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Research article

SPATIOTEMPORAL ANALYSIS OF LUMPY SKIN DISEASE IN TÜRKİYE (2013-2021)

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Lumpy skin disease (LSD) is a serious, transboundary disease that affects cattle all over the world and results in considerable productivity losses. Although Türkiye's first outbreak of LSD was reported in August 2013, there is very little information available about the outbreak's spatiotemporal distribution or severity. GIS-based data analysis provides crucial tools for describing the spatial epidemiology of the disease by assessing the spatial distribution of LSD across time. This study used information on outbreaks reported to the the World Animal Health Organization (WOAH-OIE) between 2013 and 2021 to conduct a retrospective study on the epidemiology of LSD in Türkiye. Differences in the number of reported outbreaks and cases across different regions, provinces, months, and years were evaluated and descriptive statistics were calculated. In addition, spatial statistical tests (Local Moran's I and Getis-Ord Gi*) and Geographical Information Systems (GIS) were used to assess LSD outbreaks that had taken place at the province level in Türkiye. Possible epidemiological clusters of LSD were identified. A total of 1787 outbreaks and 10109 cases of LSD were reported from 75 out of 81 provinces of Türkiye during the course of the nine-year period. Hotspots for the circulation of LSD were identified in the Aegean, Southeastern and Eastern regions using spatial cluster analyses and it was observed that the spatial autocorrelation of LSD cases is positive across the country. The findings from this study, it may help us comprehend the disease's spatial character and offer authorities the beneficial information for surveillance efforts.

Keywords: Cluster analysis, Epidemiology, Lumpy skin disease, Outbreak, Spatial analysis, Türkiye.

INTRODUCTION

Lumpy skin disease (LSD) is a transboundary viral disease that affects cattle and water buffalo and some animals in the wild are vulnerable to the disease [1,2]. Despite the disease incidence being quite high and sometimes reaching 100%, the death rate is low, often under 5%, but can occasionally approach 20% in severe circumstances [3]. It is brought on by the LSD virus, which belongs to the genus Capripoxvirus,

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family Poxviridae [4,5]. Production of cattle is seriously impacted by the disease and it frequently spreads in outbreaks [6]. All cattle are at risk of infection, and calves and cows towards the height of their lactation are especially vulnerable [7]. Unfortunately, the disease did not remain constant in Zambia with its place of origin, and has spread to most of the African countries, the Middle East countries and more recently European countries. The possibility exists that LSD might ultimately spread globally [8-11]. Acute or subacute forms of the disease are characterized by fever, increasing nasal discharge, enlarged lymph nodes, formation of nodules on the skin, mucosal membranes and interior tissues, damaged skin, and at times death [12,13].

The first LSD outbreak in Türkiye was seen in August 2013. Since the majority of outbreaks in Türkiye occurred in the eastern portion of the southern border with Syria and Iraq, LSD possibly migrated from those two countries to Türkiye [14,15]. Live cattle from LSD affected provinces were transported throughout the country in significant numbers between 2013 and 2014 and LSD spread rapidly within the country, especially in 2014. This occured especially before Eid al-Adha, when live animals are transported from cattle-rearing regions, such as central and eastern Türkiye, to major urban areas west of the country [16,17]. This situation emphasizes how critical it is to implement movement limitations as soon as LSD cases are discovered to be able to stop the disease from spreading [16].

The recent LSD outbreaks put the security and steady expansion of the global cattle industry in peril. Geographical information systems (GIS) are utilized in this study to evaluate the disease patterns of LSD because of their spatial analysis and appearance capabilities. This approach helps to make geographical and temporal linkages that are hard to see in other data display forms. Animal disease risk investigation has recently used GIS spatial analysis more and more [18-21].

Important knowledge on the worldwide condition and regional or national situation of LSD outbreaks, the epidemiology and etiology of LSD in many countries and the spreading of LSD from Africa to the whole world has been published in a number of scientific articles [7, 22-25]. However, just some of the papers have discussed the spatial clustering of LSD occurrences, and no investigation of outbreak clustering was observed using Moran's I and Gi* statistical methods. Furthermore, there is inadequate research using clustering methods for spatial clustering of LSD reports. In accordance with this knowledge, the aim of this study is to evaluate the LSD clusters within the Turkish provinces and determine how the clustering pattern has advanced as a result of the nation's controlling approach. It is also possible to evaluate the overall progression of the disease in Türkiye from its emergence until its eradication.

