n=50)	n=108		
Did you buy cattle in the last month?	Yes	5 (8.6)	9 (18)	14 (12.96)	0.148/2.008	0.749-
	No	53 (91.4)	41 (82)	94 (87.04)		5.824
Did you adapt the environment in a separate pen to the cattle you just bought?	Yes	17 (29.31)	2 (4)	19 (17.59)	0.001/0.136	0.136-
	No	41(70.68)	48 (96)	89 (82.41)		0.562
Presence of flies on the farm	Yes	50 (86.2)	7 (14)	57 (52.78)	<0.001/0.162	0.081-
	No	8 (13.8)	43(86)	51 (47.22)		0.325
Did you know that the animal market is a source of transmission of LSD?	Yes	40 (68.96)	29 (58)	69 (63.89)	0.237/0.841	0.628-
	No	18 (31.03)	21 (42)	39 (36.11)		1.127
Did you sell animals during LSD outbreak?	Yes	43 (74.13)	3 (6)	46 (42.59)	0.006/0.232	0.071-
	No	15 (25.86)	47 (94)	62 (57.41)		0.755
Do you isolate sick cattle in separate pens?	Yes	25 (43.10)	2 (4)	27 (25)	<0.001/0.093	0.023-
	No	33 (56.89)	48 (96)	81 (75)		0.372
Feeding method	Outdoor (grazing)	29 (69)	13 (31)	42 (38.89)	0.001	N/A
	Indoor (Stall feeding)	20 (36)	35 (64)	55 (50.93)		
	Both	9 (82)	2 (18)	11 (10.19)		
At which season do you vaccinate your animals?	Rainy season	50 (51)	49 (49)	99 (91.66)	0.027/1.137	1.018-
	Dry season	8(89)	1 (11)	9 (8.34)		1.269
Do you think that the LSD vaccine (lumpy skin disease) in cattle is quite effective?	Non-Effective	3 (75)	1 (25)	4 (3.71)	0.384/0.387	0.042-
	Effective	55 (53)	49 (47)	104 (96.29)		3.601

OR=Odd ratio; Cl=Confidence interval; >=Large than.

The purpose of this questionnaire study was to determine important risk variables associated with the occurrence of LSD and assess the effectiveness of a vaccine against Lumpy Skin Disease (LSD) in two administrative districts (Blitar and Sidoarjo) of East Java, Indonesia. Blitar had a higher proportion of respondents (53.7%) than Sidoarjo district (46.3%) and the study was significantly greater (P=0.003, OR=12.7, CI=1.598-2.627) in Blitar than in Sidoarjo district (Table 1).

According to reports (Ali et al. 1990; Tuppurainen et al. 2012b), the spread of the disease is primarily caused by the presence of insect vectors, host vulnerability, livestock density in feeding and watering areas, husbandry practices, rainy seasons and agro-ecological conditions, presence of moisture, relative humidity, marketplace conditions, and the unchecked introduction of new animals.

According to the findings of current study most of (87.96%) the respondents were men having age >30 years. Based on their education, 46.29% had completed high school, while only 0.9% had received a master's degree. In addition, 53.7% practiced mixed agriculture, while 46.31% exclusively practiced livestock.

Our findings were consistent with the findings of Abera et al. (2015), who stated that the majority of participants in Gimbi and Lalo Assabi districts of West Wollega were males, adults, and working in mixed agriculture (Abera et al. 2015).

The findings of current study revealed that keeping local breeds with larger herd sizes were significantly associated with the occurrence of LSD in the studied area.

Our findings were consistent with a study published by Ochwo et al. (2019) in Uganda, which found that native breeds have a higher risk of LSD incidence (Ochwo et al. 2019). In contrast, Molla et al. (2017), Davies (1991) and Abera et al. (2015) discovered that the prevalence of LSD and mortality loss was higher in exotic crossbreeds than in native breeds.

According to our findings, 52.78% of the respondents claimed to have observed flies on their farms, which was significantly linked (P<0.001) to the occurrence of LSD in East Java. Our findings are consistent with previous research indicating that blood-feeding mosquitoes, biting flies, and certain parasite species (Lubinga et al. 2013b; Rouby et al. 2017; Sohier et al. 2019) are significantly associated with the occurrence of LSD.

The current study found that selling animals during an LSD outbreak had a significant association (P=0.006; OR=0.232 Cl=0.071-0.755) with the outbreak of LSD in the assessed area. These findings were in line with the findings of previous studies (Gari et al. 2010; Salib and Osman 2011; Kiplagat et al. 2020; Issimov et al. 2022). Through the current analysis, it was discovered that there exists a noteworthy correlation (P<0.001 OR=0.093 Cl=0.023-0.372) between the failure to isolate sick animals in separate pens and an increase in the number of cases of LSD. Isolating sick animals, restricting the movement of infected cattle, and outlawing the cow trade have all been shown to reduce the occurrence of disease in prior study by (Sudhakar et al. 2020).

In this study, approximately 91.66% of the participants reported that their cattle had received LSD vaccination during the rainy season. However, a significant correlation (P=002) was found between LSD occurrence and vaccination during the rainy season in both districts, indicating that the vaccine was ineffective. In previous studies, the most effective technique for reducing LSD in both endemic and non-endemic areas was vaccination (EFSA 2019; Dubie et al. 2022).

According to our findings, more respondents (50.93%) claimed that they practiced indoor feeding, which was significantly correlated (P=0.001) with the presence of LSD in both districts (Table 4). These findings were similar to those reported by various researchers regarding watering stations, grazing plots, and post-harvest areas that are shared between herds (Chihota et al. 2011) and enhance the likelihood of exposure to LSD (Waret-Szkuta et al. 2011).

Conclusion

In conclusion the results of this study indicate that farm with local breeds, larger herd size, presence of flies, failing to adopt a separate pen for newly purchased cattle, selling animals during an LSD outbreak, mixing sick and healthy animals and outdoor (grazing) feeding of cattle were the main risk factors that were significantly associated with the occurrence of LSD in this study. Additionally, the results showed that vaccinations during rainy seasons reduce vaccine effectiveness and raise the likelihood of LSD occurrence in the research area. Furthermore, the potential role of insect vectors, such as ixodic ticks in the transmission of LSDV should be further studied to better understand and combat the disease. Overall, a comprehensive approach is necessary to effectively control and prevent the spread of LSD in East Java, Indonesia and other regions affected by this disease.

Author's contribution

Conceptualization: Rehman S, and Abuzahra M; Data curation: Rehman S, Abuzahra M, Wibisono FJ and Effendi MH; Formal analysis: Rehman S, Abuzahra, and Rahman A; Funding acquisition: Effendi MH and Rehman S; Investigation: Rehman S, Abuzahra M, Wibisono FJ, Effendi MH and Rahman A; Methodology: Rehman S, Abuzahra M, Wibisono FJ and Effendi MH; Project administration: Rehman S and Effendi MH; Resources: Rehman S, Abuzahra M, Wibisono FJ and Effendi MH; Supervision: Effendi MH and Rehman S; Validation: Rehman S, Abuzahra M, Wibisono FJ and Effendi MH; Writing - original draft: Rehman S, Abuzahra M, Wibisono FJ and Effendi MH; Writing - review & editing: Rehman S, Abuzahra M, Wibisono FJ, Effendi MH, Abubakar AA, Shah MK , Khan MS, Ullah S, Malik MI, Zaman A and Rahman A,

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Conflict of Interest

The authors have declared no hidden potential conflict of interest

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