MATERIAL AND METHODS

Data collection and preparation

Study area

This study was done in Türkiye. Between Asia and Europe, it serves as a bridge. There are 81 provinces in Türkiye. It is a country with 85,279,553 population and a land area of 780,580 km^2. Aegean, Black Sea, Central Anatolia, Eastern Anatolia, Marmara, Mediterranean and Southeastern Anatolia are the seven geographical divisions of the country.

Data sources

Geographic data displaying province borders and data on LSD outbreaks by province were used in this study. Data on LSD outbreaks used in this study includes the number of cases and outbreaks brought on by the annual LSD reported by the World Animal Health Organization (WOAH-OIE) between 2013 and 2021 in Türkiye. Geographic data (Türkiye province administrative borders) is represented using polygon shape and and is made up of 81 province boundaries.

Data analysis

Descriptive analysis

The proportions of LSD outbreaks and cases, calculated by month, season, and year, with corresponding 95% CI (confidence intervals) are summarized in Table. The IBM SPSS version 23 software was used to process the data. The incidence rate was computed for cases per 10000 livestocks in the country. LSD data created in Excel format were converted to CSV format. shp extension file of provincial administrative borders and LSD data converted to CSV format were joined. In the following stage, spatial maps of the incidence of LSD were created using GIS and the spatial extent of LSD was evaluated. The software used in this study was GeoDa 1.14 and QGIS 3.18.

Exploratory spatial data analysis

Exploratory Spatial Data Analysis (ESDA) offers methods for exploring spatial clusters, identifying outliers, and visualizing and explaining the spread of data. Observing the spatial pattern of LSD incidence and its alteration over the years can be accomplished by analyzing and evaluating clustered locations. ESDA was applied to identify changes in LSD between provinces. Due to this, spatial cluster analysis using GIS was carried out in the study. The geographic distribution of the clusters was determined using the

Local Moran's I and the suitable spatial distribution of hot and cold areas using the Getis-Ord-Gi* statistic [26,27].

Spatial weight matrix was employed in spatial data analysis to ascertain interplay between the locations under study. The spatial relationship of 81 provinces was illustrated using the weight matrix shown below:

$$W = \begin{bmatrix} \omega_{1,1} & \cdots & \omega_{1,81} \\ \vdots & \ddots & \vdots \\ \omega_{81,1} & \cdots & \omega_{81,81} \end{bmatrix}$$

$\omega_{i,j}$, reflects the connection among the provinces i and j, i, j =1,2, …, 81. In this study queen contiguity matrix was used [26, 28].

The Local Moran's I statistic aims to calculate the strength for every parameter pattern. It analyzes the heterogeneity in the study area to identify local clusters and outliers. Outliers that are statistically significant may be accompanied by high or low values. P values must be sufficiently low to qualify as statistically important for the cluster or outlier [29]. Moran's I statistic was used to evaluate the spatial autocorrelation features of LSD. The Moran's I statistic shown below:

$$I_i = n \times \frac{x_i \sum_{j=1}^{n} W_{ij}\left(x_j - \bar{x}\right)}{\sum_{j=1}^{n}\left(x_j - \bar{x}\right)^2}$$

I_i, local spatial autocorrelation measure; n indicates the number of features representing provinces; x_i and x_j are the values of the variable of at provinces i and j; $W_{i,j}$ the matrix of spatial weight. The range of Moran's I value is from – 1 to +1. When this value is near to zero, it means the cluster test's distribution is randomly. When this value is zero, since there is no spatial autocorrelation, the spread of each province that makes up the study is random and there is no cluster in the relating area. If this value is 1, it denotes a excellent positive correlation in which values that are similar to one another cluster or interact. If this value is – 1, there is a excellent negative correlation resulting in clustering of different observations. Provinces of high and low value are classified together in this situation [28].

Another widely used analysis for measuring local spatial autocorrelation is the Getis-Ord Gi * [30,31]. For the purpose of identifying the hot and cold spots of LSD, the Gi * statistic was computed. Gi * statistic shown below:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{ij}x_j - \bar{x}\sum_{j=1}^{n} w_{ij}}{S\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{ij}^2 - \left(\sum_{j=1}^{n} w_{ij}\right)^2\right]}{n-1}}}$$

RESULTS

Descriptive statistics

In total, 75 provinces reported 1787 LSD outbreaks and 10109 LSD cases during the course of the nine-year period. The largest number of LSD cases were registered in the month of August (19.86%) and during the summer season (52.26%). The Aegean region had the highest percentage of reported cases (29.00%) and the Marmara region had the lowest percentage of reported cases (4.17%), but the Central Anatolia region had the highest percentage of recorded outbreaks (23.78%) (Supplementary Table 1). Distribution of LSD outbreaks and case numbers by region between 2013-2021 is presented (Supplementary Table 2).

When the epidemic reports were evaluated, it was determined that LSD was documented between 2013-2021 and the last single outbreak was seen in February in 2021. It was determined that the incidence rate varied, but decreased after 2019 (Figure 1). The incidence rate was computed for cases per 10000 livestock in the country.

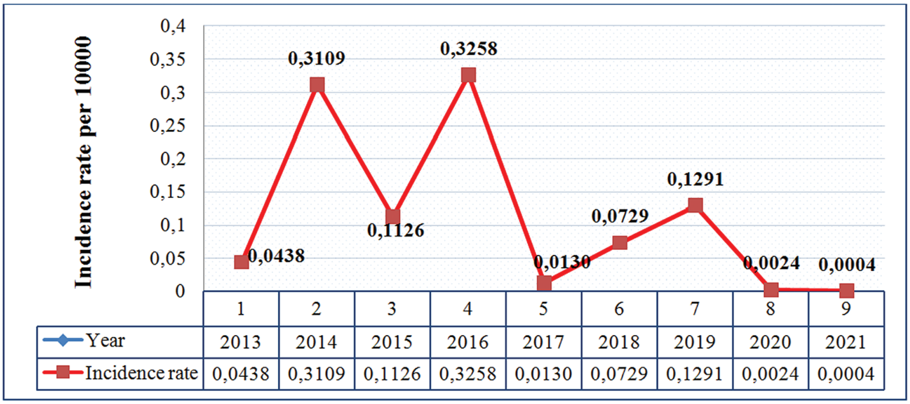

Figure 1. The trend of the incidence of LSD in Türkiye from 2013 to 2021.

Spatial statistics

The thematic maps were created by using QGIS software. The thematic maps display the incidence of LSD in the provinces between 2013 and 2021 (Figure 2).

This study investigated whether there is a spatial correlation in LSD cases in Türkiye. Moran's I measurements were made for the relevant time periods to assess the association between the number of LSD cases in each province and the number of cases in provinces adjacent (Figure 3). Figure 3 depicts the correlation between the number of LSD cases in each province (represented on the x-axis) and the number of LSD cases in neighboring provinces (represented on the y-axis) for the periods (2013–2015, 2016–2018, 2019–2021 and the entire period). The entire time periods' Moran's I indices are all higher than 0, as seen in Figure 3. The calculated Moran's I were 0.100 (Z-score = 1.7988, p = 0.06), 0.330 (Z-score = 6.7877, p = 0.001), 0.106 (Z-score = 1,7647, p = 0.05) and 0.130 (Z-score = 2.3544, p = 0.03) respectively, in 2013-2015, 2016-2018, 2019-2021 and entire period indicating clearly clustering of LSD cases. On the basis of LSD cases, there is therefore a spatial association between province and its neighboring provinces.

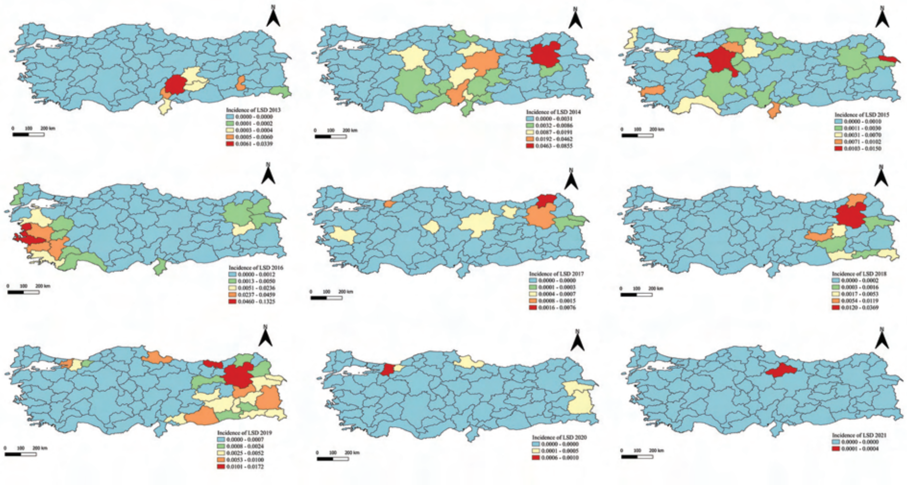

Figure 2. The incidence of LSD in provinces in Türkiye from 2013 to 2021.

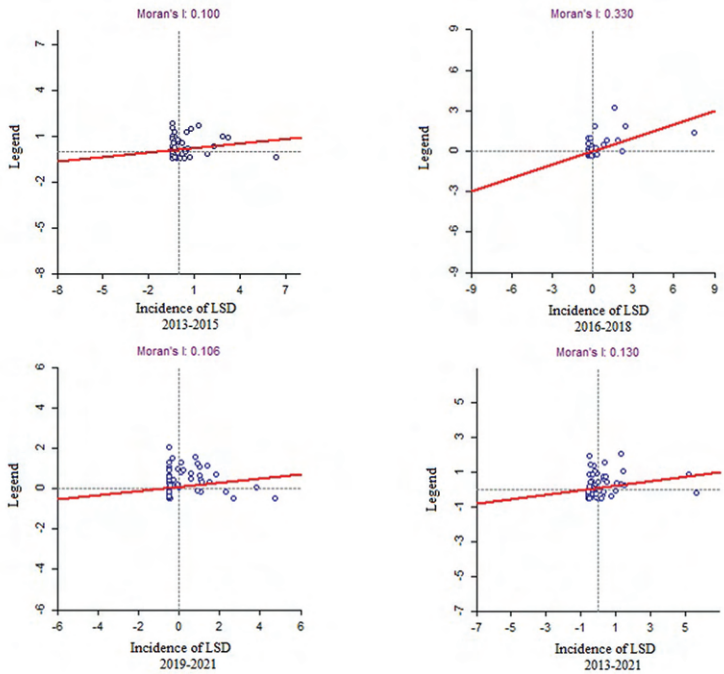

Figure 3. Moran scatter plots of LSD for 2013-2015, 2016-2018 and 2019-2021 in Türkiye.

Local Indicators of Spatial Association (LISA) was done on LSD case data for Türkiye provinces for the four periods (2013-2015, 2016-2018, 2019-2021 and entire period) (Figure 4). High-high cluster is displayed in red and reflects high numbers of cases in a province containing high numbers of cases in neighboring provinces, low-low cluster is displayed in dark blue and reflects low numbers of cases in a province containing low numbers of cases in neighboring provinces, high-low outlier is indicated in pink and reflects high numbers of cases in a province containing low numbers of cases in neighboring provinces, low-high outlier is indicated in light blue and reflects low numbers of cases in a province containing high numbers of cases in neighboring provinces.

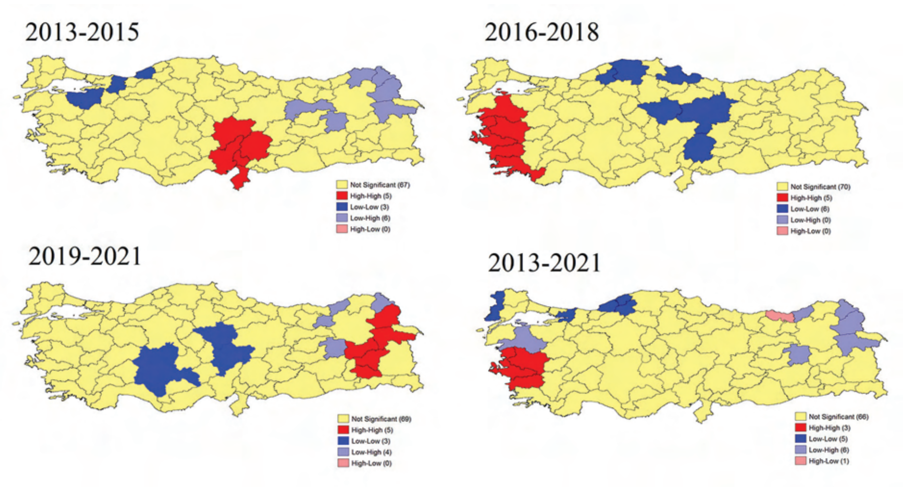

Figure 4. Spatial clustering and outliers of LSD using LISA clustering for 2013-2015, 2016-2018, 2019-2021 and the entire period.

For the purpose of locating LSD hot and cold regions, the Gi* statistic was computed. The Gi* uses the information from every province affected by LSD to examine the local situation and compare it to that of the provinces surrounding. Based on data from 2013 to 2021, Gi* clusters illustrate the risk of LSD. With a 95% confidence level in this study, clustering of cold spots and hot spots were identified in Türkiye (Figure 5).

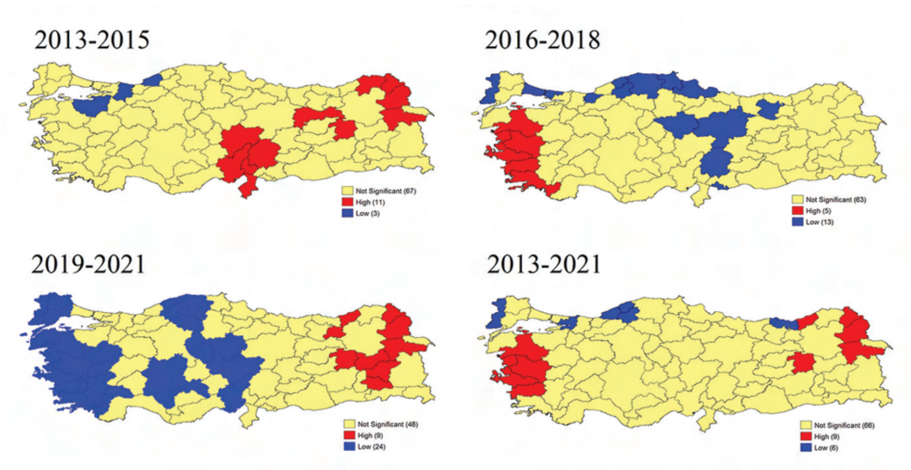

Figure 5. Cold-hot spots of LSD using Gi* statistic for 2013-2015, 2016-2018, 2019-2021 and the entire period.

DISCUSSION

This study indicates the epidemiologic assessment of LSD in Türkiye after the discovery of LSDV in 2013. Türkiye sent a total of 1787 notifications to the WOAH-OIE between 2013 and 2021: 18 in 2013, 784 in 2014, 510 in 2015, 221 in 2016 and 17 in 2017, 51 in 2018, 180 in 2019, five in 2020, and one in 2021. In this study Moran's I statistics and hotspots for LSD in Türkiye were explained for the first time using nine years of passive surveillance information. High-high and low-low clusters, and hotspots were identified.

The main objectives of this study are to locate the clusters, assess how the planned eradication strategy affects the spread of the disease and to identify the spatial pattern of LSD cases at the province level in Türkiye. As far as I'm aware, this study is the initial study to have ever been conducted in Türkiye that used Moran's I and Gi* statistics to explore spatial patterns.

In the study, Moran's I coefficients were calculated first in order to analyze the relationship between LSD cases in any province and LSD cases in neighboring provinces. Spatial autocorrelation indicates whether LSD numbers are associated with close locations. Accordingly, it was observed that the spatial autocorrelation of LSD cases is positive across the country. Moran's I values for LSD were recorded in the range of 0.100–0.330, confirming the presence of spatial structure. Changes that occurred during the observed period in Türkiye have similarly closely coincided with the Moran I findings. The entire country exhibits a spatial pattern in accordance with the Moran's I values.

Across the country, local clusters and outliers can be found using local spatial autocorrelation analysis. In this study, high-high cluster counts remained constant over the three periods, while local correlation features altered spatially over time. In the first period examined most of the first outbreaks in Türkiye, high-high clusters were observed in the southern provinces on the Syrian border. A similar result was reported by EFSA report. According to reports, the main channel for LSD to spread was through the vast border crossing of animals from Syria and Iraq to Türkiye. There were intense live animal movements from East Africa to Palestine, Jordan and Arabia in 2008-2013. From these countries, it was seen that there are animal movements towards Syria, Iran and Iraq, which have land borders with Türkiye. It was stated that there was a high amount of animal movements, especially shortly before the feast of sacrifice, and the risk of transmission of infectious diseases between countries increased [32]. High-high clusters were observed to west of the country between 2016 and 2018 and to east of the country between 2019 and 2021. The reason for this may be that immigrants dealing with livestock move to the highlands in the summer and to the pastures in the winter and carry the disease to the east. Because, live cattle animal movements frequently influence distribution of LSD outbreaks [10]. Also, throughout the years 2016 to 2018, as well as 2019 to 2021, low-low clusters were observed through the country's interior and north. High-high clusters were changed places from the Southeastern to the Aegean and Eastern Anatolia regions, in that order. As a result, clustering were observed these regions. Similarly, in another study evaluating LSD in Türkiye based on cluster analysis, clustering was reported in the Aegean, Southeastern and Eastern regions between 2013 and 2017 [33].

LSDV can be transmitted mechanically from infected animals to healthy individuals via blood-feeding arthropod vectors [15]. The vast majority blood-sucking insects are capable of flying up to 100 meters when there is no airflow motion [34]. But, as the virus frequently survives in the insect's mouth parts, the direction of the wind and strength can enable the LSD virus spreading across kilometers after insects' motion [35,36]. In 11 provinces emerged hot spots between 2013 and 2015, according to the hot spot analyses' findings. During the years 2013 to 2015, hot spots concentrated in the provinces along the country's southern and northeastern borders. Between 2016 and 2018, hotspots observed in the west of the country. Once again, the Eastern region and northeastern borders were home to the hotspots between 2019 and 2021. However, an increase in cold spots was observed in tthe country's inner and western regions. In this context, the positive effect of control strategy was seen.

LSD spreading exhibits a notable seasonal trend [37]. Between 2013 and 2021, most of the LSD outbreaks in Türkiye happened mostly in the late summer and early autumn seasons, with most epidemic peaks observing in August. This time interval is the period when there are suitable climatic conditions for the proliferation of vectors that play a role in the transmission of the disease. Arthropods are more likely to thrive and survive in a warm climate [3]. However, it was observed that LSD outbreaks were also detected in the winter season when the vector activity was not high. This is in line with existing understanding of the virus lengthy lifespan in living tissues, its ability to survive the winter in ticks, and the possibility that unchecked animal movements can cause LSD outbreaks to persist all year long [33,38].

For the control of LSD, a live attenuated vaccination based on a strain of sheep and goat pox (SGPV) discovered in Türkiye in 1975 was widely employed. The Ministry of Agriculture and Forestry's vaccination strategy provides free LSD vaccine to Türkiye's present cattle population. In Türkiye, vaccination rates reached 66% in 2016, 89% in 2017, 93% in 2018, and 94% in 2019, %97 in 2020 [39,40]. From 2013 through the end of 2018, active outbreaks were documented, despite vaccination campaigns and the population of Turkish cattle appearing to have an increased vaccination rate. Similarly in this study fluctuations in LSD incidence were identified. For improved protection of cattle and stop LSD spreading to the EU, the use of homologous LSD vaccine was recommend in Türkiye, particularly in the Thrace region [39]. Under the regulation of funding from the European Union and the Ministry for 2020, vaccination using a homologous LSD strain in the Thrace region and SP Bakırköy strain in Anatolia was carried out and the vaccination effort concluded before seasonal vector movements began [41]. Findings from this study also clearly demonstrated that vaccination is highly effective in the spread and control of LSD. The gradual increase of cold spots and the determination of completely cold regions especially in Thrace and the west and inner parts of the country shows this.

The results give authorities important data that may be incorporated into plans to track and stop future LSD outbreaks. Actually, clusters are produced based on historical observations; as a result, they do not account for any potential changes in circumstances or action. Less outbreak notifications than anticipated may be reported if efforts like the adoption of better management strategies are made. In this respect, it is useful to use the findings obtained as basic information or benchmarks to prevent epidemics.

There are various restrictions on the current study. Instant LSD outbreak reports weren't obtained because of the biannual structure of the available data. Therefore, it would be beneficial for future research if the information gathered by WOAH-OIE was made available immediately. Furthermore, it is crucial to remember that clustering results must be evaluated with care. Additionally, the reports employed in this study might not precisely represent the reality because LSD outbreaks may not be reported to the proper authorities at specific times. Furthermore, clustering was constrained by two approaches. As a result, it should also be examined using different approaches to clustering. Spatial models of data on environmental risk factors can be explored, along with incidence associated with LSD clustering, and spatial dependence of clusters on risk parameters in incidence rates.

CONCLUSIONS

In this study, potential endemic spots for LSD outbreaks were determined with LISA and Getis-Ord-Gi* in GeoDa software of LSD cases that started to be seen in Türkiye for the first time in 2013 and caused 1787 outbreaks for the next nine years. When the place and time intervals of clusters are observed, it is understood that although there are fluctuations in the outbreak numbers of LSD throughout the year, it is seen throughout the year. Therefore, it is thought that the fight against LSD should be carried out actively all year, and the precautions to be taken especially in the winter months would reduce the high number of outbreaks that can be seen in the spring and summer months. According to this research, LSD does not now pose a serious threat to Türkiye's cattle industry; nonetheless, efforts for controlling both within and across regions must be done to ensure the sustainability of this status. In addition, as LSD is acknowledged as a significant transboundary disease, rigorous reducing the spread of diseases are crucial, particularly in bordering nations to the south and east. Additionally, cooperation between nations is crucial for containing and eradicating the disease.

Authors' contributions

TB did the collection and organization of LSD outbreak data, drafted the manuscript, performed the statistical analysis and wrote the article.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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PROSTORNO VREMENSKA ANALIZA BOLESTI KVRGAVE KOŽE U TURSKOJ (2013-2021)

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Bolest kvrgave kože (LSD) pogađa goveda širom sveta i rezultira značajnim gubicima produktivnosti. Iako je prva epidemija LSD-a u Turskoj prijavljena u avgustu 2013. godine, postoji vrlo malo dostupnih informacija o prostorno-vremenskoj distribuciji ili značaju epidemije. Analiza podataka zasnovana na GIS-u pruža ključne alate za opisivanje prostorne epidemiologije bolesti procenom prostorne distribucije LSD-a kroz vreme. Ova studija je koristila informacije o epidemijama koje su prijavljene Svetskoj organizaciji za zdravlje životinja (VOAH-OIE) između 2013. i 2021. kako bi sprovela retrospektivnu studiju o epidemiologiji LSD-a u Turskoj. Procenjene su razlike u broju prijavljenih epidemija i slučajeva u različitim regionima, pokrajinama, mesecima i godinama i izračunata je deskriptivna statistika. Pored toga, korišćeni su prostorni statistički testovi (Local Moran's I i Getis-Ord Gi*) i Geografski informacioni sistemi (GIS) za procenu izbijanja LSD-a do kojih je došlo na nivou pokrajine u Turskoj. Identifikovani su mogući epidemiološki klasteri LSD-a. Tokom devetogodišnjeg perioda prijavljeno je ukupno 1787 žarišta i 10109 slučajeva LSD-a u 75 od 81 pokrajine Turske. Vruće tačke za cirkulaciju LSD-a identifikovane su u Egejskom, jugoistočnom i istočnom regionu korišćenjem prostorne klaster analize i primećeno je da je prostorna autokorelacija slučajeva LSD-a pozitivna u celoj zemlji. Nalazi ove studije mogu nam pomoći da shvatimo prostorni karakter bolesti i mogu ponuditi nadležnim organima korisne informacije za napore nadzora.

Supplementary Table 1. Distribution of LSD disease data reported from 75 provinces in Türkiye during 2013–2021.

Year	Outbreak	% (95% Confidence Interval)	Case	% (95% Confidence Interval)
2013	18	1.01 (0.56-1.51)	438	4.33 (3.95-4.74)
2014	784	43.87 (41.64-46.11)	3109	30.75 (29.82-31.62)
2015	510	28.54 (26.41-30-50)	1126	11.14 (10.54-11.76)
2016	221	12.37 (10.80-13.93)	3258	32.23 (31.37-33.20)
2017	17	0.95 (0.50-1.40)	130	1.29 (1.08-1.51)
2018	51	2.85 (2.13-3.75)	729	7.21 (6.69-7.72)
2019	180	10.07 (8.68-11.47)	1291	12.77 (12.07-13.40)
2020	5	0.28 (0.06-0.56)	24	0.24 (0.15-0.34)
2021	1	0.06 (0.00-0.22)	4	0.04 (0.00-0.08)
Month				
December	89	4.98 (3.97-5.93)	478	4.73 (4.32-5.13)
January	40	2.24 (1.57-2.97)	161	1.59 (1.36-1.83)
February	44	2.46 (1.79-3.19)	333	3.29 (2.93-3.65)
Winter (Dec–Feb)	173	9.68 (8.28-11.13)	972	9.62 (9.02-10.17)
March	46	2.57 (1.85-3.30)	185	1.83 (1.57-2.10)
April	68	3.81 (2.91-4.70)	123	1.22 (1.02-1.42)
May	145	8.11 (6.94-9.40)	362	3.58 (3.26-3.95)
Spring (Mar-May)	259	14.49 (12.87-16.12)	670	6.63(6.15-711)
June	166	9.29 (8.00-10.63)	1922	19.01 (18.25-19.78)
July	206	11.53 (10.18-13.09)	1353	13.38 (12.75-14.08)
August	301	16.84 (15.22-18.52)	2008	19.86 (19.08-20.65)
Summer (Jun-Aug)	673	37.66 (35.31-39.90)	5283	52.26 (51.31-53.21)
September	257	14.38 (12.65-16.00)	1332	13.18 (12.47-13.81)
October	231	12.93 (11.47-14.55)	1132	11.20 (10.62-11.83)
November	194	10.86 (9.46-12.26)	720	7.12 (6.57-7.66)
Autumn (Sep-Nov)	682	38.16 (35.98-40.40)	3184	31.50 (30.60-32.38)

Continuation of the Supplementary Table 1.

Region				
Aegean	228	12.76 (11.19-14.27)	2932	29.00 (28.09-29.87)
Black Sea	226	12.65 (11.19-14.27)	878	8.69(8.11-9.22)
Central Anatolia	425	23.78 (21.60-25.74)	1219	12.06 (11.44-12.67)
Eastern Anatolia	394	22.05 (20.31-24.01)	2636	26.08 (25.23-26.87)
Marmara	67	3.75 (2.97-4.64)	422	4.17 (3.79-4.58)
Mediterranean	338	18.91 (17.24-20.65)	1518	15.02 (14.36-15.71)
Southeastern Anatolia	109	6.10 (5.04-7.27)	504	4.99 (4.54-5.41)

Supplementary Table 2. Distribution of LSD outbreaks and case numbers by region between 2013-2021.

Years	**Regions**													
	Aegean		**Black Sea**		**Central Anatolia**		**Eastern Anatolia**		**Marmara**		**Mediterranean**		**Southeastern Anatolia**	
	Outbreak (%)	Case (%)	Outbreak (%)	Case (%)	Outbreak (%)	Case (%)	Outbreak (%)	Case (%)	Outbreak (%)	Case (%)	Outbreak (%)	Case (%)	Outbreak (%)	Case (%)
2013	-	-	-	-	-	-	3 (16.67%)	6 (1.37%)	-	-	12 (66.67%)	368 (84.02%)	3 (16.67%)	64 (14.61%)
2014	19 (2.42%)	40 (1.29%)	85 (10.84%)	202 (6.50%)	299 (38.14%)	846 (27.21%)	117 (14.92%)	1057 (34.00%)	1 (0.13%)	1 (0.03%)	233 (29.72%)	878 (28.24%)	30 (3.83%)	85 (2.73%)
2015	58 (11.37%)	111 (9.86%)	91 (17.84%)	140 (12.43%)	114 (22.35%)	330 (29.31)	113 (22.16%)	222 (19.72%)	33 (6.47%)	123 (10.92%)	78 (15.29%)	173 (15.36%)	23 (4.51%)	27 (2.40%)
2016	150 (67.87%)	2776 (85.21%)	-	-	8 (3.62)	24 (0.74%)	36 (16.29%)	206 (6.32%)	11 (4.98%)	152 (4.67%)	15 (6.79%)	99 (3.04%)	1 (0.45%)	1 (0.03%)
2017	1 (5.88%)	5 (3.85%)	8 (47.06%)	97 (74.62%)	2 (11.76%)	13 (10.00%)	6 (35.29%)	15 (11.54%)	-	-	-	-	-	-
2018	-	-	18 (35.29%)	119 (16.32%)	-	0.00%	28 (54.90%)	568 (77.91%)	-	-	-	-	5 (9.80%)	42 (5.76%)
2019	-	-	21 (11.67%)	308 (23.86%)	2 (1.11%)	6 (0.46%)	89 (49.44%)	556 (43.07%)	21 (11.67%)	136 (10.53%)	-	-	47 (26.11%)	285 (22.08%)
2020	-	-	2 (40.00%)	8 (33.33%)	-	-	2 (40.00%)	6 (25.00%)	1 (20.00%)	10 (41.67%)	-	-	-	-
2021	-	-	1 (100.0%)	4 (100.0%)	-	-	-	-	-	-	-	-	-	-